International Conference on the

Security of Radioactive Material

The Way Forward For Prevention and Detection

3 – 7 December 2018
Vienna, Austria

BOOK OF SYNOPSES

Organized by the

IAEA
International Atomic Energy Agency

List of Contributed Synopses

Technical Sessions

Technical Session 2A:

Number IAEA-CN-269-	Title	Presenter
26	Drive in Strengthening the Security of Radioactive Materials in Bangladesh	A. Kibria
145	Sustainable Security through Source Repatriation: A Case Study for International and Industry Cooperation	C. Streeper
317	On the Role of International Cooperation in the Process of Securing Radioactive Sources in Senegal.	M. Tall
352	Strengthening International Cooperation for Prevention and Detection in Viet Nam and in South East Asia	A. Dang
274	International Assistance in the Technical Assessment of Nuclear and other Radiological Materials our of Regulatory Control	R. Maurer
359	Nuclear Detection Working Group	V. Evans

Technical Session 2B:

Number IAEA-CN-269-	Title	Presenter
18	Nuclear Security Culture Self-Assessment Trial: Current Status and Future Plans for the Malaysia	M. Kamari
152	Should the Regulator Evaluate his own Security Culture?	C. Speicher
356	Creating a Cyber-Security Culture	D. Patrick
107	Nuclear Security Culture and Radioactive Sources: The Case of Argentina	F. Cáceres
118	Special Considerations for the Security of Radioactive Sources and Implications for Culture Assessment	I. Khripunov

169	Nuclear Security Culture Self Assessment in Radioactive Material Associated Facility	M. Solymosi
348	A Perspective on the Nuclear Security Culture: Challenges and Recommendations	A. Elabd

Technical Session 2C:

Number IAEA-CN-269-	Title	Presenter
102	Special Technical Characteristics of Equipment and Response Procedures, Using of what Increases Efficacy of Combating Illicit Trafficking of Nuclear and Radioactive Material	N. Kravchenko
206	Developing Police Capacity for Radiological Transportation Security and Theft Response	A. Daulagala
210	Bridging the Gap – Thwarting Adversaries through Strengthened Site and Law Enforcement Relationships	D. Romano
294	Nuclear Security Awakening- Strengthening Response Mechanism	N. Bakri
353	Prevent, Detect and Response to Nuclear Security Event	S. Repanovici
292	Cooperation between Regulatory Body and Custom Authorities in Preventing and Responding to out of Control Radioactive Sources at Vietnamese Border Gates	H. Vu
329	Radiation and the Public: The Role of Nuclear Security and Safeguards in Public Acceptance of Nuclear Technology in the Case of Malaysia	C. Lee

Technical Session 2D:

Number IAEA-CN-269-	Title	Presenter
22	Upgrading the Physical Protection System for Category I of Radioactive Sources in Thailand by International Physical Protection Advisory	U. Youngchuay
115	Protection Concepts for Irradiators in a Laboratory Environment	M. Kuca
43	Impact of Electric Power Disturbances on Physical Protection System Equipments and Solution Techniques in Nuclear Facilities	H. El Eissawi

315	Physical Protection of Radioactive Materials and Associated Facilities	A. Izmaylov
52	Computer Security for Radiological Facilities	N. Butler
368	Feedback and Results of an RPM System Based on Passive Measurement Technologies for Nuclear Safety	K. Boudergui
19	Upgrade of Security of Radiological Facilities in Ghana	F. Otoo
244	Security of Sealed Radioactive Sources – Operator's Perspective	S. Ali

Technical Session 2E:

Number IAEA-CN-269-	**Title**	**Presenter**
47	The Way Forward Against Insider Threats	K. Phyo
211	Insider Threat Analysis Tool (ITAT)	J. Townsend
335	Information Security for Nuclear and Other Radioactive Material and Associated Facilities: Roles and Responsibilities	S. Shaban
105	University of California System-wide Plan to Replace Cesium Irradiators with Alternative Technologies	C. MacKenzie
35	Permanent Removal of the Risk of Terrorist Attack using Radioactive Materials as a Dirty Bomb (RDD) by Means of Alternative Technologies	J. Kamen
347	A New Perspective on Categorization of Radioactive Sources	M. Assi

Technical Session 2F:

Number IAEA-CN-269-	**Title**	**Presenter**
4	Search for and Recovery of Orphan and Disused Radioactive Sources	K. Haroyan
128	Improving the Development of the National System in Iraq, for Education, Training Capable to Provide the Stations Nuclear the Skills of Human the Necessary at Al-Twaitha Nuclear Site, Baghdad-IRAQ	A. Ahmed
88	Secure Management of Radioactive Sources in Libya: Achievements vs Challenges	H. Shames

100	Suggestions for Improvement in Security of Disused Sealed Radioactive Sources in Uganda	S. Nalumansi
151	Sri Lankan Experience in Implementation of a Search and Recovery Operation for Radioactive Sources	A. Liyanage
230	Secure Management of Disused Sealed Radioactive Sources (DSRS) in Pakistan	A. Ahmad
143	Security and Technological Best Practices for Central Storage Facilities	I. Gisca

Technical Session 2G:

Number IAEA-CN-269-	**Title**	**Presenter**
225	3-D CdZnTe Gamma-ray Imaging Spectrometers for Nuclear Material Detection and Characterization	Z. He
373	Priorities for Effective Adoption and Sustainable use of Linacs in Teletherapy Cancer Treatment In Africa	H. Foy
384	Integrated Uranium Geology Analysis Platform (IUGAP) Applied to Identify Unauthorized Radioactive Materials	D. Guo
170	Modular and Integrated Sensor Network of Intelligent Radiation Monitoring Systems for Radiological and Nuclear Threat Response.	M. Corbo
84	Evaluation of a Potential RDD Risk Posed by Non-Reactor Radionuclide Production Technologies	A. Solodov
288	Identification of Effective Parameters and Their Relations for Normalization of Radiation Profiles From Radiation Portal Monitors for Initial Alarm Assessment At The Ports of Entry	I. Liyanage
380	The Application of Virtual Reality to Support Training Concepts for Nuclear Security	J. Chaput

Technical Session 2H:

Number IAEA-CN-269-	**Title**	**Presenter**
188	Implementing Multiple Layers of Security to Promote Effective Detection of Nuclear and Other Radioactive Material out of Regulatory Control: Cuba Perspective.	J. Paredes

131	Detection by Defense in Depth: Building out the Interior Layer of a Nuclear Security Detection Architecture	S. Mui
275	Contribution of the MONTE CARLO Modelling for the Minimum Detectable Activity of Spectrometer Gamma of Large Volume	S. Menard
301	Viet Nam's Nuclear Security Measures and System in Prevention and Detection of Nuclear Security Events at the designated Point of Entries and the Interior	N. Nguyen
302	Radioactive and Nuclear Security of Critical Infrastructures and Major Events: Contribution of Reachback Expertise Center for First Responders	D. Masse
378	Radioactive Materials Detection System at the Borders of Burkina Faso; Alert and Assessment Procedure	O. Kabore
33	Development of Nigerian Nuclear Security Detection Architecture (NSDA): Current Activities and Future Actions	N. Bello
358	The Dutch Detection Architecture for Orphan Sources in Scrap Metal	P. Brandhoff

Technical Session 2I:

Number IAEA-CN-269-	Title	Presenter
270	Enhancing Regulatory Requirements for Security of Radioactive Material In Albania	R. Paci
55	IEC Standards for Evaluation of Radiation Instrumentation Used for The Detection of Illicit Trafficking of Radioactive Material	M. Voytchev
75	Pakistan's Experience of Enhancing Security Measures for Sealed Radioactive Sources (SRS)	M. Zubair
21	Experiences and Challenges On Prevention and Detection of Radioactive Sources In Uganda	S. Nalumansi
221	Tunisia's Plan to Develop a New Legal and Regulatory Framework for Nuclear Security	N. Reguigui
184	Evaluating Effectiveness: US NRC's Review of the Radioactive Material Security Regulatory Infrastructure and 10 CFR Part 37	M. Cervera
265	Introduction to China's Legal System for the Security of Radioactive Material	J. Wang

Technical Session 3A:

Number IAEA-CN-269-	Title	Presenter
218	Strengthening the Security of Radioactive Sources in Central Asia	L. Ratz
342	The Committee on Hemispheric Security and eventually the Permanent Council of the Organization of American States (OAS) as a Valid Forum for Discussing Nuclear Security of Radioactive Material in the America	J. Facetti
280	Supporting Comprehensive, International Radiological Security through Alternative Technologies	J. Elster
284	Implementation of Strengthening National Nuclear Security Regime	L. Oo
382	Radioactive Material Security Education and Training in the Context of Global Nuclear Cooperation Regime	H. Rehman

Technical Session 3B:

Number IAEA-CN-269-	Title	Presenter
180	Assessment of Radioactive Material Security Culture at Universities and Medical Facilities	J. Harris
231	Fostering Security Culture at Facilities Handling Radioactive Material	M. Umar
328	Exploring Industry Incentives to Demonstrate Due Care for the Security of Radiological Material	M. Umayam
44	The Implementation of Security Culture of Radioactive Source in BATAN's Facility: Applied Sampling Culture Indicator from IAEA CRP JO2007	K. Khairul
165	Radioprotection versus security: the necessary evolution of protection measures and attitude.	K. Hocde
125	Public Company "Nuclear Facilities of Serbia" Experience in Strengthening Nuclear Security Culture	M. Mladenovic
82	A Systemic Approach to Enhancing Nuclear Security Culture	F. De Lemos

Technical Session 3C:

Number IAEA-CN-269-	Title	Presenter
85	Strengthening Sustainability for Security of Radioactive Material and Associated Facilities through Interaction With Operators During the Improvement of Normative and Legal Framework	M. Ivanov
92	Vulnerability Assessment for Radioactive Material	M. Snell
340	Using Operational Research Techniques to Inform Strategic Investment in Nuclear Security Technology Development	G. Bentoumi
192	Sustainability Challenges and Recommendations for Internationally Deployed Radiation Detection Instruments	B. Tucker
80	Evaluation of Polyvinyl Toluene Plastic Detectors to Distinguish Man-Made Sources from Naturally Occurring Radioactive Material (NORM)	A. Alsalman

Technical Session 3D:

Number IAEA-CN-269-	Title	Presenter
163	Challenges in Establishing Nuclear Security Systems in Uganda	N. Luwalira
234	Radioactive Source Security in Nepal: Status, Issues & Challenges	K. Adhikari
285	Security of Radioactive Sources; Gaps Analysis and Recommended Actions	A. Alzyoud
191	Radiological Security Considerations in Areas Lacking Infrastructure, Reliable Power, and Resources	D. Sweeney
297	Enhancing of Detection and Prevention Measures of Nuclear and Radioactive Materials in Libya	B. Abbani
122	New Approach to Securing Radioactive Materials	R. Karanam
69	Fostering Synergy of Security of Radiography Sources and Radiation Safety in Industrial Applications	N. Ramamoorthy

Technical Session 3E:

Number IAEA-CN-269-	Title	Presenter
178	Detection of Nuclear or Other Radiological Materials Out of Regulatory Control as Criminal/Unauthorized Threats to Major Public Events	R. Maurer
235	Detection of Radioactive Material in Public Places: Handheld Tele Radionuclide Alarm Device (Tele-RAD)	V. Jain
261	Georgia Lessons Learned from Deploying Detection Operations Strengthening the National-Level Nuclear Security Detection Architecture	D. Makharadze
267	Nuclear Security Measures in Tunisia: Prevention and Detection Systems	A. Slimani
268	Investigation of the suspected radioactive contaminated container at the Kribi deep Seaport - Cameroon	J. Beyala Ateba
304	Systems for Detection of Unauthorised Movement / Illicit Trafficking of Radioactive Material	S. Saindane
162	Strengthening Nuclear Security Detection Capabilities in Serbia	V. Janjić

Technical Session 3F:

Number IAEA-CN-269-	Title	Presenter
216	Developing a Secure Logistics System for Radiological Material	P. Singley
62	Research on the Use of New Tracking Technologies for Category 2 and 3 Radioactive Sealed Sources in Transport	R. Duguay
214	Best Practices for Safety and Security Interface in Transport Security	M. Devaney
319	ARG-US Remote Monitoring Systems for Enhancing Security of Radioactive Material	Y. Liu
324	Security During the Transport of Radioactive Material: An End to End Multi Modal Approach to Vitrified Residue Returns	B. Officer
367	The H2020 C-BORD Project: Feedback and Conclusion of an Advanced Non-Destructive Techniques to Improve Control of Cargo Containers	F. Carrel

Technical Session 3G:

Number IAEA-CN-269-	Title	Presenter
171	A Novel Portable Device or Gamma and Neutron Spectroscopy with Special Nuclear Material Identification Capabilities	G. Mangiagalli
249	Remote Operated Vehicles for Radiological Emergencies	R. Vazquez-Cervantes
313	Wearable Neutron Detector for Dosimetry and Nuclear Non-Proliferation	T. Ochs
323	Gamma Cameras as New Technological Developments to Strengthen Nuclear Security Detection Architectures: Emerging Potential Approaches within Regulatory Frameworks and Implementation Practice, Expected added Value to Existing Measures from Instrumentation-Specific Technical and Functional Characteristics.	D. Rothan
363	Environment Insensitive Detection of Fissionable Material with a Short Pulse Neutron Source	Y. Podpaly
113	Radiological Security through Cesium Irradiator Replacement in the United States	L. Garrison

Technical Session 3H:

Number IAEA-CN-269-	Title	Presenter
104	Administrative Monetary Penalties in Nuclear Security	J. Vucicevic
166	A Graded Approach to Cybersecurity: Smaller Facilities, Temporary Jobsites, or Multiple Authorities	M. Cervera
233	State Supervision and Control over Security of Radioactive Materials	R. Pashayev
322	Best Practices and Challenges for Securing Radioactive Materials	R. Elsayd
327	Assessment and Licensing Mechanism to Ensure Nuclear Security in Malaysia	N. Rabani
9	Process Oriented Approach in Updating and Maintaining National Register of Radiation Sources	R. Samba

87	Improving Global Radiological Source Security: National Legal Frameworks, Penalty Provisions, and Preventive Enforcement	R. Cupitt
164	Strengthening Security of Radioactive Sources in the Republic of Moldova	I. Apostol

Technical Session 3I:

Number IAEA-CN-269-	Title	Presenter
27	Implementing Strategies for the Security and Safe use of Radioactive Materials at the Centre for Energy Research and Training (CERT), Zaria., Nigeria	I. Ewa
375	Security of Radioactive Material, Associated Facilities and Associated Activities in Togo	Y. Fiagan
117	Practices and Regulation for Effectiveness on Nuclear Security Control of Radioactive Sources at Medical Facilities in Malaysia	Z. Kayun
276	Challenges in the Elaboration of the New Regulation for Security of Radioactive Sources in Brazil	F. Da Silva
12	Design of the French Regulations on the Security of Radioactive Sources - Challenges and Lessons Learnt	V. Lesage
137	Maintaining and Regaining Control of Radioactive Sources: Legislative and Regulatory Approaches	F. Morris

Technical Session 4A:

Number IAEA-CN-269-	Title	Presenter
3	Development of Access Control System (ACS) in the Protected Area (PA) at Al-Tuwaitha Nuclear Site	H. Al-Hamadani
119	Current Status for Radioactive Material “Security” of Japan: Toward 2020 Tokyo Olympic and Paralympic Games	H. Ito
138	A Case Study on a Successful Collaborative Project to Increase Security for a Device Containing Radiological Material	M. Kuca
258	Introduction to the Graded Approach to the Security of Radioactive Material in China	L. Wang

139	Global Cesium Security Initiative – A Comprehensive Approach to Cesium Security	M. Hazel

Technical Session 4B:

Number IAEA-CN-269-	**Title**	**Presenter**
45	Infusing Nuclear Security Topics into Present Nuclear Engineering Curriculum in Universitas Gadjah Mada: An International Cooperation, Local Action and International Impact	S. Putero
54	Security of Radioactive Material and Human Resource Development: Sri Lanka Navy's Effort	H. Dassanaike
70	Brazilian Seminar "Safety and Security: Harmonization and Action": A tool for Human Resource Development	F. Da Silva
89	Penn State Nuclear Security Graduate Education Program: Nuclear Security System Design	K. Unlu
303	World Institute of Nuclear Security (WINS) Programmes for Sustainable Radioactive Source Security	R. Evans
349	Radiological Source Security in Major Urban Areas	T. Bieda
72	Security of Radioactive Material in Nuclear Security Training Programmes in Kazakhstan	N. Izmailova
307	Human Resource Development: A key Asset in Detecting Nuclear and Other Radioactive Material	J. Galy

Technical Session 4C:

Number IAEA-CN-269-	**Title**	**Presenter**
242	Nuclear Security Continual Improvement	P. Gray
326	Considerations for Newcomers to Strengthen the Security of Radioactive Materials and Associated Facilities	O. Elhefnawy
238	Sustainability Considerations for Advanced Nuclear Smuggling Detection Systems	J. Hoyt
229	The Importance of National Stakeholders' Involvement and Synergies in Setting up an Effective Integrated System for the	N. Alawadhi

	Security of Radioactive Material: Kuwait's Approach and Experience	
190	The Exercise Development Workshop: A Suite of Tools for Exercises and Evaluation	C. Roberts
111	In a New York Minute: Economic Impacts of Radiological Dispersion Device	L. Trost

Technical Session 4D:

Number IAEA-CN-269-	Title	Presenter
56	BATAN's Practices on Prevention and Detection Measures for the Security System of its Radioactive Material	Y. Hasan
116	Development of an International Security Standard for Devices Containing High Levels of Radiological Material	M. Kuca
198	Nuclear Security features for the Interim Radioactive Source Storage Facility in Uganda	R. Asaba
345	Challenges Implementing Physical Security Measures at a Source Manufacturing Facility	J. Miller
142	Site Security Plans: Best Practices and Common Pitfalls	J. Manion
385	Security of Radioactive Materials: The Jamaican Regulatory Authority Perspective	T. Warner
293	Technical and Scientific Support Capabilities of the Nuclear Security Department (MTA EK, Hungary)	P. Völgyesi

Technical Session 4E:

Number IAEA-CN-269-	Title	Presenter
174	Best Practices for Security of Mobile Radioactive Devices Commonly Used in the Industrial Radiography Industry	B. Kluse
176	Best Practices for Security of Mobile Radioactive Devices Commonly Used in the Well Logging Industry	B. Kluse
195	A Practical Sharing Experience for Pilot Project in On-line Tracking of Mobile Radioactive Sources in Viet Nam	V. Phi

308	Unmanned Ariel Systems as an Enhancement and Threat to Radioactive Material Transport and Physical Security	A. Aaron
296	Legal and Regulatory Framework on Security Transport of Radioactive Material	S. Utami

Technical Session 4F:

Number IAEA-CN-269-	Title	Presenter
10	Prioritizing Security Risks in Research Reactors	A. Sfetsos
65	Radiological Threat: Where We've Come from and a Path to the Future	C. Potter
94	Risk Informed Approach for Nuclear Security Measures for Radioactive Material Under Regulatory Control	D. Ek
108	Risk Context for Radiological Material: How to Assess Threats and Consequences	M. Ladd
205	Malicious Use of Radioactive Materials as Radiological Dispersion or Radiological Exposure Devices: A Historical Review	J. Adduci
377	National Threat Assessment for Radioactive Materials	D. White
325	Threat Assessment and Development of DBT in Croatia	M. Medić

Technical Session 4G:

Number IAEA-CN-269-	Title	Presenter
73	Regulatory Inspections of Radioactive Materials-Relationship with Licensing and Enforcement Process	S. Shah
96	Sudanese Development of Sustainable Nuclear Security Detection Capability	M. Mogahed
337	Enhancing National Regulatory Frameworks for the Security of Radioactive Material in Africa	P. Gizowska
318	Criminalization and its Impact in the Egyptian Nuclear and Radiation Law	F. Elsisi
140	Eliminating the Target – Regulatory Incentives for Alternative Technologies to Radioactive Sources	F. Morris

1	Reglementation of Radioactive Materials in Niger	H. Barke

Technical Session 5A:

Number IAEA-CN-269-	Title	Presenter
278	Main Outcome of the Fierce Falcon GICNT Radiological Source Security and Theft Response Workshop Organized in Hungary	E. Kovacs-Szeles
298	Proposing an Informal Radioactive Communication Network on Voluntary Basis Between Counter-Terrorism Officers and the License Holders	N. Ishak
172	Effective Inter-Organizational Coordination for Response to Nuclear Security Events Involving Radioactive Sources: Exemplary National Practices	D. Donnelly
299	Malaysia's Experience in Enhancing National Concept of Operation to address Cross Cutting Nuclear Security Needs	P. Gan
264	Impact of Nuclear Information and Cyber Response Team Building on the Security of Radioactive Materials	M. Hossain
305	Communication Strategy following Radiological Threats / Emergencies	M. Seshadri

Technical Session 5B:

Number IAEA-CN-269-	Title	Presenter
181	Training Project for First Police Response to Chemical, Biological, Radiological or Nuclear Threats	J. Garces
287	Human Resource Development	P. Mallawa Arachchige
361	Knowledge Management: The Tool of the Conceptual Map in the Evaluation of a Seminar on Safety and Security	F. Da Silva
374	The EC-US 2018 Counter Nuclear Smuggling Workshop in Karlsruhe – Outcomes and Findings -	K. Mayer
76	Pakistan's Approach for Development of Human Resource for Secure Management of Radioactive Sources	I. Khan

53	Human Resource Development in Radiological Security for an International Audience: Lessons from the UK's Experience	C. Hobbs

Technical Session 5C:

Number IAEA-CN-269-	Title	Presenter
93	Development of Physical Protection Measure Performance Data for Radioactive Material Facilities	M. Snell
189	Tools for Promoting Sustainability: Tabletop Exercises, Site Security Plans, and Standard Operating Procedures	J. Manion
186	The Value of Nuclear Security Simulation Exercises	R. Chatelus
254	Scenario-based Learning to Manage Nuclear Threats in Virtual Electronic Environment	H. Toivonen
217	Lessons Learned from implementing an Exercise Program for Ukrainian Border Guards	D. Linville

Interactive Content Presentations

Number IAEA-CN-269-	Title	Presenter
8	Challenges of maintaining the security of radioactive sources of categories 1,2and 3 in the liberated Iraqi provinces	F. Mizban
40	The revolution of information security in Sudan	M. Abdulrahman
64	Particle resuspension and its relation to radiological risk	C. Potter
90	Mixed Reality 3D Tabletop Tool with Radioactive Source Model Visualization	T. Le
91	Randomized Operations–Board Exercise (ROBEx)	C. Cole
144	Development of a National Train-the-Trainer Programme for Nuclear Security Detection in Malaysia via Collaboration between the International Nuclear Security Education Network (INSEN) and the Network of Nuclear Security Support Centres (NSSC)	I. Abdul Rahman
146	Assessment Framework for Legal and Regulatory Provisions for the Detection of Criminal or Intentional Unauthorized Acts Involving Nuclear or Other Radioactive Material out of Regulatory Control	A. Askin
185	US NRC's Integrated Source Management Portfolio: tools to support security and licensing	M. Cervera
201	Strengthening Radioactive Security in Mexico and Central America through Collaboration, Training and Certification	R. Delgado
232	Research on Computer-Based Analytical Tool for Evaluating Physical Protection System Effectiveness	A. Mardhi
237	Radiological Threat Reduction through Collaboration and Capacity Building: Planning for the Future in Secure Disposal of Radioactive Material	J.s Cole
239	Indonesia's Criminal Law Policy to Suppress Nuclear Crimes on Radioactive Material	D. Rushartono
248	Radiological Security for Mass Events	M. Woolley
277	Strengthening the Security of Radioactive Sources in Brazil: A Roadmap to Success	R. Alves Tavares
291	Optimization Planning Tool for Urban Search (OPTUS)	T. Edmunds
334	Public Involvement in Radioactive Material Security	D. McIntyre

Poster Presentations

Number IAEA-CN-269-	Title	Presenter
2	A Model Transport Security Arrangement of Radioactive Material for Oil Exploration In Ghana	Y. Kyei
11	A Real-Time Surveillance and Management System for Mobile Radiation Sources	V. Tran-Quang
13	Self-Assessment of Nuclear Security Culture In Polish Medical Facility	M. Wiśniewska
14	Regulatory Functions and Practices to Prevent and Detect Illicit Trafficking of Radioactive Materials in Ghana	O. Agbenorku
17	Physical Protection System for Gamma Chamber 5000 in Myanmar	C. Zaw
28	Enhancing Information Security in the Transport of Radioactive Materials in Ghana: Current Status	N. Agbemava
29	Security of Radioactive Sources on the Revision of BAPETEN Chairman Regulation (BCR) Number 3 Year 2013 about Radiotheraphy in Indonesia	S. Sawiyah
30	Implementation of Security Plan as Requirement on Approval of Transport of Radioactive Sources from Regulatory Body Based on Indonesian Regulation	A. Hayani
31	Strengthening Sustainability and Effectiveness for Security of Radioactive Material by Promoting International Cooperation and Domestic Interfaces in Myanmar	K. Tun
36	Development of Course Module on Detection Systems for Radioactive Material for Graduate Program at Universitas Gadjah Mada	S. Sihana
37	Overview Implementation of Radioactive Source Security Regulation on Radioisotope Production Facilities in Indonesia	N. Yusuf
39	Evaluation of Security Measures during Transportation of Radioisotope Material from Radioisotope Production Facility	H. Elkhatib
49	Enhancing of Nuclear and Radioactive Materials Security in Academic Institute	P. Pengvanich
57	Detecting Criminal/Unauthorized Acts Involving Nuclear and other Radioactive Material out of Regulatory Control	V. Okoye

133	Organizational Culture Change: A Path to Sustainable Nuclear Security Measures and Systems	C. Stinson
135	Testing and performances of radiation detection instruments for nuclear security	C. Deyglun
136	A Case Study on the Effectiveness of Mechanical Attack Testing to Help Determine Vulnerabilities of a Device that contains Radiological Material and Proven Methods of Addressing such Vulnerabilities	M. Kuca
147	Front Line Officer Standard Operating Procedure Development for MORC Detection Operations	T. Wright
148	Incorporating Security into the Design and Transportation of Type B Packaging: Lessons Learned and Best Practices	J. Zarling
149	Strengthening of Integrated Operational Procedures for the Detection of Radioactive Material at Border from the Binational Perspective.	X. Pazmiño
150	National Detection Strategy for Nuclear Security Detection Architecture – Case Study Indonesia	I. Annisa
154	International cooperation in HRD (Master programme in Nuclear Security)	D. Dimitrov
155	The Use of Innovative Approaches in the Search for and Regaining Control Over Orphan Radioactive Sources in the Republic of Moldova	I. Balan
156	Reviewing the Prescriptive-based Regulation of the Continental Shelf Territory of Indonesia for Regulating Security of Radioactive Sources	A. Syuryavin
157	Enhancing Security System of Irradiation Facility in Vinca Institute Belgrade - Serbia	I. Vujcic
160	Robust and Flexible Design of Neutron Scintillation Detector Based on Wavelength Shifter and Silicon Photomultiplier	A. Osovizky
161	Lessons Learned from Adversaries 'Perfected' Activities in Kenya	B. Kaboro
167	Aspects of Nuclear Security during the re-Export of Unused Sources of Co-60 in Paraguay	F. Invernizzi
182	Cooperation on Radioactive Materials Transportation Security: Beyond the Signed Agreement	M. Cervera
182	Cooperation on Radioactive Materials Transportation Security: Beyond the Signed Agreement	M. Cervera
183	US NRC's Evaluation for Category 3 Sources: Is Increased	M. Cervera

Abstract ID : 26

Drive in Strengthening the Security of Radioactive Materials in Bangladesh

Kibria, A.[1], Alam, H.[1]

[1] Bangladesh Atomic Energy Commission, Banglandesh

Corresponding Speaker: A., Kibria

In Bangladesh, the application of radioactive material began in sixties of the nineteenth century in the field of medicine. After becoming the member of IAEA in 1973, the application of radioactive materials augmented in the country and at present appreciably expanded in the field of research & education, industry, food and agriculture. Utilization of different categories of radioactive materials/sources such as Co-60, Cs-137, Sr-90, Am-241, Ir-192, Am/Be-241 and so on are in place. The country is paying profound attention in ensuring their security during use, transport and storage. Bangladesh is fully aware of global threat of radiological terrorism and thereby always aspiring in fulfilling the indispensable and obligatory needs by formulating and revising the responsibilities of competent authorities to achieve better radioactive security sustainability. In 1993, Bangladesh enacted its first regulatory instrument named Nuclear Safety and Radiation Control (NSRC) Act. From then licensing system of radioactive materials was started through the Bangladesh Atomic Energy Commission (BAEC) which was founded in 1973. In 1997, Bangladesh enacted Nuclear Safety and Radiation Control (NSRC) Rules in view to regulate all the nuclear and radiological activities and facilities of the country. The NSRC Rules included the implementation of security system as the mandatory requirement for the issuance of license. In 2012, the country enacted Bangladesh Atomic Energy Regulatory (BAER) Act and accordingly in 2013 Bangladesh Atomic Energy Regulatory Authority (BAERA) was founded. Now, it is overseeing the safe and peaceful use of atomic energy in the country. The country is committed to protect radioactive materials in use, storage and transport and facilities; and to establish and enforce necessary standards, codes and manuals. The licensee is liable to radiation safety, radiation protection, physical protection (PP), emergency preparedness including verification thereof during all the phases of radiation facility from siting to decommissioning. Licensee is also liable to maintain the PP of radioactive materials during import, export, transport and storage. The BAER Act empowers to develop regulations consistent with above subjects, although no regulations are published yet. The NSRC Rules are still in force to meet such vital regulatory needs. It is essential to incorporate the recommendations accessible in the relevant IAEA publications and Code of Conduct on the Safety and Security of Radioactive Sources. At present, BAERA, operators, national stakeholders and international communities are jointly driving in strengthening the security regime of the country by emphasizing the safe storage of the unused radioactive materials and so on. BAERA is strictly maintaining the inventory of the radioactive materials and imposing licensees to manage their unused radioactive materials.

Disused radioactive materials are storing in the Central Radioactive Waste Processing and Storage Facility (CWPSF) of BAEC which was built through the cooperation of IAEA. It is the only authorized national facility for transportation and management of radioactive wastes. Starting from 2004 to today, 59 category 1-5 sources and 90 category 3-5 sources recovered from different devices were stored in the CWPSF. At least 203 disused Ra-226 sources collected from different medical, industry and research institutes were also stored in it. The national policy for radioactive waste management is waiting for the Governmental approval. With the help of US- DOE, Bangladesh has been developing the PP system of the radioactive materials facilities since 2006. Moreover, USDOE is offering trainings covering radiological security awareness, PP sys- tem and management, search-secure and recovery of orphan radioactive sources. Bangladesh has an approved IAEA Integrated Nuclear Security Support Plan (INSSP). Through this Bangladesh is strengthening its nuclear security regime primarily emphasizing the development of national detection strategy. US Megaports is helping in controlling illicit trafficking of radioactive materials. Through cooperation with Japan and the Forum for Nuclear Cooperation in Asia (FNCA), the country is enhancing its expertise on strengthening the security of radioactive materials. For successful Human Resource Development (HRD), young scientists are sending to India and Russian Federation for subjective training and higher studies. However, challenges such as development of qualified and competent HR for processing, conditioning and management of disused radioactive sources (DRSs), development of capabilities to establish long-term storage/disposal facility for Category-1 and 2 DRSs, built confidence in moving to non-isotopic alternatives, interim storage under proper regulatory requirements and with adequate infrastructure, conduct hands on training exercises on the search and securing of orphan sources are duly needed. Threat on radioactive materials and their facilities is increasing worldwide day by day, but Bangladesh is committed to ensure the security of radioactive materials till achieving a better sustainability.

Abstract ID : 145

Sustainable Security through Source Repatriation: A Case Study for International and Industry Cooperation

Streeper, C.[1]; Smith, C.[2]; Zamroni, H.[3]

[1] Los Alamos National Laboratory, United States; [2] Qal-Tek Associates, United States; 3 Nuclear Energy Agency of Indonesia.

Corresponding Speaker: C. Streeper

Ensuring that there is a viable pathway for characterizing, transporting, and disposing of disused radioactive sealed sources (sources) is essential to any end-of-life management strategy. The Off- Site Source Recovery Program (OSRP), sponsored by the Department of Energy National Nuclear Security Administration's Office of Radiological Security (ORS), provides permanent and sustained threat reduction through the secure removal and repatriation of disused sealed radioactive sources of US origin at international locations. With over two decades of operations, the OSRP has developed source removal processes and techniques to ensure the compliant, effective and timely disposition of the material.

In 2018, OSRP and Qal-Tek a device disassembly firm out of Idaho, sent a team to Indonesia to implement a source repatriation mission on behalf of ORS. This cooperative effort resulted in the disassembly of over 60 devices and the removal of 46 sources totaling 6.9 TBq (187 Ci). This rep- resents the permanent threat reduction of over eleven times the IAEA Category 2 threshold of Am241 (0.6 TBq, 16 Ci).

This source repatriation provides a useful case study on a challenging international cooperative effort at the Center for Radioactive Waste Technology at the National Nuclear Energy Agency of Indonesia (BATAN). The authors will describe the steps taken by OSRP, BATAN and Qal-Tek from pre-planning and implementing the mission to the resultant source repatriation to the United States (US).

Since 2006, when its mandate for the repatriation of US origin sources began, OSRP has recovered 3,116 sources from 27 countries. Each country's repatriation effort involves a unique set of circumstances creating planning challenges, but the processes employed from characterizing the sources to their packaging for disposal are procedural and mostly uniform. In most cases, navigation of the shipping and customs clearance are the variables of least predictability and pose the highest potential for unforeseen challenges.

Sources are often found intact inside of their gauges. This can be helpful for the transport, shielding and identification of the sources. However, OSRP and often the sites where sources are stored are not licensed to disassemble devices for source removal. OSRP and the work-site must engage with a limited number of industry partners to get to the bare source.

At the conclusion of the disassembly and packaging mission at BATAN, few devices remained of the original inventory. Most devices were disassembled and the sources encapsulated into LANL special form capsules. This left BATAN with sources in a more secure consolidated configuration suitable for further storage or compliant future transport. The partnership of OSRP, Qal-Tek and BATAN demonstrates an effective method for international source repatriation. Similar efforts are underway worldwide and the processes and lessons learned from these complex missions can be shared and emulated among all government and industry partners.

Abstract ID : 289

Opportunities and Challenges to Strengthen Security of Nuclear Material

Ariyanto, S.[1]**; Basuki, F.**[2]**; Khairul, K.** [2]

[1] Center for Education and Training, National Nuclear Energy Agency, Indonesia; [2] National Nuclear Energy Agency (BATAN), Indonesia

Corresponding Speaker: S. Ariyanto

Condition of nuclear security regime in any country may be influenced by various changes of politic, social condition, and technology as well. Political change may affect the ability of country to secure nuclear material in the country, and it may also induce unauthorized uses of nuclear material by non-state actors. Social condition today may be affected by the spread of social media. Social media is changing the people communicating and collecting information. It can be used for both benign or malicious intent that may affect the global nuclear security regime. Product of technology such as advance 3-D printing, unmanned aerial vehicles, and computer security may pose significant proliferation concerns. Furthermore, electronic trading platforms offer new methods of acquisition for malicious actors. Strong nuclear security regime ensure the security of nuclear materials from unauthorized uses by non-state actors. There are opportunities to strengthen nuclear material security in the framework of nuclear security regime: position of the IAEA as prominent organization in promoting nuclear security, the availability of the IAEA nuclear security program in 2018-2021 and the Center of Excellence (CoE) in some region, and supports of developed countries to improve nuclear security regime of developing countries. There are some issue of challenges for global nuclear security: 1) Usage of the nuclear security architecture to promote senior level scenario-based policy discussions at national, regional, and international levels, to support decision making of senior policymakers, 2) Improve coordination and collaboration among CoEs in capacity building activities at regional and international levels, 3) Usage of he International Net- work for Nuclear Security Training and Support Centres (NSSC Network) for capacity building in nuclear security and to organize regional discussions to identify new and emerging threats and trends, 4) Diverse level of nuclear security and the needs of countries that may affect development of capacity building program. On the other hands there are also issue of nuclear security challenges at national level: 1) Establishment of a national coordinating body to coordinate activities of nuclear security involving various stakeholders, 2) improvement of capacity of technical support organizations to strengthen nuclear security regime, 3) strengthening cooperation and co- ordination with law enforcement institutions, 4) less number of personnel familiar with nuclear security issues, and there may be also wide gaps in age and knowledge of senior and junior staffs.

Abstract ID: 317

On the Role of International Cooperation in the Process of Securing Radioactive Sources in Senegal

Boye Faye, N.[1]; Ndao, A.[1]; Tall, M.[1]

[1] Senegalese Authority for Radiation Protection and Nuclear Safety, Senegal

Corresponding Speaker: M. Tall

Radioactive sources were used in Senegal long before independence in 1960.

The inventory of these sources throughout the national territory, the search for sources out of regulatory control and the control of their safety and security are among the missions of the national regulatory authority created in the year 2011.

The implementation of this mission from scarce resources has necessitated the development of strong and sustained international cooperation.

The purpose of this article is to show how certain issues relating to the management of the security of radioactive sources have been undertaken thanks to international cooperation and through the development and progressive implementation of an integrated nuclear security support plan.

Abstract ID: 352

Strengthening International Cooperation for Prevention and Detection in Viet Nam and in South East Asia

Dang, A.[1]

[1] Vietnam Agency for Radiation and Nuclear Safety (VARANS), Vietnam

Corresponding Speaker: A. Dang

Radioactive sources are widely used in various fields, bringing about lots of benefits but also posing the escalating danger of these materials being diverted by terrorists and acts of sabotage. Since the 11 September events in 2001, the threat of terrorism involving nuclear and radioactive materials has been a common concern for the international community. Hence, strengthening international cooperation for security of radioactive sources has been one of priority policies of many countries.

Viet Nam is located in South East Asia (SEA) and has land borders with China, Laos and Cambodia. According to VARANS's statistics based on RAISVN system, Viet Nam has approximately 5600 radioactive sources used in research, training, industry, medicine and radiation safety services, in which there are 35 sources with radioactivity above 1000 Ci. Some accidents related to security of radioactive sources in the past years has called serious attention of the government, typically losses of radioactive sources including Cs-137 in 2003, Eu-152 in 2006, Ir-192 in 2014 and the illegal trafficking of radioactive cards in some provinces in 2006 and 2014. Recognizing the importance of international cooperation activities in enhancing security for radioactive sources, especially in prevention and detection, Viet Nam has established close relationships with the IAEA, USA, Japan, South Korea and some countries in the region. As a result, the physical protection system of 24 radiation facilities with radioactivity greater than 1000 Ci has been significantly improved. 8 Radiation Portal Monitors (RPM) have been installed at Noi Bai International airport and 12 RPMs at 3 sea ports. All these systems have been put into operation since 2014. Some detection equipment have been also installed for Da Nang international airport for enhancing the detection capability. The Integrated Nuclear Security Support Plan (INSSP) was developed for Viet Nam in 2011 and updated in 2014 and 2018. Various training courses and workshops on prevention and detection measures have been organised to raise awareness and enhance capability of relevant authorities including prevention and detection arrangements for major public events. A Pilot Project for Radioactive Source Location Tracking System (RADLOT) has been implemented in Viet Nam since 2014. Besides, Viet Nam has been also actively participating in many regional cooperation activities.

With majority is developing countries sharing many common needs, SEA has established a good cooperation relationship with its international counterparts to obtain technical support and assistance for enhancing security of radioactive sources consistent with relevant international recommendations and guidances. Since 2004, the international programs of the Australian Regional Security of Radioactive Sources (RSRS) Project and the United States's Department of Energy's National Nuclear Security Administration's Global Threat Reduction Initiative (GTRI) has supported a number of SEA countries in enhancing physical protection and security management measures. Since 2011, with the support of European Commission (EU), SEA countries have participated in CoE Initiative of EU for Chemical, Biological, Radiological and Nuclear (CBRN) Risks Mitigation. Under this initiative, many projects focusing on enhancing legal frameworks, technical capability and inter-agency coordination for security of CBRN materials have been implemented. EU has also provided support for SEA countries in establishing the National Action Plan (NAP) for prevention, detection and respond to CBRN threats and planned to formulate a regional NAP for SEA.

There is no doubt that through the above cooperation activities, the security of radioactive sources in Viet Nam in particular and SEA in general has been enhanced. From the experiences of Viet Nam and SEA, some lessons could be shared and learnt. Besides, there are still some aspects of such international cooperation activities could be improved and further enhancement could be made to better assist the country and the region in obtaining and maintaining an effective system for security of radioactive sources focusing on strengthening prevention and detection capability, which would be elaborated hereafter.

Abstract ID : 274

International Assistance in the Technical Assessment of Nuclear and other Radiological Materials our of Regulatory Control

Maurer, R.[1]; Zubarev, J.[1]

[1] Department of Energy, USA

Corresponding Speaker: R. Maurer

Considerable resources are dedicated worldwide to detect illicit materials of all types amid the concern of their potential use in criminal acts or acts of terrorism. Of particular concern are illicit nuclear and radiological materials as they have potential to cause serious harm to the general public if not in regulatory control. As such, the international community has developed recommendations and guidance for State's and their Competent Authorities to establish, implement, maintain, and strengthen their nuclear security regimes. The International Atomic Energy Agency (IAEA) provides recommendations for the security of nuclear and other radioactive material out of regulatory control through the publication Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control, Nuclear Security Series No.15. Based on this guidance and national/international practical experience and best practices, the international community has made considerable advances in the detection of nuclear and other radiological materials out of regulatory control. The United States has national/international experience to share on how our advanced detection capabilities have been applied to nuclear and other radioactive material out of regulatory control.

Introduction

Best practices for the detection of illicit radioactive materials at international borders, port of entry, and railways involve the use of high sensitivity radiation portal monitors to scan cargo shipments. Radiation portal monitors are designed to passively detect the faint gamma-ray and neutron radiation emissions from radioactive materials. Using these systems, thousands of detections occur annually around the world – all of which need to be investigated to determine the cause of the alarm. The majority of these investigations result in a determination that the alarms are innocent. Innocent alarms can occur from common legitimate commercial and industrial materials which contain very low activity levels of naturally occurring radioactive materials (NORM). When the radiation level on a radiation portal monitor exceeds the detection threshold, an alarm will sound alerting the portal operator to initiate procedures and protocols to investigate the cause of the alarm. Most alarms are resolved through a security investigation which involves a driver/shipper interview, manifest review, and identification of the radioisotope. If the incident cannot be resolved using established procedures and protocols, the best practice is to engage the State's Competent Authority or other qualified authority to conduct a technical assessment of the information collected to determine if the shipment is legitimate or a potential threat.

Competent Authority Expert Assistance

The ability to reach back to subject matter experts with experience in the analysis and interpretation of radiation data and receive timely advice is critical in resolving nuclear security events. The U.S. Department of Energy, National Nuclear Security Administration (DOE/NNSA) maintains the radiological Triage program, which is a 24/7 reach back capability for radiation detector operators. The program provides access to radiation experts to aid in the assessment and interpretation of radiological data. The Triage program has a cadre of on-call scientists and engineers from the national laboratories with extensive experience in radiation measurements and data analysis and interpretation. The experts analyze the information from the interview, manifest, radiation portal monitor, and radioisotope identification measurement and provide an initial verbal assessment via a telephone call within one hour. The radiation portal monitor scan data for gamma-rays and neutrons and the radioisotope identification spectrum contain a wealth of information about the radiation source when analyzed using specialized analysis tools. The assessment includes the nature of the radioactive material, including identifies potential threats, and provides detailed radioisotope identification, activity estimates, shielding materials, and radiation health and safety guidance. The experts also provide advice on recovering and securing the radioactive material.

Practical Experience

Two case studies will be presented to share DOE/NNSA's practical experience providing valuable assistance in the assessment of illicit radioactive materials detected at international shipping ports. Sample data sets will be discussed and the process of extracting information about the radioactive material and how it is used to identify radiological material out of regulatory control.

Summary

Radioactive materials are routinely detected by radiation portal monitors at international borders, ports of entry, and railways around the world. The majority of the detections are assessed and re- solved by the portal operators using established protocols to be legitimate shipments and attributed to commercial and industrial materials containing naturally occurring radioactive materials. How- ever, when the site assessment protocols cannot resolve the situation, the best practice is access to a technical reach back capability with experts from the State's Competent Authority or other qualified authority. The experts can review the data and provide timely assessments of potential threats or illicit radioactive materials.

Abstract ID: 359

Nuclear Detection Working Group

Evans, V.[1]

[1] Global Initiative to Combat Nuclear Terrorism, United Kingdom

Corresponding Speaker: V. Evans

The Nuclear Detection Working Group (NDWG) was established in 2010 and since then it has worked to promote best practices to enhance our Partners nuclear detection capabilities. The NDWG Chair, currently held by the United Kingdom, oversees the work plan and sets the priorities of the working group. This presentation would highlight these priorities as well as available NDWG products and key outcomes from activities held since 2015. Some key elements of the envisioned presentation are included below.

The NDWG Vision for 2017-2019:

Promoting best practices for implementing and sustaining national nuclear detection architectures by creating opportunities for partners to present their national models, identify common detection challenges and potential solutions, and promote regional and international cooperation.

Continuing to focus on building partners' capacity to develop, implement, and sustain detection strategies that effectively integrate policies, procedures, and capabilities into a coordinated government approach to detect illicit trafficking of nuclear and other radioactive materials out of regulatory control.

Exercising the procedures and mechanisms that ensure partner nations gain the expertise needed to develop sustainable plans and capabilities, and support interoperability and coordination within and between partner nations during a nuclear security incident.

Products and Tools

The NDWG has produced four policy documents as part of its "Developing a Nuclear Detection Architecture" series. The series provides guidance, best practices, and case studies from Partner nations on how to establish, enhance, and sustain national nuclear detection architectures. These documents have been helpful in supporting the development of IAEA guidance in related areas.

The Exercise Playbook is another NDWG product that is a compendium of ready-made detectionoriented exercises, adaptable to a range of potential engagements. It is a tool that can be modified and utilised by all GICNT partners. GICNT is currently in the process of adding nuclear forensics and response chapters to the Exercise Playbook.

Event Outcomes

Outcomes from these events have helped scope the priorities of the NDWG and would be beneficial to share:

Northern Lights (Helsinki, Finland) focused on the application of traditional law enforcement techniques towards investigations, how radiation detection capabilities can effectively support those investigations, and the importance of a whole-of-government effort to detect and respond to illicit trafficking activities involving RN materials.

Radiant City (Karlsruhe, Germany) closely followed Northern Lights as a joint event with nuclear detection and forensics experts brought together to identify strategies for how their respective expertise and capabilities could be effectively leveraged in support of an ongoing investigation. Radiant City highlighted the need for comprehensive management of an investigation into illicit trafficking from the beginning of the investigation and deployment of detection resources to the courtroom for prosecution.

Olympus Exercise Series (Bucharest, Romania) Olympus focused on identifying challenges and best practices related to interagency coordination and communication between law enforcement and technical detection experts in support of technical reachback during a law enforcement operation involving a nuclear incident. In 2017, the second iteration of the Olympus series, Olympus Reloaded, addressed collaboration between law enforcement and nuclear forensics experts during a nuclear security incident by focusing on the procedures, policies, and mechanisms for crime scene management.

Magic Maggiore (Ispara, Italy) explored the responsibilities, challenges, and opportunities of technical expert support within Nuclear Security Detection Architectures.

Roof of the World (Dushanbe, Tajikistan) highlighted the work of regional partners in Central Asia in promoting the development of national nuclear detection architectures. In addition, it identified challenges and best practices in developing a national exercise program, encouraged the sharing of best practices during a nuclear security incident, and identified opportunities for future regional collaboration.

2018 Experts Meeting (Bilthoven, the Netherlands) gathered detection experts to identify the priorities and challenges that are impacting the nuclear detection community, and then sought to develop event frameworks to address those areas through future NDWG activities.

Future Priorities

The NDWG will continue to focus on promoting the practical application of nuclear detection guidance, while addressing topics that have been identified as relevant by our Partners to include developing and strengthening nuclear security detection architectures, and addressing detection operations in challenging domains. The NDWG will also continue to lead GICNT efforts in the cross-disciplinary area of Sustainability, specifically through the "Sentinel" workshops that focus on the development and implementation of national-level nuclear security exercise programmes. The proposed presentation would describe future priorities that were recommended at the GICNT's June 11-12, Implementation and Assessment Group (IAG) Meeting in Helsinki.

NDWG Cooperation with the IAEA

As an official observer and active participant in GICNT activities, the IAEA has been an important partner in advancing the NDWG's work and priorities. This envisioned presentation would highlight important areas of collaboration and priorities for future collaborative efforts.

Abstract ID : 18

Nuclear Security Culture Self-Assessment Trial: Current Status and Future Plans for the Malaysia

Mohd Kamari, M.[1]

[1] Ministry of Health, Malaysia

Corresponding Speaker: M., Mohd Kamari

Blood irradiation is known as the best method to prevent the risk of transfusion-associated graft- versus-host disease (TA-GvHD). Gamma-irradiation was commonly used for blood product irradiation where Caesium-137 (Cs-137) is utilised as a main radioactive source with activity ranging 40 - 120 TBq. Cs-137 is assigned to Category 1, corresponding to security Level A based on the IAEA Code of Conduct on the Safety and Security of Radioactive Sources and IAEA Nuclear Security Series. The purpose of this study is to evaluate the nuclear security culture in organization and to determine how extensive nuclear security as part of the organisation's culture. Two locations were chosen as a research location which is National Blood Centre and Ampang Hospital. The system was assessed through surveys and interviews where questionnaires was distributed to all respondent that inclusive medical officers, science officers, medical laboratory technicians and hospital attendants. The interviews session was conducted by one interviewer and few observers for verbal and non-verbal data collection. The study found that security system and policy are al- ready in place but the security culture is not fully practiced by all staff. Management foresees the need of structured training programme to improve staff understanding on security culture. Even though majority of the staff are aware of security culture, they still didn't embraced the security culture due to lack of awareness on the potential threat. Improvements can be made by developing a comprehensive nuclear security training programme, encouraging effective communication be- tween top management and staff members and ensure staff members adhere to procedures in order to support and enhance nuclear security. Apart of conducting another round of self-assessment on nuclear security culture for government, private and university hospital, there also will be initiative to develop a close cooperation with IAEA and to be listed in Integrated Nuclear Security Support Plan (INSSP) 2018-2021 as part of the future plan.

Abstract ID : 152

Should the Regulator Evaluate his own Security Culture?

Speicher, C. [1]

[1] Ministry of the Environment, Climate Protection and the Energy Sector, Baden-Württemberg, Germany

Corresponding Speaker: C. Speicher

This paper is dedicated to highlight the question if a regulator should perform a self-assessment of nuclear security culture within its own organization. The answer summarizes a comprehensive way how such a self-assessment can be performed. The applied methodology is strongly adapted from the recently published IAEA technical guidance NSS No. 28-T (Self-assessment of Nuclear Security Culture in Facilities and Activities). As already claimed in various IAEA recommendations, implementing guides and technical guidances, such as IAEA NSS No. 14, No. 15, No. 11 and No. 17, the use of self-assessment is not strictly confined to the operators' side but seems rather to be a kind of social obligation for the any organization that deals with radioactive and/or nuclear material with the goal to foster a robust security culture.

In various publications different ways how to implement an appropriate and sustainable methodology and thus perform such a self-assessment procedure in a fruitful way. However no appropriate adaption for the regulator (and TSOs) have been published so far. Whereas a positive security culture is widely recognized as an indispensable issue for any organization, handy and easily applicable tools are still missing. So this paper defines the framework conditions, the set-up of a self-assessment questionnaire, finally a useful routine for the evaluation of the current state of the security culture, for the derivation of an action-plan and last but not least hints and tools to make the desired progress sustainable.

It should be mentioned already here, that all required tools can be found in IAEA NSS No. 7 and No. 28-T; they just have to be tailor-fitted to the needs of the regulatory body. The regulatory body plays a central role here, taking his self-reflection about his own role modelling into account. One big advantage seems to be to highlight the importance of a positive security culture not only to the security related personnel of the regulator (who is already supposed to be aware in this regard at least to a certain extend) but also to non-security related inspectors and approvers (e.g. safety inspectors, inspectors for radiation protection, workplace safety etc.).

The self-assessment campaign for the regulator should be easily understandable and applicable so that it may affect any level of inspector in an effective and efficient way. Therefore anonymity and voluntary participation should be granted. In addition the self-assessment survey should be limited and focussed to appropriate topics and not try to cover all the indicators in the above mentioned IAEA papers. So the survey form can be limited to max. 20 statements not to annoy or overburden the staff. "Keep it short and simple" is highly recommended here (always keeping in mind the danger of over-simplification however). In general there is a big danger of generating another "data grave-Yard" which is neither useful for the regulator nor for the operator or any other stakeholder involved. The main challenge consists in selecting appropriate characteristics from the generic IAEA model to be able to tailor-fit a suitable bunch of indicators in the second step. The next crucial step deals with fitting a bunch of suitable statements with unambiguous and understandable messages. Performing such a campaign should therefore lead to a deeper under- standing of the security culture and its importance for an effective security regime.

Some characteristics are playing a central role for the regulator, such as work environment, training and qualification, effective communication, motivation, professional conduct and adherence to procedure whereas other areas seem to be of minor importance for the regulator himself, e.g. improving performance, expectations or performance measurement. As for any other organization an appropriate leadership behaviour is highly required e.g. in order to avoid the misuse of authority that may lead to ignorance or even complacent behaviour within the regulatory body but also within the operator's organization.

Abstract ID: 356

Creating a Cyber-Security Culture

Patrick, D.[1]; Clements, S.[1]; Vandyke, S.[1]

[1] Pacific Northwest National Lab, USA

Corresponding Speaker: D. Patrick

The fundamentals of security are changing with the integration of computers and electronic devices everywhere and with everything we do. In order to have a robust physical protection program, you must include the cyber-security component.

Computers are a part of each step in the life-cycle of radioactive material. Computers touch everything from fuel processing to waste disposal, to badging and access to facilities.

How are you ensuring access to your facilities are secure?

Operational technology (OT) is the hardware and software that directly impact physical equipment and access to facilities. Whereas, information technology (IT) is the infrastructure of hardware and software that transforms data, but does not impact the physical world. It is important to understand, in today's world of technology, IT and OT directly impact one another and fall within a cyber-security program; which is important to have to accomplish nuclear security goals.

Nuclear security goals are:

- Protection of nuclear facilities
- Protection of radioactive material
- Security of material out of regulatory control (MORC)
- Protection of sensitive information
- Protection of sensitive digital assets (SDA)

Understanding OT and IT is critical to accomplishing the nuclear security goals.

We explore and discuss a best practice to accomplishing the nuclear security goals by implementing a proper instructional strategy for a cyber-security training program that aligns to the desired outcomes of the nuclear security goals.

Cyber-security has grown into a specialized field to help nuclear programs stay secure. A good cyber-security program has training implemented that helps people apply what is taught. An appropriate instructional strategy aligns with a desired human performance after training has taken place. The appropriate instructional strategy for cyber-security is a critical andragogical approach. Meaning, it has adult learners critically thinking about their current program and helps them identify ways to implement better cyber-security techniques. This is done through case studies, scenarios, and stories that learners can relate to. As well as, getting their hands-on equipment to apply some of the techniques taught within training.

We have shifted training from a less academic feel and more of a facilitation approach with the class and a more hands-on delivery technique.

Approach:

- Identified a team of cyber-security experts and an instructional designer
- Clearly define an instructional strategy that aligns to adult learning behaviors
- Created an overarching training strategy
- Reduced PowerPoint and made a more cause and effect learning environment
- Created case-studies, stories, and scenarios
- Created life-like demonstrations with training equipment

Training is a fundamental piece to creating a cyber-security culture and protecting nuclear resources. In order to protect nuclear resources you need training that is engaging and properly aligned to get the desired outcome.

Abstract ID : 107

Nuclear Security Culture and Radioactive Sources: The Case of Argentina

Cáceres, F.[1]; Fourcade, M.[1], Longo, M.[1]

[1] Undersecretary of Nuclear Energy, Argentina

Corresponding Speaker: F. Cáceres

Argentina is a country with a long lasting nuclear tradition. It has a diverse and developed nuclear industry, that has always been tight to the civilian uses if this technology. Almost 5% of its electrical grid matrix comes from nuclear sources. It is also a country with a large medical and industrial nuclear industry, being one of the largest exporters of medical radioisotopes and cobalt 60 sources. So, as it can be seen, the nuclear technology is spread all through the Argentine society. Therefore, nuclear energy and its appliances are part of Argentina life, present and history. Argentina is undoubtedly a nuclear country.

As a nuclear country, Argentine's nuclear sector has a deep and large safety tradition. Its society as a whole is well aware of the risks of the nuclear industry (from a safety perspective), and even the urban areas surrounding the many nuclear sites that this country has, knows exactly what to do in the case of a safety incident. It could be said that Argentina has a strong nuclear safety culture. As an example, while performing many focus groups as a qualitative tool to analyze different parts of the society to "understand" it, when the participants were asked what was the first thing they though when the word "nuclear" was mention , the answer was always a "nuclear mushroom" or "Chernobyl". Never for instance, a "dirty bomb". So, safeguards and safety, not security.

Since the creation of the Undersecretary of Nuclear Energy, in 2015, its leadership believes that there is an important challenge within the nuclear security area and many things to improve, specifically when it comes to nuclear security culture. Latin America, as a region, believes (or hopes) that is faraway from any major global conflict. It relies (perhaps too much) on the fact that this is a pacific region, with not many domestic, regional or inter-country armed struggle, nor terrorist activity. So, Argentina's nuclear security culture still needs further development, in order to match the level that it has in different areas -such as the aforementioned safety.

In fact, the Undersecretary of Nuclear Energy puts special emphasis on nuclear security culture. This paper is going to present its experience in trying to further develop the public engagement on this topic, and the different ways that as a Member State has explored to rise awareness of the harm and damage that a radioactive source can do in the hands of the wrong people with malicious intentions.

This paper presents the lessons learned from the effort of enhancing nuclear security culture, trying to raise awareness on the potential harm it can do in the hands of a terrorist, and how to engage the public on security matters. This, specifically on radioactive sources being used for medical and industrial purposes.

So, the focus is on the best practices to address operators on how to use these sources (under safety protocols, but also how to combine them with precautionary security measures), and how to "digest" this topic to the general audience in order to make the industry feasible, safe and secure, avoiding any possibility of generating a backfire or boomerang effect. In other words, how to combine safety and security with public acceptance of radioactive sources for medical and industrial appliances.

Abstract ID : 118

Special Considerations for the Security of Radioactive Sources and Implications for Culture Assessment

Khripunov, I.[1]

[1] University of Georgia in Athens, United States of America

Corresponding Speaker: I., Khripunov

The current emphasis on the need to protect radioactive sources from being used for malicious purposes makes it imperative to explore and shape an appropriate culture-based response. It would including relevant self-assessment tools and a series of culture indicators as benchmarks to take a culture's measure and identify practical ways for improvements in security. This approach can adjust the existing IAEA model and self-assessment methodology for nuclear security culture to specific requirements for and mode of operation of radioactive sources. Though the IAEA security culture concept and self-assessment recommendations are designed as generic to be applicable to a wide range of facilities and activities, the modifications proposed in this paper are needed to make them user friendly and consistent with the security risks and requirements.

Their distinct features to be included in the culture design can be summarized as: continued prevalence of safety orientation, application in diverse work environments, multiple and inter-modal transport, integration into overall security regime of host organizations, mobile and portable operation, limited security awareness and resources, and disposal challenges.

These special features also justify a differentiated approach to security culture. More frequent and intense efforts including training and self-assessment are expected to focus on a select group employees who have a direct relationship with radioactive sources (management teams, security personnel, operational staff, technicians and others). As to all other employees, efforts are concurrently made to engage them in the security awareness raising, which is a less proactive construct compared to culture and its development. The proposed differentiation is a targeted approach de- signed to make time and resource investment in training and culture assessment commensurate with specific roles and responsibilities of individuals.

This approach can facilitate a more robust and sustainable security regime for radioactive sources throughout their life cycle, i.e. from cradle to grave.

Abstract ID : 169

Nuclear Security Culture Self Assessment in Radioactive Material Associated Facility

Solymosi, M.[1]; Petrányi, J.[2]; Horvath, K.[3]

[1] Somos Environmental Protection Ltd., Hungary; [2] Gamma Technical Corporation, Hungary; [3] International Atomic Energy Agency

Corresponding Speaker: M. Solymosi

The use of the nuclear energy to produce electricity is the sole decision of each country, which is influenced by economic and political considerations. On the contrary, the radioactive sources are consistently in use all over the world in industrial, medical, education and research applications. Parallel with it, the necessity of the enhancement of the security of these applications is increasing too, which has been emphasized several times, even on Nuclear Security Summits.

The level of the security (and even safety) is basically determined by the level and quality of the designed, applied and maintained systems and technologies. From that perspective, probably the most relevant risk is the human component. The people inside the organization maintaining these systems are responsible for the (safe and) secure operation of the facility. The culture for nuclear and radioactive security is essential, because its goal is to reduce human risks. Technical equipment can effectively assure the secure operation, as long as the culture for security (and safety) is a privilege of the management and the personnel.

There are significant differences between organizations using nuclear material and those using radiative sources. The potential radiological consequences meant by radioactive sources are significantly lower, than in the case of nuclear materials. Hence, at radioactive material associated facilities the available resources, the level and the quality of the security equipment, the number of security barriers, and also the number of the security personnel are lower. Due to that, the human factor and a good security culture and especially, that everybody in the facility should feel ownership for security is essential, since in this case the nuclear security culture of the personnel and the facility more directly and more significantly influences the nuclear security performance.

Although in 2017, the IAEA has published a guidance about the Self-Assessment of Nuclear Security Culture, but the main target of the NST 28-T is nuclear facilities. The main difference between nuclear and radioactive material associated facilities is the number of the employees. Operators of nuclear facilities are basically larger organizations. The recommendations of the guidance about the methodology of the self-assessment are not always efficient or even applicable to the small number of employees and managers working at radioactive material associated facilities. Instead of a comprehensive survey the authors highlight the importance of the open ended and interactive nature of the interview/focus group and recommend specific methods to assess and also raise awareness and enhance the culture of security.

The main objective of the paper is based on the experience of the authors to set a “good practice” how to apply the recommendations that are established in the NST 28-T Guidance to radioactive material associated facilities.

In the paper, the authors present the theoretical background and the components of Nuclear Security Culture, the methods and the process of nuclear security culture self-assessment and the special considerations which must be taken into account when an assessment is performed at a radioactive material.

Abstract ID: 348

A Perspective on the Nuclear Security Culture: Challenges and Recommendations

Elabd, A.[1]

[1] Egyptian Nuclear and Radiological Regulatory Authority (ENRRA), Egypt

Corresponding Speaker: A. Elabd

Millions of radioactive sources have been distributed worldwide over the past 50 years throughout medicine, industry, agriculture, academia, facilities for a variety of purposes, and stored in thousands of facilities, many of which are poorly secured and vulnerable to theft. In many countries, the inventory amounts are not well known as regulatory control of radioactive sources is weak. The International Atomic Energy Agency (IAEA) Incident and Trafficking Database (ITDB) reports a total of 2,889 confirmed incidents (as of 31 December 2015) reported by participating states, but this could be just the tip of the iceberg. One of an intangible challenge facing developing countries is a lack of security awareness and security culture. Therefore, the paper is focused on security culture challenges facing developing countries to strength sustainability and effectiveness of radiological security regime. There exist a number of challenges when it comes to securing radioactive sources, which are briefly summarized below:

- The diversity of radioactive source applications and affiliated organizations, as well as the primarily "safety" orientation of operators and regulators, presents significant challenges for users;
- Coordination and collaboration among stakeholders;
- National culture will be one of the influences on the security culture, and on the likely success or failure of improvement programs';
- Implementing and sustaining a management system to ensure an organization works properly and efficiently;
- Availability of guidance to all staff concerning security culture: Staff needs to know what they are doing, why they are doing it and what is acceptable and what is not;
- Managing the interaction of the way in which individuals involved in safety and security activities approach the goal of risk mitigation and protection of public health and safety;

- Managing the interaction of the way of information sharing between individuals involved in safety and security activities. These aspects and others identified through stakeholder interactions must be resolved and managed; and

- Power and change issues play an important role in the workings of an organization through its effect on the ways employees relate to each other.

As well as, the paper is focused on the recommendations, if implemented, would contribute to strengthening radiological security framework, which are briefly summarized below:

- Preparing strategic plans and action plans to integrate security into all aspects of an organization's activities;

- Regular monitoring and review of progress in implementing the strategic plans and action plans to confirm that they remain valid. Information about progress and the outcome of reviews should be communicated to all employees;

- Involving all stakeholders in the collective task of promoting the importance of nuclear security and creating a mind-set that is supportive of nuclear security;

- Taking national culture factors into consideration when analyzing and developing security culture. It is important that characteristics of national culture should be used and fostered in developing security culture;

- Raising security awareness among staff members of the entire organization while building an effective security culture for individuals who are managing and operating, or are otherwise professionally associated with their use;

- Providing the organization with the means to develop and improve its security culture as well as make it sustainable;

- Ensuring a common understanding of the key aspects of security culture within the organization;

- Training every employee on a rolling basis for all employees;

- Reinforcing a learning and questioning attitude at all levels of the organization;

- Establishing policies and procedures that identify both the safety and the security as being a high priority;

- Establishing organizational arrangements and communication links that result in an appropriate flow of information discussing the safety and the security at various management and staff levels as well as between them;

- Taking major decisions regarding safety and security with the participation of experts on safety and security on a continuous basis;

- Ensuring effective security measures, when appropriate, by complementing existing safety measures with additional security measures identified through a specific vulnerability assessment;

- Leadership and Accountability for safety and security is clear;

- Handling power issues begins with an assessment of the level of support for change, using personal interviews, not only with key people, but also with a cross-section of employees;

- Taking into account lessons learned and feedback to continuously improve nuclear security; and

- Developing a learning organization that will be able to make its own continual diagnosis, and self-manage whatever transformations are needed as the environment changes. A fundamental assumption underpinning the development of a learning organization is that people can change by increasing their knowledge and skills.

Abstract ID : 102

Special Technical Characteristics of Equipment and Response Procedures, Using of What Increases Efficacy of Combating Illicit Trafficking of Nuclear and Radioactive Material

Kravchenko, N.[1]

[1] Independent, Russian Federation

Corresponding Speaker: N., Kravchenko

A fundamental base of documents, equipment and training courses using of what helps in different countries to organize control for illicit trafficking of nuclear and radioactive material, has been created for the last years with efforts of many countries and international organizations (first, IAEA). However, experience of work of customs and other law-enforcement structures in the Russian Federation allows to talk about some peculiarities, accounting for what increases efficacy of the work in this area.

The following main issues are viewed in the report:

1. Inconsistence of alarm setup with a neighbor country.
2. Device setup should be different depending on a control aim.
3. Using term "innocent" alarm in IAEA documents must not stop responding nor decrease control efficacy.
4. Currently, most countries don't have technical means of customs control of legal shipment of nuclear and radioactive materials that doesn't let obtain objective and full information on an amount and type of materials that would be placed in a transport package and crossed through the border. The fact that customs services have no means of objective control makes it possible to smuggle nuclear and radioactive materials in shipping packages under the cover of legal shipments and activity.

Specialized gamma spectrometers must be part of a complex of technical means for control of trans-border shipment to perform verification of declared data of legal shipment of nuclear and radioactive materials (without package opening).

5. Measurement procedure, detection threshold (distance, search time, sensitivity) and rate of false alarms of hand-held and mobile devices must be harmonized with corresponding characteristics of fixed RPM.
6. Automatic classification of alarms by 3 levels depending on activity of a found ionizing radiation source.
7. Following the practice of a front-line officer response at transport infrastructure facilities (railway, underground stations, etc.), it is usually found out that personnel has bad knowledge of radiation safety. Identified cases of radiation background excess often result in inadequate response measures. Safe exposure time and specified safe distance to the source are clearly understood by

all response personnel.

It’s suggested to use personal radiation detectors with a function of automatic determination of maximum permissible safe radiation exposure time.

8. Specialized requirements (that are absent in standards) for equipment.

On every this issue, suggestions to fulfil them are given in the report. It’s proposed to use these suggestions when developing documents of Nuclear Security Series of IAEA and preparing training courses for combating illicit trafficking of nuclear and radioactive material and nuclear terrorism.

Abstract ID : 206

Developing Police Capacity for Radiological Transportation Security and Theft Response

Daulagala, A. [1]; Rudich, R. [2]; Hill, S. [3]

[1] Special Task Force Sri Lanka Police, [2] Office of Radiological Security, Department of Energy, USA; [3] Sandia National Laboratory

Corresponding Speaker: A. Daulagala

High activity radioactive sources have many legitimate uses for medical, research, industrial and other applications. However, malicious actors have targeted these materials and seek to use them to build a radiological dispersal or exposure device. Such a weapon could force the evacuation of millions of people and result in economic impacts in the billions of dollars. To avoid these consequences, regulators and licensees must work to protect radioactive materials. It is equally important that law enforcement be prepared to disrupt any attempted theft of material, this is especially critical when the material is in transit, and particularly vulnerable. Sri Lanka operates high activity radioactive sources at 14 locations across the country. Because of its experience with terrorism and insurgency, the Country made it a priority to protect its sources and develop specialized police teams and assets to respond to any attempted theft of radioactive material.

The U.S. Department of Energy's, National Nuclear Security Administration's Office of Radiological Security (ORS), and its predecessor organization, the Global Threat Reduction Initiative have been working with Sri Lankan authorities to protect radioactive material since 2008. ORS works worldwide providing physical protection systems, and related training focused on the protection of high activity material both at fixed facilities and while in transit. The IAEA Nuclear Security Series Publication number 11 considers an immediate and adequate response to be a core aspect of preventing the unauthorized removal of radioactive sources. To support this objective, ORS provides law enforcement the necessary training and equipment to respond to an attempted theft of material, and to internally sustain their radiological theft response capabilities.

When internal conflict began in Sri Lanka in the early 1980s, the existing police were not equipped to combat armed attacks and assassinations from terrorist organizations. As a result, the Sri Lanka Special Task Force (STF) was established in 1983 to fulfil the need for a paramilitary strike force. The STF is now a 7,500 person force and, in 2011 at the request of Sri Lanka's Atomic Energy Authority, the STF was formally assigned the mission of preventing theft or sabotage or radiological or nuclear material. Since that time, the STF has worked with the Sri Lankan Atomic Energy Regulatory Council, the International Atomic Energy Agency and ORS to develop capabilities to successfully perform this mission. The STF hopes to share their experience globally with other law enforcement entities responsible for preventing and responding to the attempted theft of radioactive material.

Abstract ID : 210

Bridging the Gap – Thwarting Adversaries through Strengthened Site and Law Enforcement Relationships

Romano, D. [1]; Williams, J.[2]; Uhrig, K.[3]

[1] Y-12 National Security Complex, National Nuclear Security Administration, USA; [2]. Contractor, National Nuclear Security Administration, USA; [3] Office of Radiological Security, Department of Energy, USA

Corresponding Speaker: D. Romano

Terrorists continue to seek radioactive materials to cause harm and disruption. Many soft targets (e.g., hospitals and universities), which use radioactive materials for research and to treat cancer, take steps to increase the security surrounding these materials. However, any detection and de- lay measures at a site are meaningless if there is no timely and effective response from the local law enforcement agency. The Office of Radiological Security's Training Academy at Y-12 provides multiple resources to bridge the gap between sites and local law enforcement so that the law enforcement is aware and prepared to respond to a site's event involving radioactive materials.

The Office of Radiological Security's Alarm Response Training establishes a bridge between sites and local law enforcement by bringing them together to initiate a dialogue. By the end of the week long training local law enforcement understand the threat posed by the material, its location within their jurisdiction, and how to respond to an event involving the radioactive material. After training sites and local law enforcement implement facility walk downs and conduct exercises together to continue strengthening the bridge.

The Office of Radiological Security also recognizes it cannot train ever single law enforcement officer in the United States at its Y-12 Training Academy. Therefore, the office developed Customized Alarm Response Training. Customized Alarm Response Training takes the course directly to the local law enforcement working with them to develop and establish their own one-day Alarm Response training program so that they can train their own responders. Customized Alarm Response Training enables the law enforcement to be ready to respond to actual events in the area while receiving valuable training specific to their jurisdiction and needs. Taking ownership of the training through Customized Alarm Response Training expands the bridge between sites and local law enforcement by ensuring all officers in a jurisdiction are aware of a site's radioactive materials and are prepared to effectively respond.

A timely and effectively response by local law enforcement is key to stopping an event involving radioactive materials. Without it a site's security system is ineffective against an adversary. The

Office of Radiological Security provides tools to build and reinforce bridges between sites and their local law enforcement agency so that responders are prepared to thwart the most determined of adversaries from obtaining radioactive materials.

Abstract ID : 294

Nuclear Security Awakening- Strengthening Response Mechanism

Mohd Tahar, R.[1]; Bakri, N.[1]

1 Atomic Energy Licensing Board, Malaysia

Corresponding Speaker: N. Bakri

Due to the nature of their operation, mobile sources of category 2 and 3 are vulnerable and prone to be out of regulatory control. In February 2017, two (2) units of gamma projectors belongs to an authorized industrial radiography company in Malaysia were stolen from a vehicle parked at their commercial building. Through a joint search operation between Malaysian authorities, the stolen gamma projectors contained Ir-192 sources with activities of 43.6 Ci and 35.8 Ci respectively were found dismantled at a nearby residential area. Although missing and theft of such sources was not the first occurrence in Malaysia, the plot of this event was the first of its kind; where the sources were intentionally removed and left at the public area. This event was escalated from normal missing cases towards public evacuation event that require for immediate radiological emergency response. Learning from this case, Malaysian authorities conducted an immediate reformed towards approach of our long standing cooperation to integrate the control measures. In the current approach, our joint responsibilities begin as early as awareness programme to the users and public at large up to conducting joint investigation. Existing SOPs for response within Malaysian authority are now integrated for both security and safety response measures. The Royal Malaysian police (RMP) has specifically established internal task force to properly developed over- all capacity of their forces to better address nuclear security threat. Authorization and inspection programme within Atomic Energy Licensing Board (AELB) are also updated to address the gaps identified as lesson learned from the incident. The AELB and RMP are now more equipped with better SOPs and knowledge to address nuclear security in Malaysia. Through this incident, Malaysia has also reaffirmed our belief on the important role of capacity building programme and the strong interface between preventive and reactive control for both materials under regulatory control and outside regulatory control.

Abstract ID: 353

Prevent, Detect and Response to Nuclear Security Event

Repanovici, S.[1]; Strosinski, M.[2]; Cristian, M.[3]

[1] National Commission for Nuclear Activities Control, Romania; [2] Sandia National Laboratories, United States of America; [3] General Inspectorate of the Romanian Gendarmerie, Romania

Corresponding Speaker: S. Repanovici

National Commission for Nuclear Activities Control (CNCAN) is the national regulatory body with regulation, authorization and control responsibilities. CNCAN has the right and obligation to ensure that physical protection are applied, in accordance with international and national regulations in the State, under its jurisdiction or carried out under its control anywhere, for the exclusive purpose of verifying that such material is not diverted to nuclear weapons or other nuclear explosive devices. CNCAN has built a strong primary and secondary legislation in order to have a strong legal framework to fulfil international requirements and commitments.

Since 2009, NNSA and CNCAN have partnered to complete security enhancements at twelve buildings containing radioactive sources throughout Romania, including various medical facilities and the Pitesti research reactor site/RATEN Institute. The completed physical protection systems make material less vulnerable to theft, including sources that could be stolen in order to create a radioactive dispersal device, or RDD.

More recently, NNSA's Office of Radiological Security (ORS) partnered with CNCAN to complete additional security enhancements, including installation of In-Device Delay (IDD) kits. This additional layer of protection within the radiological device itself further delays an adversary's ability to steal the material for malicious use.

As the lead response agency, the Romanian Gendarmerie plays a critical role in monitoring the security of facilities with radioactive materials and in providing rapid response. The Gendarmerie also supports CNCAN implementation of vital site security inspections to ensure facility compliance and readiness, as well as transportation security for radioactive materials.

Abstract ID : 292

Cooperation between Regulatory Body and Custom Authorities in Preventing and Responding to out of Control Radioactive Sources at Vietnamese Border Gates

Vu, H.[1]**; Nguyen, N.**[1]**; Tao, X.** [1]

[1] Emergency Response Unit, Technical Support Center for Radiation and Nuclear Safety and Emergency Response, Viet Nam Agency for Radiation and Nuclear Safety (VARANS), Viet Nam

Corresponding Speaker: H. Vu

Viet Nam Agency for Radiation and Nuclear Safety (VARANS) established in 2003, which belongs to Ministry of Science and Technology (MOST) in State management of radiation and nuclear safety and security (Atomic Energy Law, Article 8). General Department of Customs is an authority belonged to Ministry of Finance (MOF) has responsibility on control all import/export of goods included radioactive sources. The first cooperation between VARANS and Customs is the process of control of import/export radioactive materials. Follow that, there is no radioactive material will be released from customs without license that is approved by VARANS. In 2010 VARANS and Viet Nam Customs participated in the IAEA-EU Joint Action Project. The goals of this project is strengthening national infrastructure for radiation monitoring at border gates (airport) through the provision of radiation detection equipment by IAEA-EU. Therefore, 12 Radiation Portal Moni- tors (RPM) were installed at an international arrival gate at Noi Bai International Airport and there is an internal information connection line among VARANS, General Department of Custom and Noi Bai Custom. Point of contact for this project is at VARANS. At the same time, Megaport Initiative (or NSDD Project) is supported by the US government to deter, detect and interdict the illicit trafficking of special nuclear and other radioactive sources through seaports in Viet Nam. 12 RPMs have been installed at 3 ports of Cai Mep – Thi Vai. Contact point for NSDD project is at General Department of Customs. After 3 years trial operation of system, a cooperation mechanism be- tween VARANS and Customs has been established by Joint Circular 112/2015/TTLT-BTC-BKHCN dated 29 July 2015 on guiding the mechanism of coordination and handling in the inspection and detection of radioactive materials at border gates. This paper presents the JC content, including the assigned specific responsibility to several related parties and the coordination mechanism be- tween VARANS and Customs. This JC is legal basis for both VARANS and Customs to deploy more coordination activities. Several ministry projects have been simultaneously implemented by both of Parties to study the current system and develop new RPM systems.

The Integrated Nuclear Security Network (INSN) is a very useful tool for information exchange and operational process between Front Line Officer (FLO) - Customs and Mobile Expert Support Team (MEST) - VARANS. For the current INSN, we encountered some difficulties, as we cannot arrange 24/7 a staff member at Alarm Support Center (ASC) to timely provide assistant to Customs in some case. So we temporary use a remote software to access to ASC computer via internet to get information when FLO ask for support. But in this case, we may face with cyber security problems. Viet Nam has comments and proposed to IAEA develop new INSN and volunteer to trial use new INSN. Like other countries in the region, Viet Nam has also

encountered some difficulties in implementing the coordination between the two agencies, there are human, technical, training, financial issues. Example for human issues, Viet Nam customs has policy of period change of position of working for each 3 years. When the FLO point of contact change, we need train for new user the technical issues, ConOps, coordination process, etc. All prospects and challenges of Viet Nam on cooperation between regulatory body and custom authorities will be presented in this paper.

Abstract ID: 329

Radiation and the Public: the Role of Nuclear Security and Safeguards in Public Acceptance of Nuclear Technology in the Case of Malaysia

Lee, C.[1]

[1] Jeffrey Sachs Center on Sustainable Development, Sunway University, Malaysia

Corresponding Speaker: C. Lee

This paper develops from another paper to be present3d at another conference on the topic of communicating the science of radiation and radiation risks to the public, as well as the controversies surrounding it, in the Malaysian context. The proposed presentation will take on a social scientific approach for facilitating a more comprehensive and holistic approach to safeguards and radiation standards as they are being revised and improved upon in a presently non-proliferation emergent nuclear market. At the same time, the paper also proposes for a public science literacy programme of a participatory nature that would encourage more direct involvement of the public by educating them on the scientific content and providing the latter with a critical framework for contributing to policy and risks mitigation an act crucial to regaining public trust. The public in this case does not merely mean a lay participant but also other experts not immediately part of the nuclear science and technology community but who could provide expert contribution to the issue at hand by virtue of their relevant expertise. By using historical evidence, I also argue that the role of the public is important to the development of deterrence policies.

Abstract ID: 22

Upgrading the Physical Protection System for Category I of Radioactive Sources in Thailand by International physical protection advisory

Youngchuay, U.[1]**, Phenboonmee, T.**[1]

[1] Thailand

Corresponding Speaker: U. Youngchuay

In the year 2000, an unsecured radioactive waste had caused serious injuries and three deaths in Thailand. Thailand Institute of Nuclear Technology (TINT) owns the category I of radioactive sources in the waste storage facility and agriculture product irradiation facility. The Physical Protection System (PPS) recommended by IAEA guide for security of radioactive sources was introduced by the physical protection advisories to TINT for upgrading are strengthen the PPS of a category I radioactive sources. The Pacific Northwest National Laboratory (PNNL), operated by Battelle Memorial Institute, is the advisory and implementing agent on behalf of the United States Department of Energy (DOE). The advisory mission's objectives of the upgrading are strengthen on the performance of the PPS to oppose and limit the adversary toward radioactive sources and are based on the IAEA Nuclear Security Series No. 11 Security of Radioactive Sources. The enhanced security systems were incorporated into existing site access control, intrusion detection, and applicable CCTV system(s) for the high and low activity storage rooms, shipping and receiving areas and alarm monitoring station. Next steps, a security upgrading is to establish the contingency plan and evaluate the performance of the PPS.

Abstract ID : 115

Protection Concepts for Irradiators in a Laboratory Environment

Baumann, M.[1]**; Adams, D.**[1]**; Kuca, M.**[2]

[1] Department of Energy / Sandia National Laboratories, USA; [2] Office of Radiological Security, Department of Energy, USA

Corresponding Speaker: M., Baumann

Laboratory and research irradiators are widely used to sterilize blood and medical supplies, preserve food, and conduct basic research. These irradiators typically use cobalt (Co-60) or cesium (Cs-137) sources to expose samples to gamma radiation. Unfortunately, terrorists' and criminal organizations' interest in these radioactive materials is on the rise, with experts warning that Co- 60 and Cs-137 are being actively pursued by malevolent actors to create dirty bombs and other radiological dispersal devices. Protection of irradiators that contain highly radioactive sources is critical to preventing unwanted removal and misuse of the source material. Irradiators in laboratory or blood bank settings pose a unique security challenge to protect because of the number of people with access to the laboratory, the multitude of activities conducted in most laboratories, and the limited physical space available for security-related devices.

This work will present considerations and challenges associated with developing a security system for a multi-purpose laboratory that is open 24 hours per day, 7 days per week. Although response is a critical security system element, it will not be specifically addressed in this presentation since its implementation varies widely by location. Instead, this presentation will focus on continuous and balanced layers of security measures of protection for research laboratories and blood banks, including laboratory access control, human activated duress, area motion sensing, In-Device Delay (IDD) systems, irradiator immobility systems, and irradiator-specific room/cage designs. Several representative scenarios will be presented that address typical laboratory environments with security elements that could be applied to improve the protection of the source material from an overt attack on an irradiator

Abstract ID : 43

Impact of Electric Power Disturbances on Physical Protection System Equipments and Solution Techniques in Nuclear Facilities

Eleissawi, H.[1]

1 Egypt

Corresponding Speaker: H. Eleissawi

Physical protection system is a very important system in nuclear facilities. According definition of international atomic energy authority, it is entity of protecting measures, designed in order to prevent unauthorized removal radiological sabotage of nuclear materials or facilities. Physical protection system involves the use of multiple layers of interdependent systems which include CCTV surveillance, access control, control panel, computers devices and many other types of equipments. Physical protection system is involving very sensitive electronic equipments. And these sensitive equipments are affected by any power disturbance which may lead to an equipments failure, erratic operation of sensitive devices; malfunction and error signals lead to bad performance of the system. Normally, there are several disturbances exceed the thresholds. Among of all electrical power disturbances, harmonic distortion and voltage fluctuations (flicker) are disturbances that cause most problems to sensitive equipment. Harmonic distortion originates in the nonlinear characteristics of devices and loads in the power system. It is also common to use a single quantity, the Total Harmonic Distortion (THD) as a measure of the effective value of harmonic distortion. One of the major problems related to harmonic disturbances is harmonic resonance, the resonance can magnify harmonic distortions to a level that can damage the equipment or cause equipment malfunction. Other effects of harmonics are equipment overloading and increase losses lead to overheating and equipment failure. Voltage fluctuations are cyclical variations in the voltage rms value or a series of random voltage changes, whose magnitude does not normally exceed voltage ranges of 0.9 p.u. to 1.1 p.u. A common phenomenon of voltage fluctuations is flicker. Arc furnaces and welders are the most common causes of voltage fluctuations in utility transmission and distribution systems. It causes lamps light to blink rapidly and causes erratic operation of sensitive equipment. So, it is necessary to mitigate power disturbances and feed physical protection system equipments with suitable electric source according to standards to maintain accurate operation and good performance of the system. The present research discusses impact of power disturbances such as; voltage, current or frequency deviation may result in failure or malfunction of sensitive equipment. A case study is done; field data is collected by real time analyzer and analyzed with reference to standards. And also problems are analyzed. Solution techniques are suggested all sen- sitive and critical equipments

should be fed through separate eclectic circuits. And these circuits should isolate by using isolation transformer and fed through double conversion uninterruptible power supply to protect the sensitive equipments and hence achieve high efficiency of the system. Isolation transformer is used to maximize the power quality benefits of a standard transformer when transferring electrical power from an AC current source to any equipment. Shielded isolation transformer is very popular power-conditioning devices. It isolates sensitive loads from transients and noise caused by the utility. They can also keep harmonics produced by end-user nonlinear equipment from getting onto the utility's system. The on-line or double conversion UPS, is the ultimate in UPS protection because the utility supply power does not flow directly to the load like the other types of UPS. Instead, the power flows continuously through a charger/rectifier that feeds both a storage battery and an inverter. The inverter generates AC power to the load being protected. In the event of a power failure, the inverter is fed by the battery. Since the power flows through the rectifier and inverter before reaching the load, most power disturbances are eliminated through constant filtering. Therefore, double conversion UPS is a good idea for any system which is sensitive to transients, noise, and/or cannot tolerate any power interruption. It has all its power flow continuously through the input rectifier and DC voltage link. Hence, most disturbances on the input are isolated from the output. The bypass for this system may be used to take the UPS out of service. The present work also discuss and analysis of power disturbances and their effects on physical protection system equipments. And also show a design of modern technique to protect the sensitive equipment from power disturbances to keep good and accurate operation of the system and economic calculation.

Security of radioactive material is very important and physical security system is very necessary for prevention and detection. This paper presents the bad effects of power quality problems on the behavior of the physical protection system in nuclear facility. The analysis of the recorded data yields that, harmonics and flickers are the most severe events and should be taken in consideration for any evaluation. It is recommended that mitigation technique should be done to keep good performance and accurate operation of the physical protection system and then void operation problems. to mitigate power problems a design of modern technique will be done to protect the sensitive equipment from power disturbances to keep good and accurate operation of the system. and also economic calculation will present.

Abstract ID: 315

Physical Protection of Radioactive Materials and Associated Facilities

Izmaylov, A.[1]

[1] JSC "Federal Centre of Science And High Technologies "SNPO "Eleron", Russian Federation

Corresponding Speaker: A. Izmaylov

Along with Nuclear Security (NS) of Nuclear Materials and Facilities in the context of Nuclear non-proliferation and Anti-terrorism there is very topical problem to provide NS of Radioactive Materials and associated facilities. Physical Protection (PP) plays one of the main roles to solve this problem. Radioactive materials Physical Protection Systems (PPS) structure and main functions of its sub-systems are described in the paper. Stages and milestones of development and upgrading of PPS are also considered in this presentation. Special attention is paid to the importance of realistic Design Basis Threat (DBT) development and to its influence on PP organizational and technical measures. International IAEA documents "Nuclear Security Series" (NSS) are briefly described, in particular IAEA NSS № 14 (Nuclear security recommendations on radioactive material and associated facilities). Russian federal level legal and regulatory documents on Radioactive Materials Physical Protection are given as an examples. These documents are reflecting main objectives of NSS Documents taking into account national specificity. Attention is paid to the Risk Evaluation methodology based on analysis of PPS effectiveness and consequences of unauthorized adversary actions against radioactive materials and associated facilities. Some examples of PPS implementation are presented.

Abstract ID : 52

Computer Security for Radiological Facilities

Herdes, G.1; Butler, N.1

1 Office of Radiological Security, Department of Energy, USA

Corresponding Speaker: N. Butler

Increasingly, security systems are evolving from analog equipment to Internet Protocol (IP)-based components which means that computer security must be considered when implementing physical security upgrades. The blending of physical protection systems with information technology is advancing at such a rapid pace that the two can no longer be viewed independently or separately. Security systems are evolving from stand-alone hardwired devices to network-based devices where both power and data may be provided by a single Ethernet cable. Most physical protection systems contain some form of intrusion detection system, access control system, video surveillance systems, and a method for monitoring alarms and video either on-site, off-site, or in many cases both.

The following types of physical security system devices used to protect radioactive sources increas- ingly use network-based communications that can increase a site's potential for a cyberattack:

Alarm concentrators/panels, which communicate to the host using various communications protocols over ethernet, cellular, or a combination of communications means

- IP-based cameras
- Network devices including VPN appliances installed to secure communication pathways
- IP-addressable access control/alarm keypads (biometrics, proximity card, pin keypads)
- Remote monitoring systems used for insider mitigation
- Alarm monitoring stations
- Remote system access

As security technologies continue to evolve and more and more security devices become IP-based, the cyberattack surface will continue to grow, ensuring the gap between the threat and cyber defense methodologies remains a constantly evolving issue. As legacy security systems give way to new technologies, radiological facilities have a challenge to stay abreast of the threat while accurately assessing cyber threats related to physical protection systems protecting radioactive sources, mitigating the risks, and sustaining risk reduction.

The primary computer security concerns that face radiological facilities are:

An adversary who could use a cyberattack to override a facility’s existing network controls and physical security measures, allowing them to facilitate a physical attack that could result in unauthorized and/or undetected access to radioactive sources.

An adversary exploiting security equipment to gain access to a site’s network(s) to carry out a cyberattack, for example installing ransomware or stealing proprietary or other sensitive information.

An adversary using social engineering (e.g., phishing emails or phony web pages) to exploit personnel to gain access to physical protection systems, networks, and related subsystems without the need to hack or conduct a cyberattack.

To address these security concerns, ORS has developed a Cybersecurity Best Practices for Users of Radioactive Sources. The ORS best practices guide provides an overview of how physical protection systems have computer security issues and covers recommended best practices for sites to improve their computer security posture with a focus on computer security hygiene measures. The intended users of the best practices guide are regulators, site security officers, site management, and security vendors. Users of radioactive sources that are part of large organizations such as research institutes, universities, medical facilities, or large companies may have computer security programs. Smaller organizations may rely on IT staff, contractors, or perhaps may have to perform these duties themselves. The best practices guide is geared towards users of radioactive sources with limited computer security experience to provide information for countering potential cyber threats to their radiological facilities.

NSS 17 Computer Security at Nuclear Facilities can provide users of radioactive sources with helpful information on computer security concepts and higher-level responsibilities, but it doesn’t pro- vide the specific computer security controls that a radiological facility should implement. The ORS Cybersecurity Best Practices for Users of Radioactive Sources fills this void by recommending measures for developing a computer security program, implementing specific computer security controls appropriate for a radiological facility, and provides recommended measures to sustain the computer security program.

Abstract ID: 368

Feedback and Results of an RPM System Based on Passive Measurement Technologies for Nuclear Safety

Boudergui, K.[1]; Carrel, F.[1]

[1] French Alternative Energy and Atomic Energy Commission, France

Corresponding Speaker: K. Boudergui

CEA is an important player in the global security domain and developed its experience through different European, national or internal research projects. The paper presents recent concept and technological solutions related to the Radiation Portal Monitor (RPM) domain. RPM is a key solution in the frame of Homeland Security applications in order to prevent a terrorist attack including nuclear or radiological threats and MORC (Material Out of Regulatory Control).

In the frame of the Horizon 2020 C-BORD project (duration of 42 months, started in 2014, led by CEA LIST), CEA LIST carried out an important work for developing advanced RPMs and tested them in real measurement environment. This paper makes a focus on these specific developments of the C-BORD project. First of all, we present new RPMs designed and developed in the frame of C-BORD. A specific focus will be made on the algorithmic aspect implemented in these systems, for optimizing the identification step of radionuclides and minimizing the rate of non detection and false alarms.

Then, we will expose experimental results obtained using our RPM in three real environments located in three different countries. The first configuration corresponds to big port environment (Rotterdam – Netherlands), the second configuration is focused on container terminals (Gdansk–Poland) and the last one is dedicated to road checks (Rözske –Hungary). We will present the feedback resulting from these trials and the potential ways of improvement. Finally, we will present our future developments, including Artificial Intelligence (AI) approaches which seems to be a promising way to address the false alarm detection problem.

Abstract ID : 19

Upgrade Of Security Of Radiological Facilities In Ghana

Otoo, F.[1], Emi-Reynolds, G.[2], Adu, S.[3]

[1] Radiation Protection Institute, Ghana Atomic Energy Commission; [2] Ghana Atomic Energy Commission; [3] Ghana Nuclear Regulatory Authority

Corresponding Speaker: F., Otoo

The use of radioactive sources and their associated facilities and activities form part of the critical infrastructure in Ghana. They are found to be vulnerable to attack especially during transport, storage and in use, therefore the need to establish a system for periodic security upgrade is essential. The vulnerability of such radiological facilities pose a significant risk to the public if an adversary establishes control of radioactive materials that are used and kept in such facilities. The vulnerability of such radiological facilities pose a significant risk to the public if an adversary establishes control of radioactive materials that are used and kept in such facilities. In order to effectively secure the radiological facilities and the radiological materials in Ghana, issues regarding nuclear security enhancement need critical assessment by security professionals to ensure a robust nuclear security regime to protect persons, property, society and the environment from malicious acts in- volving nuclear material and other radioactive material which may cause a nuclear security event to ensure a robust nuclear security regime. This includes but not limited to nuclear security culture which has evolved over a period of time and has aided build-up of nuclear security regime in the country. The strategies used to protect the organization's assets need to have a layered approach. It is harder for an adversary to reach their objective when multiple layers have to be bypassed to access a resource security at facilities using administrative, technical and physical controls. The objective of this work is to describe additional upgrades of physical security systems of radiological facilities in Ghana in order to safeguard personnel, information, equipment, IT infrastructure, facilities, environment and all other company assets. The upgrades are done to increase detection and assessment capabilities whiles restricting access into more sensitive areas. In 2015, the NRA Act 895 was promulgated, establishing and independent Nuclear Regulatory Authority mandated for the regulation of nuclear safety and security, physical protection, radiation protection, trans- port and waste safety in Ghana. This paper summarizes the security upgrades that have been or is currently been implemented at these facilities namely: Korle Bu Teaching Hospital, Komfo Anokye Teaching Hospital, Gamma Irradiation facility, three Cobalt 60 destination scanners in Ghana as well as a waste management facility. Typical upgrades include: improvement in access control, hardening of storage facilities, intrusion detection systems, Closed Circuit Television Cam- era (CCTV) assessment, central alarm station improvements as well as improvement of new voice communication systems. The system designs are based on international security guidelines of the IAEA

Nuclear Security Series 11. This integrated system will greatly enhance the existing security at the facilities and give the security personnel and the management the needed information to make key decisions on a daily basis. Methods used to implement these upgrades and problems encountered are discussed. Training issues are also discussed. The study also will highlight the relevant provisions of the NRA Act which will enforce nuclear security.

Abstract ID : 244

Security of Sealed Radioactive Sources – Operator's Perspective

Ali, S.[1]; Iqbal, J.[1]; Liaquat, M.[1]; Tahir, M.[1]

[1] Pakistan Atomic Energy Commission

Corresponding Speaker: S. Ali

Nuclear facilities are focused on the use/production/storage of nuclear material and appropriate Physical Protection (PP) system are in place to protect against theft, sabotage or other unlawful taking of nuclear material. Nuclear facilities extensively use Sealed Radioactive Sources (SRS) as operational requirement e.g. for calibration of various equipment vital for operation of nuclear facilities. These radioactive sources are also used in various domains of science & technology in Pakistan. Depending on the type, activity and application, these sources are widely used in Nu- clear Powers Plants, Nuclear Medical Centers, Food Irradiation, Industry, Agriculture and Research Institutes. Security of these sources is essential requirement so that they may not become attractive target for adversaries. If these sources are not managed properly, loss, theft or mishandling of sources may lead to accidental exposure to workers and public. Pakistan, being a responsible nuclear state, is quite vigilant in the security of SRS and a continuous watch is kept through a comprehensively organized programme viz. Accountability & Control Programme for SRS. A corresponding range of effective Physical Protection (PP) measures have been utilized to ensure that sources are adequately protected using the concept of graded approach and balanced protection. In order to ensure suitable PP capability without imposing overly restrictive measures, the concept of security levels have been used.

This paper highlights the key features of accountability & control programme for SRS which are the custody of PAEC facilities. This programme affords corporate level watch on PAEC nuclear facilities for achieving and maintaining a high level of safety and security for SRS. Key elements of accountability & control programme include development of SRS database at corporate level and convergence of annual SRS data from all PAEC nuclear facilities, periodic inspections, physical inventory verifications and recommendations for improvement of PP measures. The compliance with regulatory requirements is the fundamental instrument of accountability & control programme. This programme also oversee the operator level measures which comprise of management responsibilities, risk assessment, Categorization of SRS, receipt, labelling, inventory management, storage, accounting, leak testing, key control, retention of records and security measures for SRS i.e. detection, delay, access control. The conformance of PP measures with regulatory requirements are checked and evaluated based on categorization and corresponding security level reflected in security plan of the facility. This security plan addresses security related responsibilities, clear line of authority of each individual, effective response to the threat spectrum and contingencies related to security of SRS. Recommendations for improvement of PP measures are provided in the light of the best international practices and national regulations. Tracking of SRS from its import to final disposal/return to supplier i.e. cradle to grave, is properly maintained under strict regulatory control. Dynamic and effective security culture is being promoted at each working levels and periodic training, retraining and awareness programs are conducted for safe & secure use/handling of SRS. Reliability of all personnel, authorized to use/handle SRS, is being ensured through background checks. This accountability & control programme for SRS is very helpful in managing source tracking, measures to secure, round the clock surveillance, controlled access, reporting mechanism in case loss or theft and controls needed to prevent undesired consequences. These stringent measures ultimately reduce the likelihood of unauthorized access, removal or sabotage to the minimum possible.

Key words: Accountability & Control programme, Physical Protection (PP), Sealed Radioactive Source (SRS), Security Culture

Abstract ID : 47

The Way Forward Against Insider Threats

Phyo, K.[1]

[1] Mandalay Technological University, Myanmar

Corresponding Speaker: K. Phyo

Threats to nuclear facilities can involve outsiders, insiders or both together in collusion. An insider may be in any position at a facility, from the highest level employee to the lowest. The insider threats are found in nuclear facilities such as research reactors, nuclear power plants and other nuclear fuel cycle facilities. The unauthorized removal of a large quantity or small quantities of nuclear material can be carried out during one event (abrupt theft) or several events (protracted theft with repeated action) respectively by insiders at targets. Insider threats present a unique problem and they may support terrorists. Insiders could take advantage of their access, complemented by their authority and knowledge of the facility, to bypass dedicated physical protection elements or other provisions such as safety, nuclear material control and accountancy (MC&A), and operating measures and procedures. Besides, insiders could be capable of defeating methods not available to outsiders. The best ways against insider threats should be found with suitable resources, preventive and protective approaches.

Abstract ID : 211

Insider Threat Analysis Tool (ITAT)

Townsend, J.[1]**; Sumner, T.** [1]

[1] Y-12 National Security Complex, National Nuclear Security Administration, USA

Corresponding Speaker: J. Townsend

Security Culture (SC) and the awareness of the insider threat are best learned through experience and active discussion. Culture is molded by ordinary life experiences and inherently difficult to teach. This form of training allows the participant to work through inadvertent or unplanned events and learn skills and gain expertise to mitigate those events. Experts from Y-12 have created an interactive Insider Threat Analysis Tool (ITAT) which puts participants in the position of identifying insider threats and mitigation measures through roleplaying and interactive discussion. Each participant is given the opportunity to play a role that leads to theft, diversion or sabotage of critical material and/or infrastructure at a hypothetical facility. ITAT stimulates complex-thought and discussion that leads to formulation of effective policies and procedures. The table-top focuses on the human element of security at a critical facility.

ITAT was created using information from IAEA Nuclear Security Series No. 7 (Nuclear Security Culture), and No. 8 (Preventive and Protective Measures against the Insider Threats). The typical participant would be a person that works at a critical facility and has a basic understanding of the processes that are conducted. Each participant prior to playing the exercise are taught a baseline understanding of physical security measures and how it does or does not pertain to the insider, as well as a comprehensive overview of the mock facility and the various roles that will be played out. Typical roles include; security police officer, site manager, radiation technician, radiation worker, etc.… From there the participants are assigned one of the roles and the scenario is started. Playing out the scenario creates an evaluation of systems and processes that are in place and how an in- sider might be able to mitigate the security in place. Using their knowledge of normal day-to-day practices, the participants will identify and attempt to exploit any weaknesses in the mock facility security. An illustration of one step in this process is shown below:

What is the probability of success (on a scale of 1-100) that a malicious adversary could sneak out the emergency exit without being caught?

- Is the exit alarmed?
- Is there an emergency in progress?
- Is there security present to respond to the alarm?
- Is the alarm ever turned off?

The questions asked in the illustration will help the role players have a broader understanding of the tactics of an insider and realize the possible incidents that may be encountered that are beyond the cultural norm of the work place.

Results from previous iterations of this exercise were very well received and participants stated that this tool does a great job of not only introducing the idea that there is potential for a malicious insider at ones facility, but it also helps the participants understand various mitigation techniques that could be implemented to develop a stronger security culture.

Abstract ID: 335

Information Security for Nuclear and Other Radioactive Material and Associated Facilities: Roles and Responsibilities

Shaban, S.[1]; Hazzaa, M.[1]; Eltyebany, R.[1]

[1] Egyptian Nuclear and Radiological Regulatory Authority (ENRRA), Egypt

Corresponding Speaker: S. Shaban

Basics of the nuclear security and all publications of three nuclear security recommendations focused on the importance of how to secure sensitive information. Ensuring the security of sensitive information is a cross-cutting prerequisite for nuclear security, the systems and measures to accomplish effective information security are essential elements of a state's nuclear security regime, so the state should establish and manage information security frameworks for handling information of various categories, identifying information that may be considered as sensitive information. Information security, also includes security of computer systems or cybersecurity. Policies and procedures of an organization's hierarchy should contain a plan for information security. As a minimum, the following should be addressed: (1) Information security definition and a policy statement of its overall objectives, scope and importance. (2) A definition of roles and responsibilities, including the establishment of a central point for directing and managing information security compliance requirements, including legal, regulatory and contractual requirements. (3) The establishment of a risk management plan to reduce or mitigate risks to an acceptable level. (4) Requirements for education and training for staff, contractors and other personnel to spread this and culture the consequences (i.e. penalties or sanctions) for non-compliance. This paper, provides responsibilities for the security of sensitive information. This includes (a) Competent authorities, including regulatory bodies; (b) Management in facilities, companies and organizations involved in the use, storage or transport of nuclear material or other radioactive material; (c) Facility operators and their staff, particularly the security staff; (d) Contractors or other third parties working for the authorities, organizations or facility operators; (e) Any other entities that may have been given legitimate access to sensitive information and protection of this information through information lifecycle

Finally, I recommend steps to further improve information security measures and tools concerning security of nuclear and other radioactive material and associated facilities.

Keywords: Information Security, Computer Security, Nuclear Security, Nuclear Material, Radioactive Material.

Abstract ID : 105

University of California System-wide Plan to Replace Cesium Irradiators with Alternative Technologies

Mackenzie, C.[1], Smith, K.[1]

[1] University of California, United States of America

Corresponding Speaker: C. Mackenzie

The University of California (UC) is made up of 10 campuses and 5 medical centers that contain a total of 41 Cesium irradiators that are used in a wide-variety of applications from sterilizing blood to exposing cells, small animals, and various materials and instruments to large gamma radiation exposures. The University President made a system-wide decision to eliminate the potential threat of malevolent use of Cesium by switching wherever feasible, to x-ray irradiators over a 3 year period of time. A Cesium Source Replacement Working Group of involved faculty was formed to study the available research on this topic and to make recommendations to the university as to when alternative technologies could offer equivalency. Two conferences were held in California in 2018 on "Cesium Irradiators and Alternative Technologies" to discuss technical options open to the medical and research communities. The UC Working Group reviewed the published papers, presentations and posters and provided guidance to the University and research community on how best to approach transitioning research involving the use of Cesium irradiators to x-ray irradiators. The importance of performing comparison studies prior to removing the Cesium irradiator was emphasized due to the diversity of research applications and the variability of x-ray irradiators, as compared to Cesium irradiators.

A contract with the University of California and Sandia National Laboratories was established to cover the expenses involved in the removal of the UC Cesium irradiators that choose to transition their research to x-ray irradiators. In addition, a portion of the costs of the new x-ray irradiators was provided as an incentive to make this change by the National Nuclear Security Administration (NNSA).

The x-ray irradiators were purchased through a centralized procurement office to allow the University to negotiate cost effective x-ray irradiators and service plans. The progress to date on this 3 year plan for transitioning off Cesium irradiators will be presented in this paper, as well as the lessons learned from tackling a project of this magnitude. Technical recommendations from the UC faculty Cesium Source Replacement Working Group will be shared.

Abstract ID : 35

Permanent removal of the risk of terrorist attack using radioactive materials as a dirty bomb (RDD) by means of Alternative Technologies

Kamen, J.[1]

[1] Mount Sinai Medical Center, USA

Corresponding Speaker: J. Kamen

This report is the summary of all the efforts by the Mount Sinai Hospital and the Icahn School of Medicine at Mount Sinai in New York City in the last 8 years to permanently remove the risk of terrorist attack of using radioactive materials as Radioactive Dispersal Device (RDD) or so called dirty bomb is reviewed. Due to the unique characteristics of the cesium chloride (Cs-137) used in medical and research irradiators, it is especially susceptible to be used as a dirty bombs. Mount Sinai originally had four of such irradiators with Cesium sources. To reduce and eventually re- move the risk of malicious use of radioactive materials, Mount Sinai has taken several measures so far. One of such measures was to harden the radioactive material irradiators to make it harder for terrorist to steal such sources. We increased the delay time so that the Local Law Enforcement Agency (LLEA) can have more response time to arrive at the facility to stop the terrorists. The other measure taken was to implement the enhanced security in facilities having radioactive materials. State of the art security equipment such as Biometric Access Control, 24/7 video monitoring, and Radiation Monitoring System (RMS) with Alarms have been installed and was connected to LLEA for constant monitoring and possible intervention if it is necessary in a timely manner. The other measure taken was to limit the number of people who have access to such radioactive materials alone. We adopted single person operator method and reduced the number of people having access from 145 people to only a few people. The adoption of such measures has reduced the risk significantly; however, the best way to remove the permanent risk of these radioactive materials that may be used for dirty bomb is to use alternative technology to replace these high-activity radioactive sources.

In 2013, Mount Sinai purchased its own first X-ray irradiator to investigate the feasibility of using X-ray irradiator instead of Cesium irradiators for research purposes to irradiate cells and small animals. The researchers in Mount Sinai did the comparison studies for their own applications such as bone marrow ablations, DNA double strand breaks, zebrafish embryos irradiation for drug screening …etc. Comparison studies results were promising. Therefore, we decided to permanently migrate all the experiments from using cesium-137 irradiators to use x-ray irradiators. Mount Sinai successfully disposed all its Cesium-137 irradiators. At this time, Mount Sinai, as one of the largest Health care institutions in NY with 40,000 employees has migrated completely to Alternative Technology and removed the risk permanently.

Abstract ID: 347

A New Perspective on Categorization of Radioactive Sources

Assi, M.[1]; Englefield, C.[2]

[1] Lebanese Atomic Energy Commission, Lebanon; [2] Isognos Limited, United Kingdom

Corresponding Speaker: M. Assi

It is time to review our approach to source categorization to ensure it remains relevant Categorization of radioactive sources dates back at least 13 years since TECDOC 1191 was first published. [Ref] It was later superseded by TECDOC 1344 in 2003 and RS-G-1.9 in 2005.

These documents were first concerned about radioactive sources which have the potential for causing significant harm to persons in the short term. They also specified that such categorization would be relevant to decisions regarding: notification and authorization by registration or licensing; the security requirements during each stage from manufacture, through transport, storage, use, transfer and repair, to decommissioning and disposal; and emergency preparedness. (REF TecDoc 1191).

Continuous improvement is intrinsic to a professional approach to any discipline. There is some operational experience that suggests that the original thinking, useful though it has been, deserves review to make it sure it is still relevant. We put emphasis on source categorisation, but actually that overly focusses on radiological consequences. We argue that social, economic and political consequences are at least as important and they do not obviously lend themselves to a graded approach in the same way that dose does. Focusing on the consequences as one factor to theoretically, categorize the radioactive source and, practically, apply security measures necessary to protect it gives rise to this question: Is a "secure" category 1 source, really more attractive to adversaries than a vulnerable category 3 source/sources?

This brings us back to the basic idea behind applying security measures in order to prevent any unauthorized removal of the source. Attractiveness of a source for adversaries, especially nuclear terrorists, is very much linked to the vulnerability factor and ease of removal and not only the direct consequences of the malicious uses of this source. For a terrorist, getting hands on several category 3 caesium sources used in mobile gauges could be preferable to reaching for a fixed radiotherapy cobalt source. Though categorization of radioactive sources, from a safety perspective, is relevant and adequate for approaching different safety issues in order to meet safety objectives for the protection of people and the environment, it seems to lack the same efficiency when analyzing the objectives of applying security measures and protection of the source itself.

Keeping in mind that vulnerability is linked to the threat assessment of the country, it is important to explore means of assessing vulnerability and involving it in the security-related categorization of radioactive sources. Furthermore, if security risk = threat x consequence (source strength?) x vulnerability then why are we not addressing the vulnerability component? Surely it is time to refine our thinking? This paper explores the potential for categorization of radioactive sources from another perspective with more emphasis on some security related factors beyond safety.

At least, it has to be correct to revisit a methodology that has hardly benefitted from the thirteen years of operational experience that has been gained since its methods were introduced? And if the outcome proves to be that “we got it correct first time”, then we can be more comfortable, more confident and demonstrably assiduous as professionals.

Abstract ID : 4

Search For And Recovery Of Orphan And Disused Radioactive Sources

Haroyan, K.[1], Avetisyan, A.[2], Amir- Janyan, A.[1], Petrosyan, V.[1], Mr. Gondakyan, Y.[1]

[1,] Nuclear and Radiation Safety Center, TSO of Armenian Nuclear Regulatory Authority, Armenia
[2]Armenian Nuclear Regulatory Authority, Armenia

Corresponding Speaker: Mr. Haroyan, Karen

1. Background The regaining of control over orphan radioactive sources and the recovery of disused radioactive sources are significant and important tasks for the Regulatory Authorities to ensure public and environment safety and the security of radioactive sources. To regain the regulatory control over orphan radioactive sources, the Armenian Nuclear Regulatory Authority (ANRA) developed an action plan which includes:

    - identification of possible sites where orphan and disused radioactive sources could be located,
    - planning of search activities and implementation of searching according to the developed plan,
    - assessment of physical, chemical and radiation characteristics of found radioactive sources,
    - planning of activities for recovery of found orphan and/or disused radioactive sources,
    - safety analysis and development of safety assessment reports and other supporting documents for the safe and secure dismantlement, packaging, transportation and storage of found units.

This paper presents a generalized overview of the activities implemented by the Nuclear and Radiation Safety Center (NRSC), the TSO of ANRA, for search and recovery of orphan and disused radioactive sources in Armenia, including detection, assessment of physical, chemical and radiation characteristics of found sources, planning and implementation of dismantlement, transportation and storage, as well as development of safety assessment reports and other supporting documents to gain an authorization from ANRA for dismantlement, transportation and long term storage of high activity radioactive sources.

2. Introduction The medical, industrial and other facilities in Armenia, dealing with the us- age and storage of nuclear and radioactive materials, for a certain period of time were left without regulatory control because of the collapse of the Soviet Union. Privatization of industrial facilities caused an increased risk of the usage of nuclear and radioactive materials without regulatory control. The newly established (1993) Regulatory Authority (ANRA) faced several challenges, including regaining of control over radioactive sources and obvious necessity to have local scientific and

technical capabilities. Through the establishment of the local TSO (NRSC) in 2002 it became possible to continuously increase the regulatory capabilities, including safety analyses and assessment of nuclear installations, safety and security of nuclear and radioactive materials, development of regulations, radiometric and dosimetric measurements etc. The strengthening of control over nuclear and radioactive materials in Armenia was achieved through the enhancement of NRSC capabilities, inventory of radioactive sources and nuclear materials, establishment of national register of ionizing radiation sources, licensing of activities, regulatory inspections, search for and recovery of orphan and disused radioactive sources.

3. Search for orphan radioactive sources The activities for the search and recovery of orphan and disused radioactive sources in Armenia has started since 2010 with technical and financial support of US DOE's National Nuclear Security Administration (NNSA) projects. During seven years, more than two hundred 5th, 4th, 3rd and 2nd category orphan and disused sources were found and recovered. Most of them were transferred to radioactive wastes storage facility, others were registered and corresponding authorization was gained for future usage. Activities for the search of orphan sources were implemented through the following steps:

   - Analysis of archived information and identification of potential sites/facilities (industrial, research, medical) where sources out of regulatory control might be located,
   - Prioritization of sites for search based on potential hazards,
   - Collection and assessment of available information on facilities and planning of searching activities,
   - Implementation of search and identification of physical, chemical and radiation characteristics of found sources,
   - Planning and implementation of recovery actions.

4. Recovery of high activity disused radioactive sources There are medical facilities in Armenia, which use high activity Co60 sources (design activity is about 5000 Ci) for cancer treatment. Also, in the Soviet period, there were research and industrial facilities that used high activity Co60 sources (design activity was about 4000 Ci and 5400Ci) for the purposes of irradiation and metrology, and stopped operating in the beginning of 1990s due to the economic situation. Nowadays it is practically impossible to send back the mentioned sources to the manufacturers. For safety and security reasons it was decided to relocate the mentioned sources into radioactive wastes storage facility and to store there for a long period of time. For the organization of safe and secure dismantlement, transportation and storage of dis- used high activity radioactive sources, the following steps were implemented by the NRSC:

   - Development of site survey program and assessment of existing technical conditions and radiation situation of the site were high activity sources were located
   - Development of a plan for safe and secure recovery (dismantlement, packaging, transportation and storage) of high activity radioactive sources and corresponding devices,
   - Development of safety assessment report for recovery, and other support technical documents, for authorizing the recovery,
   - Development and preparation of special matrixes for safe and secure transportation and long-term storage of high activity sources,
   - Planning, coordination and implementation of recovery activities.

Abstract ID : 128

Improving the Development of the National System in Iraq, for Education, Training Capable to Provide the Stations Nuclear the Skills of Human the Necessary at Al-Twaitha Nuclear Site, Baghdad-IRAQ

Ahmed, A.[1], Ali, H.[1]

[1] Iraqi Decommissioning Directorate, Ministry of Science and Technology, Iraq

Corresponding Speaker: A. Ahmed

ABSTRACT: This research is the way that Iraq went to solve one of the difficult problems in the dismantling and decommissioning of its nuclear facilities that were destroyed during the second Gulf war in 1991, where he did not have any experience in dismantling and decommissioning these facilities as well as the shortage of skilled and skilled technical and engineer staff for this purpose and certainly there Another problem is that it does not have a facility for the dumping and disposal of radioactive waste, which must be placed radioactive and contaminated waste that will be generated as a result of the dismantling and decontamination work.

The International Atomic Energy Agency (IAEA) contributed to the provision of material and technical support in the training of Iraqi technical and engineers. The frequent meetings between the experts of the IAEA and the Iraqi scientists and engineers were excellent to solve many problems; the Iraqi cadres were involved in training courses and workshops in various countries. Global nuclear specialist, such as Belgium's Belgo Processes where the company was credited with training the technical staff on the use of diamond wire, which was applied in the cutting of hot cells, Work began in a low radioactive pollution facilities and the aim was to train technical personnel for the purpose of gradation to reach the most complex facilities and radioactive pollution. The work started in 2008 in a facility in the center of Baghdad, which was used for the purpose of producing yellow cake in a populated area. As well as the radioactive isotope production facility and then the Tammuz-2 reactor was dismantled or work is continuing to dismantle the rest of the nuclear facilities at the site of Al-Tuwaitha nuclear.

Al-Tuwaitha site is one of the most important and oldest nuclear site in Iraq, it's about 20km south of Baghdad and consist (18) nuclear facilities. The big problem faced by the disassembly of the nuclear facilities is that it is very destructive and the large quantities of debris and metal scrap that must be removed so that the work teams can conduct radiological characterization and identify places with high radiation pollution and remove them. It was also very necessary to purchase many equipment and machines necessary to carry out the tasks and tasks to be performed.

INTRODUCTION: The main objective of this research is to convey the experience of Iraq and transfer the experience and lessons learned from the dismantling of Iraq's facilities as well as to acquire new information and access to technology in the dismantling of small nuclear research reactors. Iraq is supposed to complete the disposal of all nuclear facilities by the year 2025, which is the end of the last stage of the Iraqi program and can see the simple outline of the phases of the Iraqi program. For safely removal of these facilities, it is require maintaining the communication with experts from IAEA and various member states those who have cases of damaged nuclear facilities and then disseminate and benefit from practical information and lessons learned deriving from these cases.

One of the most important things we encountered was the radioactive waste which was generated by the disassembly works and the exceptional circumstances due to the fact that all the nuclear facilities were destroyed, which forced us to disassemble, despite the absence of a special facility to treat these wastes. The designs of this facility have been completed as a result of cooperation with the European Union. The construction of this facility will commence soon.

METHODS: The Ministry of Science and Technology Iraqi decommissioning center at the time and in cooperation with the International Agency to provide the necessary funds to train Iraqi engineers and workers in all disciplines necessary to dismantle and decommissioning (D&D)the nuclear destroyed facilities and the most important exercises like:

Radiological characterization plans and reports

Safety assessment plans and reports

National inspection

The dismantling and decommissioning of nuclear installations

Radioactive waste management

Check out modern equipment in dismantling facilities and decontamination devices

Preparing and writing decommissioning plans

RESULTS: In table (1) below shows the Decommissioning schedule, the removal of all former dam- aged nuclear facilities at AL-Tuwaitha center divided into three main phases, science we have no experience in decommissioning facilities.

Phase (1): Decommissioning of (Geopilot, LAMA, Radioactive Isotope production Facility).

Phase (2): Decommissioning planning (Tammuz-2, Adaya, IRT-5000, and Fuel Fabrication Facility). Phase (3): Decommissioning of the remaining facilities based on prioritization scheme.

D&D phase 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019…2025

1

2

3

CONCLUSIONS: For Phase 1, all projects were completed at 100% with phase deviation (2). The decommissioning of the July-2 reactor and the manufacture of fuel has been completed in about 72% of the projects. But Adiya was delayed because of the security situation. Preparations are under way to find solutions for the IRT-5000 reactor by Iraqi engineers and scientists, as they are making great efforts to find a solution because of poor material resources due to lack of financial resources as a result of Iraq's entry into the fight against terrorism.

Abstract ID : 88

Secure Management of Radioactive Sources in Libya: Achievements Vs Challenges

Shames, H.[1]

[1] The Libyan Atomic Energy Establishment

Corresponding Speaker: H. Shames

In spite of the critical situation in Libya now days, the Libyan Atomic Energy Establishment (LAEE) is continuing its efforts to securely manage Disused Sealed Radioactive Sources (DSRS) from cradle to grave. There are more than 133 facilities in Libya use Radioactive Sources for medical applications, oil and gas industry, and educational institutions. As an oil producer country, the highest portion of the used radioactive sources is in the oil fields at the desert.

Before the launching of the Nuclear Regulatory Office (NRO) and the Radioactive Waste Management By the support of the International Atomic Energy Agency (IAEA) via different Technical Cooperation • Self assessment has been achieved and published regarding the current situation of radioactive waste management in Libya (U.Elghawi & H.Shames, 2014).

• A final draft of Policy and strategy for radioactive waste management has been attained.

• A final draft safety case and safety assessment for the new centralized storage facility in its design phase has been accomplished.

• A recommendation has been reported to the Libyan government to become part of the Joint convention on the safety of spent fuel management and on the safety of radioactive waste management, moreover, to activate the Libyan participation in all the other related and signed international conventions.

• Reinforcing the cooperation with IAEA regarding DSRS management:

• A national project for improving radioactive waste management practices in Libya has been accepted by IAEA for two years 2018 - 2019.

• DSRS management with Emergency preparedness and response has been considered as high priorities in the next CPF (2018 - 2021) with IAEA.

• A proposal for a national project to improve the Libyan system for Emergency preparedness and response is under preparation.

• Improving our national practices regarding DSRS management.

• Learning from the experience of other participated countries.

• Defining future actions need to improve our RWM system.

• Establishing of DSRS management course in a national level.

It has been reported by (H.Shames, 2016) that the main challenges facing the nuclear security (including security of radioactive sources) in Libya are: the weak belief in nuclear terrorism threat, the current unstable situation of the country, and the weak knowledge management programs in LAEE. The previous mentioned challenges still exists and cause many obstacles for practicing and improving the national radioactive security system.

This paper briefly illustrates the national system of secure management of DSRS in Libya: Applications of radioactive sources, legal framework, national organizations, national regulations, international treaties, radioactive waste management policy and strategy. After that, the paper describes the achievements and current activates regarding the secure management of DSRS. The challenges and the future planes to overcome them are also clearly discussed in the paper.

Abstract ID : 100

Suggestions for Improvement in Security of Disused Sealed Radioactive Sources in Uganda

Nalumansi, S.[1], Luwalira, N.[1]

[1] Atomic Energy Council, Uganda

Corresponding Speaker: S. Nalumansi

Sealed radioactive sources are used in a wide range of applications in Uganda such as medicine, agriculture, geology, industry and other fields. After a given useful designed period, the sealed sources can no longer perform their intended purpose hence regarded as disused. However, de- pending on the activity of the source, the disused radioactive sources may be highly radioactive and so can cause significant damage to human health and contamination of the environment if mismanaged.

In Uganda, the majority of the facilities using these radioactive sources are in remote areas and open places easily accessed by large numbers of people and with inadequate protection. The high costs of return of disused radioactive sources to the manufacturers or suppliers and lack of repositories may result into end-users abandoning the sources at the end of their lifecycle. This creates a vulnerability of them being purposely or accidentally diverted for malicious use. These disused radioactive sources may represent a big risk of exposure to the public since they represent a high priority source due to their potential of being used in a dirty bomb. The psychosocial and economic effects of a radiological dispersion device are diverse and costly for any state at worst a developing country like Uganda. The management of disused sealed radioactive sources thus require a strong legal infrastructure and a national strategy to ensure their security and protection of members of the public and environment.

The Atomic Energy Council (AEC) was established in 2008 as a national regulatory body with a mandate of protecting the society and the environment from dangers resulting from ionizing radiation. The users of these radioactive sources are issued with permits or licenses on condition that a source will be returned at the end of use. However, this is extremely hard to enforce to some facilities that acquired the radioactive sources before the establishment of the regulatory body and radioactive sources out of regulatory control including orphan sources since some do not have agreements for return of sources at the end of its useful life. The authorized person has the responsibility of providing sufficient security measures against the misuse or theft of radiation sources under their possession throughout its life cycle.

However, through execution of AEC’s mandate, it has been discovered that there were some facilities whose disused radioactive sources were inadequately managed, AEC had limited equipment to carry out search and secure and AEC had inadequately trained staff to fully execute their activities. Furthermore, some facilities that initially used these radioactive sources have gone bankrupt and are not able to meet the repatriation costs. The weak legal framework for scrap metal dealers and metal recycling companies is another challenge since the casings of these disused radioactive sources are a prime target for scrap dealers given their weight.

The AEC has endeavored to counter the above challenges through a series of strategies. A national inventory of disused radioactive sources has been established and updated annually. Regarding the radioactive sources that cannot be returned to countries of origin due to either lack of return agreement or high repatriation costs, the AEC has established an interim source storage facility to provide temporary storage as the country attempts final disposal means. This interim storage facility has been built with security features with signaling devices of the authorities if and when theft has occurred. In addition, proper background checks on personnel authorized to access the interim source storage facility are implemented. Search and secure activities have been conducted in areas or facilities suspected to have abandoned radioactive sources as a measure to regain control over orphan radioactive sources although none has been secured to date.

A review of the Atomic Energy Act has been initiated to incorporate sections for scrap metal dealers and scrap metal recycling companies. Furthermore, sensitization workshops have been conducted to raise awareness of the safety and security issues related to disused radioactive sources. These include radio talk shows, TV talk shows and site visits to established scrap metal dealers in Uganda.

Given the vulnerability of radioactive sources at the end of their life cycle from both the safety and security perspectives, this paper provides Uganda's experience for a proper, harmonized and comprehensive control of disused radioactive sources put in place to enhance nuclear security for a safe environment.

These security measures are part of an integrated concept of safety and security involving industrial safety arrangements, radiation protection measures and appropriate design to achieve the necessary level of protection against unauthorized access to, or acquisition of disused radioactive sources hence reducing the immediate risk of disused radioactive sources being left unattended, avoiding misuse and accident.

Key words: Disused sealed sources, nuclear security

Abstract ID : 151

Sri Lankan Experience in Implementation of a Search and Detection Operation for Radioactive Sources

Hikkaduwa Liyanage, A.[1]; Mcree, W.[2]

[1] Sri Lanka Atomic Energy Regulatory Council, Sri Lanka; [2] Pacific Northwest National Laboratory, USA

Sri Lanka has been using radioactive material since 1957. The use of radioactive sources and ra- dioactive material has rapidly increased after 1970 with the expansion of activities in Sri Lanka in industry, medicine and research. In 1969 The Atomic Energy Authority (AEA) was established under Atomic Energy Act No.19 and in 2014 it was reorganized into the Atomic Energy Regulatory Council under Atomic Energy Act, No. 40. However, no satisfactory control of use, import and export of radioactive sources was in place until 2000 due to lack of developed regulatory infrastructure. This is because that AEA's main ambition before the year 2000 was to develop nuclear technology in Sri Lanka. As a result, there is a strong possibility of the existence of radioactive sources within the country that are not under regulatory control.

In 2009, the US Department of Energy's (US DOE) National Nuclear Security Administration's Global Threat Reduction Initiative, now known as the Office of Radiological Security (ORS), signed a bilateral agreement with Sri Lanka to assist Sri Lanka in establishing a nuclear security programme. The programme addressed: provisions for the physical protection of high activity radioactive sources used in Sri Lanka, detection and recovery of sources that were not under regulatory control, disposition of radiation sources, strengthening of source security regulations, and security in transporting radioactive sources.

The AEA carried out a survey in 2011 to list institutes which had used radioactive material be- fore 2000. An internet search provided useful information from research papers published by Sri Lankan scientists at institutes operating under Department of Agriculture that had used radiation sources. Other suspected institutions that could have used sources were listed based on the nature of activities being carried out by those institutions. Such institutions include, those involved in research in agriculture, universities, steel manufacturing industry, road construction, etc.

Results of survey were shared with the ORS programme. After a training course on searching for material out of regulatory control (MORC), the identified institutions were informed the intention of AEA to conduct MORC searches in collaboration with ORS. Assistance from the Sri Lanka Police Special Task Force was also requested.

A training courses was conducted in Colombo from 20-24 June, 2011 to provide training for an AEA search team comprised of representatives of stakeholder agencies on the search, location, identification, and recovery of sources. ORS provided AEA with a suite of radiation detection equipment to be used

during the radioactive source searches, as well as equipment manuals, search procedures, search videos, and field guides.

This paper will discuss the training process, the outcome of the resulting searches and steps taken by AERC and ORS to sustain Sri Lanka's MORC search capabilities.

Abstract ID : 230

Secure Management of Disused Sealed Radioactive Sources (DSRS) in Pakistan

Ahmad, A.[1]; Liaquat, M.[1]; Tahir, M.[1]; Ali, S.[1]

[1] Pakistan Atomic Energy Commission

Corresponding Speaker: A. Ahmad

Sealed Radioactive Sources (SRS) are used in various areas like research, medicine, industry, agri culture and food industry for wide range of applications in Pakistan. These sources are properly managed from their use to end of life (cradle to grave). All necessary security measures for sources during use, transportation to interim storage are taken according to recommendations of IAEA Code of Conduct for Safety and Security of Radioactive Sources and in the light of IAEA Nuclear Security Implementing Guide "Security of Radioactive Sources (NSS-11)". SRS categorized on the basis of NSS-11 and corresponding security levels have been assigned. In this paper, key features of secure management of Disused Sealed Radioactive Sources (DSRS) from cradle to grave will be discussed.

According to national regulations, Sealed radioactive sources containing long lived radionuclides (half-life >1 year with initial activity of 100 GBq or more) shall only be purchased by the operator with prior undertaking from the manufacturer/supplier to accept the return of the sources when no longer useful for the intended purpose (i.e., spent sources) or not useful for another purpose or not useful to another user in the country for another purpose. The user/importer is required to provide copies of the purchase contract, shipping and other related documents to the Authority when applying for no objection certificate (NOC) for import/export of the sealed radioactive sources. After compliance with this requirement, NOC for import will be granted by the Authority. The operator got license for use of Sealed Radioactive Source (SRS) at his facility by submitting all required documents (Physical Protection Plan, Safety Measures etc.). National regulator conducts periodic physical verification, record keeping and identification of sources during their useful life in order to ensure safe and secure use of Sealed Radioactive Source (SRS).

Radioactive sources which purchased before the inception of regulatory authority and those SRS which containing long lived radionuclides (half- life >1 year having initial activity of less than 100 GBq are locally managed at two interim storage facilities in Pakistan. These facilities are located at northern and southern part of the country to cover secure management of DSRS from four provinces of Pakistan. The operator contacts the regulator for disposal of DSRS, submits the transport security plan. After review and approval from regulatory body, the DSRS is transported to interim storage in transport package as per regulatory requirements. After transportation of DSRS in interim storage facility, the DSRS are managed by record keeping, identification, characterization, volume reduction, conditioning/repackaging, interim storage, inventory of DSRS and registration of DSRS. The operating area is prepared by using plastic sheets to cover the designated area. Each DSRS is checked for radioactive contaminations. The identification label is checked and its photo is taken. The sources are placed in pits prepared for DSRS interim storage.

Secure management of orphan radioactive sources is also ensured under the Standard Operating Procedures (SOPs) of national regulator. Local authorities report to Regional Nuclear Safety Di- rectorate (RNSD) which mobilizes resources for identification, recovery and subsequent disposal of orphan sources. Radiological safety is the first priority on finding an orphan source then comes identification and characterization of the source followed by conditioning, packaging and transportation to interim storage safely and securely. It should be ensured that control access area around the orphan source at an acceptable low dose rate. Condition of the shield of orphan source should be checked (either ‘damaged’ or ‘intact’ and shutter ‘open’ or ‘closed’). Once the initial actions have been completed, the orphan source is packaged for transport according to its category and transported to a safe and secure location.

Abstract ID : 143

Security and Technological Best Practices for Central Storage Facilities

Kluse, B. [1]; Gisca, I. [2];Jamison, J. [1]

[1] Pacific Northwest National Laboratory, USA; [2] Moldova Civil Protection & Emergency Situations Service, Moldova

Corresponding Speaker: I. Gisca

The U.S. Department of Energy/National Nuclear Security Administration's Office of Radiological Security (ORS) cooperates with partner countries throughout the world to enhance the security of radiological material used for legitimate purposes on a day to day basis. When material becomes disused and will no longer be used it is common practice to place the radiological material/device in a central storage facility for an extended period, depending on the permanent disposal pathways that may be present. These type of central storage facilities can accumulate a large amount of radioactive material and become a unique challenge when addressing both security and inventory control.

ORS has included central storage facilities within the mission for several years and continues to work with partner countries to address the security challenges they present. ORS's recommended security enhancements aim to increase the system effectiveness by: 1) improving the probability of detection; 2) increasing delay times; and 3) enhancing responder effectiveness. Utilizing a target-out approach the focus of the protection envelope is on the smallest and most cost-effective footprint, breaking the facility into layers that can effectively be upgraded with physical security enhancements. To support the mission of securing radioactive sources/devices in storage, inexpensive and scalable monitoring systems are needed to detect tamper of a radioactive source storage container or removal of the source containers from the storage facility. The ORS program chose to evaluate commercially available radio-frequency identification (RFID) technologies to close the detection gap in overseas central storage facilities and provide an inventory management capability.

Radioactive source storage facilities, where larger numbers of disused radioactive sources are stored, may warrant the use of integrated systems that provide additional detection and account- ability on the individual source storage containers/devices when in storage. ORS has developed and deployed a RFID system that places unique RF tags on individual source storage containers/devices and monitor the presence of the tag within a storage facility, providing immediate notification if the individual sources storage container/device is moved from its identified location or the RF tag is intentionally removed. This type of system has been piloted through a cooperative pilot project within Moldova. This system provides a commercial off the shelf RFID system that can be integrated into the facility's physical protection system. This configuration is a potential solution for above ground storage facilities. Likewise, ORS is working on a similar system that works in reverse for below ground storage facilities. In a below ground configuration the RFID tags would be hidden and programmed to alarm when the tags are “seen” without authorized access. Both configurations have the added benefit of providing a user with electronic inventory. The ORS system is customizable to the layout of a storage facility and provides multiple configurations to best address the given situation at a facility.

This paper will be a collaborative paper between ORS and partners in Moldova. The paper will identify security best practices for enhancing the system effectiveness of physical protection systems used at central storage facilities by addressing detection, delay, and response as well as explore the functionality of the RFID system. The discussion will highlight lessons learned from past deployments and provide insight from existing users who have been operating with the RFID system installed for an extended period, including modifications and updates that are being made as a result of the pilot.

Abstract ID : 225

3-D CdZnTe Gamma-ray Imaging Spectrometers for Nuclear Material Detection and Characterization

He, Z.[1]; Williams, B.[1]; Goodman, D.[1], Xia, J. [1]; Zhu, Y.[1]

The University of Michigan, United States

Corresponding Speaker: Z. He

Three-dimensional position-sensitive CdZnTe (3-D CZT) detector technology, pioneered by our research group at the University of Michigan, can provide an energy resolution of about 0.50% FWHM at 662 keV, and the position resolution of about 0.3 mm for individual gamma-ray inter- actions within a single CZT semiconductor crystal. The technological advancements on 3-D CZT detectors have enabled high energy resolution, within a factor of two compared to that of high purity germanium (HPGe) gamma-ray detectors, and gamma-ray imaging capabilities in the entire energy range (from about 20 keV up to 10 MeV). In addition, 3-D CZT detectors are operated at ambient temperatures, without the requirement of cryogenic cooling of HPGe detectors. Therefore, CZT detectors can be turned-on and off instantly without the long cooling time of HPGe detectors before measurement. The combinations of high spectroscopic resolution, high sensitivity, gamma- ray imaging and room temperature operation have made 3-D CZT detectors a new and attractive instrument to detect and characterize radioactive materials in the field.

This presentation will introduce the latest research progress at the University of Michigan, including experimental demonstration of the energy resolution approaching 0.30% FWHM at 662 keV on CZT detectors with dimensions of 2x2x1.5 cubic centimeters. This performance is achieved using direct-attachment between CZT crystal and the application-specific-integrated-circuitry (ASIC) carrier board to minimize input capacitance, and the deployment of low-noise digital VAD-UM ASICs. It was also demonstrated that an array of 3x3 CZT detectors with a total detection volume of 54 cubic centimeters can detect and locate an 88 Ci Ir-192 source from 600 meters away within just a few minutes. Gamma-ray images of MOX fuel pins with an imaging resolution of a few mm at Am-241 gamma-ray energy have also been demonstrated at Idaho National Laboratory in August 2017.

Applications of 3-D CZT detectors will be summarized. These include monitoring isotope concentration in pipes in nuclear power plants and nuclear facilities over time, radiation imaging in Chernobyl and Fukushima for radiation survey, detecting and characterizing nuclear materials at customs and boarder protection. IAEA Safeguard Division has purchased and evaluated 3-D CZT detectors for safeguard and verification applications. The advantages of 3-D CZT detectors for nuclear security, such as securing radioactive materials, preventing and detecting criminal/unauthorized shipment of radioactive materials, will be discussed.

Abstract ID: 373

Priorities for Effective Adoption and Sustainable use of Linacs in Teletherapy Cancer Treatment in Africa

Foy, H.[1]

[1] African Centre for Science and International Security, Ghana

Corresponding Speaker H. Foy

Radioactive sources—materials produced because they emit radiation useful in agriculture, industry, construction, medicine, mining, research, and transportation—are quite dangerous in their own right. Globally, they number in the millions. Tens of thousands of these sealed radioactive sources—small capsules of highly concentrated radioactive material in solid form—merit real concern. They can be vulnerable to theft and to black-market sale. Worse, they could be used by jihadists to make a radioactive dispersal device, otherwise known as a dirty bomb.

Complacency towards the threats of radiological terrorism has huge consequences to the environment, hospitals and government. If a security event were to occur in a hospital–regardless of its health effects–it could potentially damage the organization's reputation and leave it vulnerable to a range of further liabilities. On a practical level, such an event could disrupt the hospital's regular operations for days, months, or even permanently should contaminated areas fail to be restored to an acceptable level. The associated costs for clean-up and the relocation of individuals and businesses could be enormous. Furthermore, depending on the situation, an RDD explosion could create fear and panic among citizens—terrorists' desired outcome precisely.

Although global radiological security is linked to terrorism risk, little is known about the significance of increased access to cancer care and improved cancer treatment using non-radioactive external beam radiation therapy systems. The significance arises from the phasing out of high risk radiotherapy treatment technologies including Cobalt-60 and Caesium-137 machines in favor of security worry-free linear accelerator machines. Using survey data from a professional-based sample of linac operators working in radiotherapy centers across Africa, (n = 50), this study investigates priority actions for radiological security implementation in radiation therapy field. Cross-sectional and longitudinal analyses reveal those priority actions that potentially facilitate the adoption and sustainable use of linac in Africa where terrorism risk is a reality and cancer is an epidemic.

While international technical support and financial contribution partially helped African countries to introduce linacs when establishing their first radiotherapy centers or to add linacs to while expanding existing centers to address the cancer burden, this foreign support was not fully enough to address the terrorism risk and cancer challenge in Africa. Together the findings underscore the need for African

governments, civil societies, and entrepreneurs to jointly strengthen radiological security objectives in the radiotherapy treatment field and the importance of considering political buy-in, financial resources, regulatory environment, and competent local personnel as enablers for adoption and sustainable use of linac for increased access to care and improved cancer treatment in Africa.

In fact, governments of African countries can have it both ways when it comes to addressing terrorism risk and cancer epidemic: minimizing radiological terrorism risk and improving cancer care are both possible with medical linear accelerators (linacs). Permanently reducing the threat of radiological terrorism through adoption of linacs over telecobalt devices would both increase patient access to treatment services and improve quality of services. External beam radiation therapy is the most common type of cancer treatment and, presently, many experts estimate that around 60% of new cancer patients and 23% of previously radiotherapy-treated patients need radiotherapy for management of their cancer.

Dealing with the public terrorism risk and cancer epidemic is a difficult task even for high-income countries. It takes planning, determination, and incentives to attract relevant stakeholders; this effort would have to be undertaken carefully, with cooperation among international initiatives, nongovernmental organizations, professional associations, technology vendors, and other government agencies concerned about nuclear proliferation of high risk cobalt-60 treatment technology. Lessons from Western countries reveal that governments that choose to adopt linacs create opportunities to local partnerships, bring about economic development, and promote national security that contributes to world peace.

Abstract ID: 384

Integrated Uranium Geology Analysis Platform (IUGAP) Applied to Identify Unauthorized Radioactive Materials

Guo, D.[1]; Wu Z.[2]; Li B.[1]; Cui J.[1]; Yan J.[1]; Xie S.[1]; Tan J.[1]

[1] Beijing Research Institute of Uranium Geology, China; [2] National Nuclear Security Technique Center, China

Corresponding Speaker: D. Guo

Introduction

Identification of unauthorized radioactive materials is one of the components for identification of nuclear security threats 1. Many countries have established the capability to detect such materials. In China, the National Nuclear Security Technique Center (Center of Excellence) plays a very important role in detecting of unauthorized radioactive materials. Other institute like Beijing Research Institute of Uranium Geology has used its existed capability to enhance the national nuclear security practice through cooperation with COE using the Integrated Uranium Geology Analysis Platform (IUGAP). IUGAP was initially designed to uranium exploration 2. However, the functions of IUGAP are also suit able to identify unauthorized radioactive materials after some configuration.

IUGAP and Applications

The IUGAP consists of several modern analytical techniques including DA and NDA. The basic configuration is shown in Figure1. When the core sample and powder are replaced by unauthorized radioactive materials, this system becomes a nuclear security detection system.

Fig.1 Integrated Uranium Geology Analysis Platform (IUGAP)

The applications of IUGAP are focused on the identification of material type, amount and material origins among the components of threats. The typical applications are described as follows:

Answer What: if materials are caught , IUGAP techniques including high pure germaniumγspectrometry and mass spectrometry may answer what kind of radioactive materials.

Answer Where: we assume that such materials are sealed inside a cement brick, X-ray 3D microscope would be used to scan the brick. This method provides imaging of bulk sample. One can see where possible materials are. Another case, we assume that such materials are known as yellowcake, but do not know where they come from. In this case, mass spectrometry may apply to trace the origins.

Answer When: the age of material is also important factor. The mass spectrometry may apply to measure it.

1. Summary

IUGAP is an existed system. Without extra investment, it is also suitable to identify unauthorized radioactive materials. It will benefit the national security practice. The presentation will highlight the case studies using IUGAP in this conference.

REFERENCE

1GUO Dong-fa, FAN Guang , WU Zhao-hui, OU Guang-xi , CUI Jian-yong , LIU Han-bin ,ZHANG Yan-hui , XIA Chen-guang , LIU Li-kun , LI Zhen-tao , Ge Xiang-kun. Systematic analysis of uranium drilling core samples [J].Uranium Geology,2009,25(02):122-128.

IAEA Nuclear Security Series No. 24-G. Risk Informed Approach for Nuclear Security Measures for Nuclear and Other Radioactive Material out of Regulatory Control[OL]. https://wwwpub.iaea.org/MTCD/Publications/PDF/Pub1678_web.pdf

Abstract ID : 170

Modular and Integrated Sensor Network of Intelligent Radiation Monitoring Systems for Radiological and Nuclear Threat Response.

Morichi, M.[1]; Corbo, M.[1]; Pepperosa, A.[1]; Fanchini, E.[1]; Mangiagalli, G.[1]; Mini, G.[1]

[1] CAEN SyS, Italy

Corresponding Speaker: M, Morichi

The awareness of possible nuclear safety and security issues pushed designed entities or institutions to be capable to rapidly react to alarming situations. They must assess the risks and intervene in case of accident monitoring the site environment and manage the situation mitigating the radiological risks. Such activity requires real time nuclear measurements with airborne, land and underwater systems that could be easily deployed, controlled remotely and with a high level of interoperability.

Authorities have the necessity to monitor the radiological situation and implement actions to minimize radiological effects on the population. One identified issue is that in case of an alarm, the usually available systems do not allow the operator to communicate automatically the alert causing important delays in the decision-making process necessary to define the assessment and mitigation plans restoring a safe environment. Furthermore, some operations require the intervention of several instruments. If these systems were not designed to be integrated into a network, results cannot be analyzed together in real time requiring a sophisticated offline post-processing. From here the necessity to have a real time network of integrable systems for a precise and immediate evaluation of the situation.

The interconnection between equipment and the use of data fusion processes are necessary to establish the real situation, especially for critical environments, to help the decision-making process. The network solution improves the operational safety, reduces the alarm to mitigation time range improving the quality of the management plan.

Current embedded commercial electronics allow the integration of radiation monitoring systems meeting the needs of integrated solutions for radiological and nuclear security. These commercial electronics are low power and compact ARM based computers, which can store large amount of data in their non-volatile memory, run automatic data analysis and trigger alarms in case of exceeding radiation levels.

The radiation monitoring systems can be integrated in several form factors which depend mainly on type of deployment, also with internal battery for autonomous operation. In this perspective, the radiation monitoring systems can be compact to be carried in a backpack or handheld, lightweight to be transported on unmanned aerial drones, rugged designed to be transported on vehicles, tolerant to a wide temperature range and water immersion to be installed in open field. All of them can communicate with redundant interfaces in failover configuration and store the acquired environmental information in a central database center. The same monitoring systems can alert the emergency response personnel on the field as well, through wireless connection to common tablets or cellphone or SMS, guaranteeing a prompt response in case an illicit transportation of radiological or nuclear material is detected.

The building blocks of the radiation monitoring system can be easily programmed for different operations remotely or locally. The working condition can be monitored real time and in case of malfunctioning the optimization of the data acquisition can be performed remotely as well. Access credentials and secured data transmission avoid that unauthorized people could read or delete the acquired data and avoid that operators on field could accidentally modify hardware or software configuration. Web based software instruments ease, at the same time, the design of user friendly graphical interfaces and guarantees a good level of data security as mentioned.

A common software platform can manage the information from different radiation detectors giving the possibility to arrange the network of deployed sensors in a modular way. This allows the emergency response teams to choose which type of system shall be deployed and to relocate the monitoring systems depending on the environment, the type of access point to be monitored, the logistic or the geometry of transported material. Moreover, the real time processing and the techniques of data fusion allow the decision makers to quickly organize the intervention on a contaminated area limiting the operator exposure and minimizing the time to execute the environmental survey.

Abstract ID : 84

Evaluation of a Potential RDD Risk Posed by Non-Reactor Radionuclide Production Technologies

Solodov, A.[1]; Potter, C.[1]

[1] Sandia National Laboratories, USA

Corresponding Speaker: A. Solodov

Most of the radionuclides used for industrial and medical applications cannot be found in nature and must be produced artificially by bombarding targets with nuclear particles. Presently, nuclear reactors are the main technological means for producing radionuclides, as they provide superior neutron fluence rates, long-term operational stability for materials activation and fissioning, and a wide range of possible nuclear reactions, which translates into high production rates and a large number of possible radionuclides that can be produced. The main disadvantages associated with using reactor technology for radionuclide production are the extremely high capital costs and remote locations from hospitals or industrial installations where radionuclides are used. Charged particle accelerators and other radionuclide-producing technologies are significantly less costly and can be easily acquired by a hospital or an industrial enterprise. At the same time, charged particle accelerators are only capable of producing a certain set of radionuclides and presently cannot replace reactors for the production of many radionuclides. Their production capacity is also limited compared to nuclear reactors. Most accelerator facilities are being used to produce small quantities of short-lived radionuclides that are generally considered not to be radiological dispersal device (RDD)-useable. It is important to note that recently, new commercial systems have been developed that are capable of accelerating charged particles up to 70 MeV, which is a theoretical limit for cyclotrons and until recently could only be achieved on large industrial machines. Combined with higher currents, which translate into higher production capacity, these devices potentially could be used to produce longer lived radionuclides in significant quantities. A significant effort has come about in the past several years to replace some traditional radiation sources with alternative technology devices for the purposes of enhanced safety and security. There have also been significant developments in radionuclide production technologies. Some of these new technological advances provide capabilities for undeclared or covert generation of radionuclides that potentially could be used to build a RDD. In addition, some of the radionuclides that are currently not considered an RDD risk due to relatively low world-wide inventory or short radiological half-life could now pose a higher risk than previously identified. This study aims to:

- assess the current status of charged particle accelerator radionuclide generation capabilities,
- examine other non-reactor radionuclide generation technologies and potential radiological risk posed by them, and

- reassess risks associated with non-reactor produced radionuclides.

The technologies evaluated include different classes of accelerators and other radionuclide-generating devices from small desktop devices used in medical radionuclide production to large spallation neutron sources. The researchers developed a special threat analysis methodology for the study that merges technology capabilities and capacities with potential misuse scenarios. The study concluded that it remains difficult for an adversary to produce radionuclides for dispersal either because not enough product can be produced in a reasonable time, the product is extremely difficult to handle, or the facility is such that it is difficult if not impossible for it to be redirected for clandestine use. However, due to the constant forward progression of technology, the study's authors recommend that this threat be re-evaluated periodically.

Abstract ID : 288

Identification of Effective Parameters and their Relations for Normalization of Radiation Profiles from Radiation Portal Monitors for Initial Alarm Assessment at the Ports of Entry

Ranasinghe, N.[1]; Rathnaweera, N.[1]; Mahakumara, P.[1]

[1] Sri Lanka Atomic Energy Board

Corresponding Speaker: N. Ranasinghe

In order to detect radioactive material out of regulatory control (MORCs), radiation portal monitors (RPMs) have been established in designated and undesignated ports in many countries. Following the radiation profile produced by the RPMs, the front-line officers (FLOs) at the alarm station have to make an accurate decision to determine whether it is a true alarm or not. In certain situations, they may have to request for secondary inspection of the cargo container. If the FLO is inexperienced, the identification might be a challenge. Also, requesting for secondary inspections from an external organization (expert assistance) can be a slow process with many administrative burdens. The unnecessary delays of the cargo clearance directly decrease the operation efficiency and quality of service of the port.

In order to rectify this, the International Atomic Energy Agency (IAEA) has introduced TRACE (Tool for Radiation Alarm and Commodity Evaluation) mobile app to assist the FLOs to produce accurate decisions with higher efficiency. To develop the application further, it is necessary to identify all the parameters affecting the radiation profile generated by the RPM. As a member of the Coordinated Research Project (CRP) on Improved Assessment of Initial Alarms from Radiation Detection Instruments (J02005), Sri Lanka has done several experiments and has identified the effective parameters on radiation profile. Carrier speed, Geometrical and background variations, the mass of the commodity and efficiency of detectors directly affect the shape and the sigma level of the profile. The paper presents the findings of these experiments and a preliminary analysis of data for further development of the TRACE app and overall development of alarm assessment procedures.

Introduction

The deployment of the radiation monitoring equipment at the ports of entry has emerged as a common practice among the countries that wish to minimize the illicit trafficking of radioactive material as well as the detection of other radioactive material out of regulatory control (MORC). But, with the lessons learned from the cases from different member states, it has been identified that the implementation of the detectors alone is not sufficient enough to ascertain the true alarms. Multiple parameters affect the alarms and a profound understanding of those is mandatory to assess the alarms generated by the radiation detection equipment. The naturally available radioactive material (NORMs), innocent alarms due to medical isotopes and false alarms generated by the instrument issues are commonly found. In order to identify the true alarms generated by the instrument, a specific training is required for the FLO-in-charge. Here, the simplest mechanism to identify the alarm is the visual analysis of the radiation profile generated by the Radiation Portal Monitors (RPM). The radiation profile is the of the variation of the radiation level against the vehicle (carrier) movement. It is visually represented by a continuous graph of the standard deviation of the radiation level (the number of counts against the mean count rate) or the "sigma" value against the positioning of the vehicle. However, numerous factors affect the radiation profile. The speed of the cargo carrier, the background radiation level, geometry (distance between the container and the portal monitors), the commodity factors (mass, texture, country of origin) and the detector characteristics have been identified as the major factors affecting the alarms. Therefore, it is essential to optimize these factors to obtain valid radiation profiles which entrust the FLOs' decision.

The commodity characteristics such as commodity type and its applications have already been addressed by the TRACE software. It conveniently assists the FLO to determine the alarm type (innocent, medical, false or true) by observing the commodity inside the container which can be found in the Customs Declaration (CusDec) document. Thus presently, an FLO can use the commodity details in the CusDec and the radiation profile along with the TRACE software to identify true alarm scenarios. Sri Lanka as a major research partner in the alarm assessment through the CRP J02005 has extensively contributed to the development of the TRACE.

However, since the radiation profile is affected by many parameters, it is extremely important to develop an algorithm to normalize the data for each parameter. This way, the FLO can get further assistance from the normalized database to further analyze the alarm and develop more accurate detection capabilities. The database can be uploaded with new data. When uploading, a conversion algorithm converts the data set into its normalized form. When retrieving data from the database, the operator can provide the current parameters (speed of the carrier, distance between the RPMs and the carrier, mass of the commodity etc.) and adopt them into the dataset to generate more detailed radiation profile.

Methodology

In order to identify the effective parameters, several experiments had been carried out in the detection system at the Port of Colombo, Sri Lanka. A container with a NORM (ilmenite sand) was sent through several detector systems with different geometries to identify the relationship between the detector geometry (distance between opposite detectors) and sigma level.

Another alarmed container was driven through the same detector system at different speeds to identify the effect of carrier speed. An empty container was used to identify the effect of back- ground radiation level to the radiation profile. Another test was conducted to identify the effect of detector efficiency.

An analysis of these data, the optimum conditions for a comprehensive radiation profile has been identified for the port. Using the identified optimum levels, a normalization algorithm has been drafted.

Results and Discussion

It has been identified that the optimum speed of the cargo carrier has to be 8.5 km/h to generate the best sigma levels. However, these optimum levels are specific to the conditions at the Port of Colombo. A similar approach can be used in other countries/states to enhance the experimental scope and validity of these methods. The relationship between the variation of the sigma levels/counts and the respective parameters are the normalization coefficients for each parameter.

In an extremely busy port such as Colombo, the repetition of the experiments is highly challenging since it interrupts the operations at the Port. Hence, more experimental data are needed to provide profound conclusions.

Conclusion

Country/State data can be considered as comprehensive records of experience in alarm evaluation. Therefore, a development of a normalized database and an extended assistance through the TRACE software will be highly instrumental to address the global requirement of enhancing the nuclear security practices at the ports of entries. In order to establish these, the effective parameters have to be identified and the normalization algorithms have to be formulated. This can be achieved through experiments and analysis of data gathered from RPMs. Especially the radiation profile variations due to each parameter.

Cargo carrier speed, geometrical and background variations, the mass of the commodity and efficiency of detectors have identified as the major factors affecting the radiation profile. The relation between each parameter and the sigma level provides a simple normalization coefficient to formulate a generalized database for alarm assessment.

Abstract ID: 380

The Application of Virtual Reality to Support Training Concepts for Nuclear Security

Chaput, J.[1]

[1] International Atomic Energy Agency

Corresponding Speaker: J. Chaput

Continuous training of personnel who will be involved in the response and management of nuclear security events is an important element for maintaining a country’s national nuclear security infrastructure. In 2017, the IAEA began testing the use of virtual reality for teaching emergency response personnel how to respond to nuclear and radiological emergencies. In Technical Meetings and workshops, the IAEA Incident and Emergency Centre (IEC) gained significant experience on the benefits of using room scale virtual reality to enhance its emergency preparedness and response (EPR) training and exercising capabilities. The participant feedback from these events was overwhelmingly positive and in 2018 the IAEA IEC began to incorporate virtual reality training into the IAEA’s School of Radiation Emergency Management. The virtual reality training included a supplemental set of exercises to teach key safety concepts which would be impractical to otherwise conduct (such as detector response in very high radiation field environments).

In 2018, the IAEA Division on Nuclear Security (NSNS) finished the development of the 3d model of the hypothetical Shapash Nuclear Research Institute. This 3d model is a key tool used in Member States training as it provides a nonspecific, but fully detailed, facility which is used to scrutinize and otherwise interrogate nuclear security infrastructures without the need to use secure material. Based on the benefits observed in the use of virtual reality for EPR training, NSNS enacted a trial program to develop a set of virtual reality based exercises to teach IAEA Member States important aspects of nuclear security using the Shapash 3d model as the basis. These exercises included virtual nuclear security events where the participants were able to act as either the hostile actor or the nuclear security personnel and attempt to disrupt and acquire controlled material by bypassing the security measures in pace at the hypothetical Shapash Nuclear Research Institute. These exercises have been evaluated in several trial instances and will become an important part of Member State nuclear security training capabilities in the years to come.

This presentation will summarize the experience of the IAEA in applying room scale virtual reality to EPR and nuclear security training in workshops and Technical Meetings, including a discussion of the most important lessons learned from this experience.

Abstract ID : 188

Implementing Multiple Layers of Security to Promote Effective Detection of Nuclear and Other Radioactive Material out of Regulatory Control: Cuba Perspective.

Paredes Gilisman, J.1

[1] Centro Nacional de Seguridad Nuclear, Cuba

Corresponding Speaker: J. Paredes Gilisman

The paper describes the nuclear infrastructure developed for more than 30 years in Cuba and illustrates how nuclear technologies are distributed nowadays.

Cuba has expressed support for the United Nations Global Initiative against terrorism. Dealing with the nuclear terrorism is a matter of multi-institutional concerns such as Ministry of Foreign Affairs (Terrorism), Ministry of Interior (Security) and Ministry of Science, Technology and Environment (Safety and Safeguards). A threat assessment and capacities analysis to satisfy fully the renewed commitments assumed against nuclear terrorism were performed. As a result of such analysis, an Integrated Nuclear Security Support Plan was concerted with the IAEA.

A multiple layers security detection architecture were developed. The paper highlight dimensions that takes place when developing multi-layered approach. When developing such architecture a proper combination of defense in depth and graded approach principle will enhance its effectiveness. The defense in depth approach helps to eliminate dependency on one security measure and creates vital redundancy, while the graded approach helps to ensure that money is not spent on unnecessary measures and activities. Dimensions such as capabilities, deployment and suppliers dependence are identified when dealing with both principles at border and interior layers. It is also discussed how to deal with administrative control versus surveillance dimension taking into account parameters such as authorization and inspection process, medical surveillance and reporting loss of regulatory control.

Three Case Study are presented, one for border control and two for the interior. On the last case, one is for scrap metal experiences and the other for Major Public Events.

The paper also highlights challenges such as: the integration of technologies deployed, the assurance of proper resources at proper time, the developing other detection tools (permanent and real-time radiological surveillance system interconnected to the national alarm monitoring center) and the dealing with new threats (cyber security and new technologies).

As a conclusion, Cuba has been implemented a nuclear security detection architecture in cooperation with the IAEA. Best practices on defense in depth and graded approach principles are been taken on its implementation. The expansion and updating of the architecture will take into account evolve of threats and the resources available.

Abstract ID: 131

Detection by Defense in Depth: Building out the Interior Layer of a Nuclear Security Detection Architecture

Mui, S. [1]; Askin, A. [1]; Rose, Q [2]; Wright, T.[1]

[1] Lawrence Livermore National Laboratory, USA; [2] Culmen International, USA

Corresponding Speaker: S., Mui

The interior layer is a vital component of a State's nuclear security detection architecture. Essential Element 10 in International Atomic Energy Agency's (IAEA) Nuclear Security Fundamentals: Objective and Essential Elements of a State's Nuclear Security Regime describes the locations where detection and assessment capabilities should be established, including "within a State's territory." The United Nations Security Council Resolution (UNSCR) 1540 further supports the establishment of appropriate "law enforcement efforts to detect, deter, prevent, and combat…illicit trafficking." Since 2010, the majority of reported incidents of detection of nuclear and other radioactive material out of regulatory control have occurred in the interior as indicated by the IAEA's Incident and Trafficking Database.

The multi-layered, defense-in-depth approach to detection of nuclear and other radioactive material out of regulatory control is supported by a robust interior detection capability. Detection in the interior is complementary to security at facilities and along borders. It also presents unique challenges.

Common interior detection scenarios include searching for lost or stolen nuclear or other radioactive material, law enforcement operations based on information, protection of strategic locations and major public events, and interior area surveillance and monitoring. Detection approaches in the interior share many commonalities with detection at borders; however, interior detection involves a different set of stakeholders and presents some additional challenges which require tailored solutions. Significant challenges for a robust interior detection layer which are generally distinct from border point of entry/exit detection include (A) wide open areas lacking well defined or controlled boundaries; (B) the presence of regulated nuclear and other radioactive materials at distributed locations within the interior; (C) potential targets of a nuclear security event; (D) multiple competent authorities with diverse and competing responsibilities and priorities, which make coordination and maintaining awareness of and focus on the nuclear and radioactive material threat difficult; (E) higher diversity of criminal or intentional unauthorized acts to be detected; compressed timelines between detection and response when detection occurs near potential target locations; and (G) lack of supporting communication systems, secondary inspection, and temporary storage infrastructure.

This paper presents a discussion of how lessons learned and good practices for detection within a State's interior can be applied to address these interior detection challenges. This paper builds on discussions from the IAEA Technical Meeting on the Detection of Criminal or Intentional Unauthorized Acts Involving Nuclear and Other Radioactive Material out of Regulatory Control within a State's Interior conducted at IAEA headquarters in Vienna, Austria, from 29 January to 2 February 2018. This paper will address good practices including (A) the need to have a method to assess in- formation in order to strategically position assets; (B) use of a diverse set of detection approaches for resources prioritization, monitoring or surveillance, information alert-based action, and information sharing; (C) leverage of existing capabilities such as law enforcement investigative techniques and specialized teams; (D) maintaining operational flexibility to address evolving threats or imprecise threat information; and (E) managing technical information flow to facilitate expeditious alarm adjudication as appropriate and decision-making by on scene operators.

Abstract ID : 275

Contribution of the MONTE CARLO modelling for the minimum detectable activity of spectrometer gamma of large volume

Menard, S.[1]; Petitguillaume, A [1]; Wansek, M.[1]

[1] Commissariat à l'énergie atomique et aux énergies alternatives (CEA), France

Corresponding Speaker: S. Menard

The CEA DAM has a number of high-capacity (2 – 20 litres) sodium iodide gamma detectors used in the Intervention and global safety programs. The NaI crystals are positioned in packaging adapted to their use: transport suitcases, measuring container… The knowledge of the energy response and the minimum detectable activities of these systems makes it possible to ensure the adequacy of their employment to the needs.

NaI Crystals of 2 to 20 litres were modelled using the Monte Carlo Transport Code of Radiation-material interaction MCNP6 in different containers for gamma sources available at CEA DAM. The comparison of the results of the models to the experiments allowed to refine and validate the parameters of modeling (geometry, materials, physics…) and thus to have a "model" representative of the system.

The purpose of the presentation is to show the interest of the simulation in understanding the response of the sensors used to the CEA DAM and in estimating the minimum detectable activities. One of the systems presented is the HELINUC Airborne gamma detection System. The container (see Figure 1) is loaded with 4*4-l NaI crystals. Two Ge detectors installed on either side of the container can also be deployed

HELINUC is developed and implemented by the CEA Dam to benefit the dam's nuclear intervention programs (DCI-IT, Ministry of Defence), civilian nuclear operators (GIE INTRA) and national public authorities and international agencies (IAEA…). The missions of HELINUC are:

The realization of radiological references of large agglomerations, civil and military installations

Securing Major Events

- Emergency response in case of incident/accident at a civilian or military site and the search for emission points
- Searching for Point sources

- International assistance.

During an flight mission, gamma detected by the Helinuc system come from :

- Natural radiation sources (cosmic rays, natural terrestrial radionuclides …)
- Industrial activities (phosphate processing, building materials, waste …)
- Radionuclide release of nuclear accidents : 137Cs in soil …

Natural radiation sources could be estimated using MCNP and percentage contributions of soils. The 137Cs deposits from nuclear accident migrate in the soil over the years. So these two components of gamma spectra acquired during an helinuc flight were simulated and the numerical results were compared to experimental spectra. Minimal detectable activities for several sources were derived. The presentation will introduce the different steps of the method and the results obtained.

In France, the fight against illicit trafficking of radioactive and nuclear materials is a major objective. So the development of a nuclear and radiological detection architecture is essential. A such structure rest on the homeland security national organisation which is mainly composed of security and control forces (specially police and custom) and additional technical elements in order to detect radiological and nuclear material.

In France, for this purpose, the project REDAR (REseau de Détection et d'Alerte Radiologique - detection and radiological alert network) has been developed as a part of an additional technical capacity to detect illicit nuclear and radiological material movements on national or European port

Abstract ID: 301

Viet Nam’s Nuclear Security Measures and System in Prevention and Detection of Nuclear Security Events at the Designated Point of Entries and the Interior

Nguyen, N.[1]; Tao, X.[1]

[1] Viet Nam Agency for Radiation and Nuclear Safety, Viet Nam

Corresponding Speaker: N. Nguyen

Prevention and detection are two of the primary function areas in the national integrated nuclear security support plan (INSSP). In order to implement the INSSP, along with the fulfilment of the legislative and regulatory framework, Vietnam has established the nuclear security technical infrastructure in prevention and detection of unauthorized activities that could lead to the nuclear security events at the designed point of entries (PoEs) and the Interior. Since 2007, Vietnam is one of the IAEA Member States which actively cooperated with the IAEA, the USA and other countries to equip the high technology in radiation detection equipment and other security systems. For the function area of prevention, Vietnam has installed advanced security and monitoring system at the radiation facilities with category I sources and the radioactive source location tracking system (RADLOT) for the mobile sources in industrial radiography. For the function area of detection, 28 radiation portal monitors (RPMs) and a number of hand-held equipment (personal radiation detector, identification devices) have been deployed to the PoEs and strategic locations. The technical infrastructure in prevention and detection has been used and integrated to several communication and management networks for the different stakeholders (alert/ alarm system at radiation facilities, integrated nuclear security network – INSN at the border gates). This paper presents the overall picture of Vietnam in more than 10 years of establishment and operation the nuclear security technical infrastructure with focusing on the communication and management networks in prevention and detection at following targets: (i) designed PoEs, (ii) radiation facilities and radiography sources, and (iii) strategic locations for the major public events. The existing measures, system and a number of the technical challenges faced by Vietnam Regulatory Body in the cooperation with different stakeholders will be indicated and discussed among the IAEA Member States. In addition, the idea of a national integrated system, including platform, needed information and integrated data format, which can cover all three above mentioned targets will be presented. The content of this paper contributes to fostering for using of science and technology to upgrade and improve the technical performance of current measures and system in nuclear security in Vietnam as well as other countries, as applicable.

Abstract ID: 302

Radioactive and Nuclear Security of Critical Infrastructures and Major Events: Contribution of Reachback Expertise Center for First Responders

Masse, D.[1]; Petitguillaume, A.[1]; Schoech, H.[1]

[1] Atomic Energy Commission, France

Corresponding Speaker: D. Masse

The fight against radioactive and nuclear materials illicit trafficking is a major objective for France. Therefore, developing a nuclear and radiological detection architecture is essential. The French detection architecture is intended to secured fixed critical infrastructures as much as major events. Such structure rest on the national homeland security organisation which is mainly composed of security and control forces (mainly police and custom), specialised units (fire brigades, …) supported by experts in a reachback center and additional technical elements able to detect radiological and nuclear material.

On these two points (critical infrastructures and major events) CEA supports technical operators and state services at different stages:

Take part of the set-up of intervention plans and associated reflex procedures and datasheets;

- Contribute to technical training of the workforce, in the accomplishment of their missions;
- Script, animate and conduct exercises sessions with local authority's;
- Advice and assist first-responder with a reachback expertise center;
- Take part of field operations

First, we will briefly describe technical elements and the organization in place for the RN security of a vital infrastructure such as a large seaport and the RN security of a major event. Technical elements deployed will be briefly described as well as their integration into the operational setup.

Secondly we will develop CEA assistant to technical operators and operational services concerning intervention plans, technical training and exercises. We will describe the different steps.

Incident response plans will be presented and illustrated with exercises carry out by the concerned services. In these examples, we will focus on the contribution of the center of expertise.

Abstract ID: 378

Radioactive Materials Detection System at the Borders of Burkina Faso; Alert and Assessment Procedure

Kabore, O.[1]

[1] National Radiation Protection and Nuclear Safety Authority, Burkina Faso

Corresponding Speaker: O. Kabore

Burkina Faso became a Member State of the International Atomic Energy Agency in September 1998.The country is not a nuclear state; however radioactive materials are used all around the national territory and enter from other countries mainly through the border by road crossing and airport. Bordered by six countries, Burkina Faso mainly receives shipments of the radioactive materials by the roads from Cote d'Ivoire, Ghana, Niger and Mali. According to the regulatory data base, between January 2012 and October 2016, 122 shipments of radioactive materials were transported all around the national territory 47% of which were international shipments.

The transboundary movements of these dangerous goods deem it necessary to implement relevant detection system considering the national and the regional security threat situation nowadays. A lot of efforts have been made by the government and its partners for personnel capabilities building in nuclear security and also the detection of the radioactive materials at the borders. Indeed, the national legislation and the integrated national security support plan have been developed as a framework to support the implementation of the national nuclear security regime. Furthermore, the IAEA, and the National Nuclear Security Administration (NNSA) of the U.S. Energy department have supported the country with detection and identification equipments and trainings.

Through the collaboration with IAEA, Burkina Faso has a mobile expert team (MEST) in the regulatory body "Autorité national de Radioprotection et de Sureté nucléare" (ARSN) and the team is equipped for in-depth assessment of detected radioactive materials. However, the national detection system is not yet constructed and the current practice with the customs faces to a lot of difficulties. Indeed, the actual detection system has a limited number of trained customs officers; there are no detection equipments for the borders, the detection procedure is not formalized etc.

Despite these limitations, to combat the illicit trafficking, the regulatory body and the customs authority which is the main agency responsible for the border control works to involve the control of radioactive materials in the customs existing goods checking procedure. Thus, some arrangements have been made and they are based on a visual detection and the checking of transported goods list. But a procedure is also needed for an alert in order to complete in-depth assessment in case of the detection of radioactive materials. This proposal is aimed to share the experience of the detection system performed by the customs authorities at Burkina Faso borders describing the asset and weaknesses; then to propose a procedure to strengthen the existing system in order to facilitate a prompt reaction for in-depth assessment of an alert with the national mobile expert support team.

Abstract ID : 33

Development of Nigerian Nuclear Security Detection Architecture (NSDA): Current Activities and Future Actions

Bello, N., Ofoegbu, E.

Nigerian Nuclear Regulatory Authority

Corresponding Speaker: N. Bello

The Nigerian Nuclear Regulatory Authority (NNRA) was established by the Nuclear Safety and Radiation Protection Act 19 (Act) of 1995. By the Act, the NNRA is to ensure protection of life, health and the environment from the harmful effects of ionizing radiation, while allowing beneficial practices involving exposure to ionizing radiation. The use of radioactive material predates the establishment of the NNRA, hence the concern for legacy and orphan radioactive sources in the country. Furthermore, during the early days of the NNRA, Nigeria recorded loss of control incidences involving radiological material. This prompted the development of the Nigeria Safety and Security of Radioactive Sources Regulations in 2006. Through the assistance of the IAEA and European Union, Nigeria in 2009 installed a Radiation Monitor Portal (RPM) at the Murtala Mo- hammed International Airport Export Terminal for detection and prevention of illicit trafficking of nuclear and other radioactive material. However, several challenges were encountered in the operation of the RPM. Additionally, Nigeria purchased three RPMs which were never installed. These challenges could be traced to the absence of approved NSDA for Nigeria. Nigeria in 2007 conducted the International Atomic Energy Agency, (IAEA) Verified Inventory and Orphan Source Mission. After the Mission Nigeria developed program for search and secure of orphan and legacy radioactive sources. Nigeria regularly conducts verified inventory of radioactive sources in all li- censed facilities. In all these, it has been realized that effective collaboration with all the relevant stakeholders is key and the need for detection through information alert has been recognized. It was on this premise that Nigeria in collaboration with the IAEA hosted a preparatory meeting in October 2017 with all the relevant Stakeholders in Nigeria. Nigeria finally participated in the IAEA Regional Workshop to Build Roadmap for the Establishment of National Nuclear Security Detection Architecture (NSDA). One of the outcome of the Regional Workshop was for Nigeria to develop a Draft NSDA involving all the relevant stakeholders. The objectives of this paper therefore, are to discuss the challenges that were encountered in the operation of the installed RPM; the inability to install the three RPM that were procured by Nigeria and discuss the current activities which will lead to the development of NSDA and the role of national stakeholders in the implementation of effective NSDA.

Abstract ID: 358

The Dutch Detection Architecture For Orphan Sources In Scrap Metal

Roobol, L.[1]; Brandhoff, P.[1]

[1] Dutch National Institute for Public Health and the Environment (RIVM), Netherlands

Corresponding Speaker P. Brandhoff

The Dutch National Institute for Public Health and the Environment (RIVM) is part of the national architecture for the detection of radioactive material out of regulatory control. In this abstract we will take a look at the scrap metal industry and explain the safeguards in place to detect and recover radioactive materials out of regulatory control.

Artificial radioactive sources or sources of naturally occurring radioactive material can end up in scrap metal in a number of ways. If undetected, they can pose not just a health risk, but also a security risk. To prevent/reduce this risk the regulatory framework in the Netherlands dictates that several of the largest scrap metal dealers need to be able to detect radioactive materials passing through their plant. To this end they make use of gate monitors that detect radioactivity in incoming shipments, for instance trucks. If radioactivity is detected, an alarm goes off and an inspector of the Dutch Authority for Nuclear Safety and Radiation Protection (ANVS) is called to the site to investigate.

The inspectors of the ANVS carry several types of portable radiation detectors. On site , they asses the doserate and try to determine the nuclide composition of the source. The source is confiscated and usually transported to the RIVM for further analysis.

At the RIVM the source is measured using a HPGe gammaspectroscopy detector to determine the exact nuclide composition, activities and activity concentrations. Because sources usually all have different shapes and are comprised of different materials, specific software (ISOCS, Mirion Technology) is used to compensate for these factors. In cases where fissionable materials are found in the sample it is sent to the Institute for Transuranium Elements (Karlsruhe, Germany) for additional measurements and forensic analysis.

The RIVM reports the results from this analysis to the ANVS. Depending on the results the ANVS will try to trace the origin of the material and take further legal actions.

In the presentation or poster we will give several real-life examples of how this national detection architecture operates.

Abstract ID : 270

Enhancing Regulatory Requirements for Security of Radioactive Material in Albania

Paci, R.[1]; Muraj, I.[1]

[1] Albania

Corresponding Speaker: R. Paci

Albania has established much of the legal and regulatory framework necessary to form the basis of a comprehensive security regime for radioactive sources and associated materials and facilities. The law establishes and empowers a regulatory authority Radiation Protection Commission to enact security requirements on licensees. The regulation on Physical protection of radioactive material require for licensing, inspection and enforcement for security of radioactive sources The strategic objective of the Radiation Protection Commission, as the national independent authority, nominated by Council of Ministers , is the protection of health of the workers, public and environment ensuring safety and security, taking maximum benefits of using radiations. Albania is working toward implementations of the new IAEA requirements of GSR part 3 as well as security series of IAEA. The basic law for radiation protection in the Republic of Albania is the law "On Protection from Ionizing Radiation ", no. 8025, date 09.11.1995, and also, Law. 9973, date 28.07.2008 "On some amendments and additions to Law no. 8025, Law is a law-based framework such as to pave the way for implementation of all elements of safety, security and radiation protection. The regulations complete the whole elements that are not reflected in current laws. The law No. 9973 takes into account for increasing the effective independence of Regulatory Authority, RPC members are nominated by Council of Ministers. The new amendments draw special attention on security measures, and regulations have to be approved by Council of Ministers. Key structure in the field of radiation protection, safety and security are Radiation Protection Commission (RPC) and Radiation Protection Office (RPO), respectively as regulatory organ and executive for the protection, safety and security of the ionizing radiation sources. Albania does not produce radioactive sources. There is use of ionizing radiations sources for medical, industrial, research and other purposes. Radiation protection, safety and security have not been a high priority in Albania. Adopted legislation in this area has been aimed to approximate IAEA and EU safety and security standards. Competent Authority in the field of radiation protection, which has two levels:

Radiation Protection Commission as a decision-making body, which chaired by the Minister of Health

Radiation Protection Office as its executive body. Their duties and responsibilities defined in law.

In Albanian are in use all category of radioactive materials

General principles Physical protection of radioactive sources shall be arranged according to the following principles:

A license is required to be issued by the Radiation Protection Commission (RPC) for any possession, use, storage and transportation.

All applicants for the RPC license for radioactive sources of categories 1, 2 and 3 shall have a Security Plan.

Full responsibility for the implementation of physical protection of radioactive sources rests with the licensee.

Physical protection measures must be based on categorization.

Contingency plans to respond to unauthorized removal or sabotage involving radioactive sources shall be prepared and appropriately exercised by all licensees.

Physical protection requirements for different categories of radioactive sources

The licensee shall evaluate the category of the radioactive source or aggregation of radioactive sources.

The categories of radioactive sources shall be updated.

According to the categories of radioactive sources, three groups of physical protection requirements are established, as follows:

Group A, for radioactive sources of category 1;

Group B, for radioactive sources of category 2;

Group C, for radioactive sources of category 3. Responsibilities of Radiation Protection Commission

RPC shall establish and implement a security inspection programme , The frequency of the inspections referred to in paragraph (2) shall be established taking into account the required level for physical protection.

Responsibilities of the licensees

The licensee shall be fully responsible for categorization, development of a security plan, formal assignment and training, implementation of all necessary physical protection measures, management of the radioactive sources, regular inventory of all radioactive sources, maintenance of up- to-date documentation of the use, storage and transfer,

Report

The licensee shall report to RPC in any of the following situations:

(a) loss, attempts,malicious acts , incidents, results of physical inventory, essential changes, discovery etc.

Orphan sources

(CANP) to take under control of all orphan sources

Abstract ID: 55

IEC standards for evaluation of radiation instrumentation used for the detection of illicit trafficking of radioactive material

Voytchev, M.[1]; PIBIDA, L.[2]; Chiaro, P.[3]; Radev, R. [4]

[1] Institut de Radioprotection et de Sûreté Nucléaire (IRSN), France; [2] National Institute of Standards and Technology (NIST), USA; [3] IB3 Global Solutions USA; [4] Lawrence Livermore National Laboratory, USA

Corresponding Speaker: M. Voytchev

This presentation discusses nine IEC (International Electrotechnical Commission) standards that provide the performance requirements for radiation instrumentation used for detection of illicit trafficking of radioactive and nuclear material developed by IEC Sub-committee 45B "Radiation Protection Instrumentation" working group 15. These standards cover the following types of instruments: 1. Body-worn: • IEC 62401 Ed. 2 (2017) Alarming Personal Radiation Devices (PRD); • IEC 62618 (2013) Spectroscopy-Based Alarming Personal Radiation Devices (SPRD); • IEC 62694 (2014) Backpack Based Radiation Detector (BRD). 2. Portable or hand-held: • IEC 62327 Ed. 2 (2017) Hand-held Radionuclide Identification Devices (RID); • IEC 62533 (2010) Hand-held highly sensitive Photon Devices (GSD); • IEC 62534 (2010) Hand-held highly sensitive Neutron Devices (NSD). 3. Portal: • IEC 62244 Ed. 2 (in progress) Portal Monitors (RPM); • IEC 62484 Ed. 2 (in progress) Spectroscopy-Based Portal Monitors (SPRM). 4. Vehicle-mounted • IEC 63121 (in progress) Vehicle-mounted mobile systems. A standard concerning the format for the data to be output from such instruments, IEC 62755 (2012), has been also developed by this working group. The first editions of these standards were developed progressively from 2004 to 2014. Then, revisions have been undertaken in order to harmonize them and to take into account feedback from different testing programs and international projects. Such projects include ITRAP (Illicit Trafficking Radiation Assessment Program), ITRAP+10 and ITRAP+10 phase 2. The ITRAP project was conducted by the IAEA. The ITRAP+10 was initially proposed by the IAEA and later conducted by the United States (US) Department of Homeland Security (DHS) Domestic Nuclear Detection Office (DNDO), the US Department of Energy and by the European Commission (EC). The object of these international standards is to describe the design and functional criteria along with testing methods for evaluating the performance of the applicable instrumentation. The standards specify general characteristics, general test procedures, radiation characteristics, as well as electrical, electromagnetic, mechanical, environmental and safety characteristics. The main requirements such as gamma/neutron alarms, false alarms, relative intrinsic error, ambient dose equivalent rate, radionuclide identification, over-range, etc. for the different types of instruments will be compared and their evolution will be shown. The criteria and compliance test methods in these standards are the result of an optimization, compromise and consensus among the participating experts from many countries searching for acceptable detection performance that reflects

the positions of the national regulatory agencies, scientific and technological progress of the industry, testing laboratories capabilities, end user needs, testing cost and the way the instruments are used in the field. International Co … / Report of Abstracts IEC standards for evaluation of ra … These standards provide manufacturers with internationally acceptable requirements and provide consistent test methods for compliance with the stated performance requirements. The connection of these IEC standards with similar American National Standard Institute (ANSI) standards and European (EN) standards will be also discussed.

Abstract ID : 75

Pakistan's Experience of Enhancing Security Measures for Sealed Radioactive Sources (Srs)

Zubair, M.[1]

[1] Government of Pakistan

Corresponding Speaker: M. Zubair

Pakistan Nuclear Regulatory Authority (PNRA) is responsible for ensuring safe and secure management of radioactive sources by formulating regulatory requirements and exercising enforcement measures in case of non-compliance. Development of the IAEA Code of Conduct on the Safety and Security of Radioactive Sources is a global effort. Pakistan has expressed its commitment to the IAEA and is following the norms of the code of conduct in its true spirit through the national regulatory body. PNRA is the point of contact for the IAEA code of conduct on safety and security of radioactive sources and its supplementary guidance on import/export of radioactive sources. Several regulations on safety of radioactive sources were issued by PNRA and currently, security is covered under these regulations. PNRA is also in the process to develop regulations on 'security of radioactive sources' which are consistent with the national requirements, international instruments as well as the best practices adopted by the international community. The regulatory framework with respect to security of radioactive sources includes granting authorization, submission of security related documents (i.e. Physical Security Plans, Transport Security Plans, etc.), assessing the security measures through inspections during use, storage, transport and disposal of radioactive sources and taking enforcement actions when unsafe/unsecure or potentially unsafe/unsecure practices are noticed. In order to have an effective "cradle to grave" control, PNRA has established liaison with other national stakeholders such as customs, and impose an obligation to the licensee to obtain NOC from PNRA for customs clearance of any consignment containing radioactive sources which are being imported or exported in the country. PNRA encourages the reuse or recycling of radioactive sources when practicable and the replacement of high risk sources with low risk alternatives. Also, PNRA has repatriation requirements in their regulations and do not permit the licensee to import high activity radioactive sources, without the undertaking from the manufacturer/supplier to accept the return of the source when it will no longer be useful for the intended or another purpose in the country. PNRA ensures that the licensees are complying with the regulatory requirements for the protection of radioactive sources and have implemented the required security measures using the concept of graded approach. The licensing procedures, import/export laws, inspections and physical protection measures around facilities provide first line of defense to prevent possibility of acquisition of nuclear and other radioactive materials for unlawful purposes. Pakistan realized that there is a need to enhance security measures, considering the current dynamic nature of threats, for sources used in different application in public and private sector. While adopting a holistic approach, the security levels of all such facilities were assessed for identification of potential weaknesses and vulnerabilities and recommendations were made for enhancing security measures at facilities posing high risks. The assessment was carried out in accordance with national regulations and IAEA Nuclear Security Series documents. IAEA provided assistance to enhance regulatory capabilities to upgrade security measures at selected facilities under Pakistan IAEA Nuclear Security Cooperation Program. Security measures enhanced on the basis of security functions i.e. deterrence, detection, delay, response and security management.

Abstract ID : 21

Experiences and Challenges on Prevention and Detection of Radioactive Sources in Uganda

Oboo, M.[1], Nalumansi S.[1]

[1] Atomic Energy Council, Uganda

Corresponding Speaker: S. Nalumansi

Prevention and detection of radioactive sources is vital in helping to mitigate the incidences of malicious acts or sabotage of facilities with radioactive sources.

Atomic Energy Council (AEC) , the national regulatory body has aided the implementation of the prevention and detection mechanisms in most of the facilities especially those with high category radioactive sources (Co-60 sources) like Uganda Cancer Institute -radiotherapy department , St. Mary's Hospital -Lacor where security preventive and detection upgrades have been installed and AEC carries regular inspections, Installation of detection systems at the interim waste storage facility, Training of personnel from mainly Uganda Police Counter Terrorism department, Customs officers and other security agencies in the country has been done, development of two safety guides namely guide on security of high category radioactive sources, and the guide on physical protection systems and measures for facilities housing radioactive sources. These were developed to guide the authorized persons on what they are expected to put in place and also helped AEC to develop an inspection checklist on security requirements and recommendations for facilities.

However, currently the country lacks portal monitors at all the major border points to the country, the regulatory body lacks equipment to carry out food and water testing on the level of radionuclide contained in them, there are no installed detection systems at the metal recycling industries and there is limited detection at annual Major Public Events in the country e.g. the Uganda Martyrs day Celebrations, National prayer day among others.

This paper will discuss broadly on the above mentioned challenges faced by the regulatory body in ensuring effective implementation and enforcement of its regulatory function on this subject matter, the key recommendations to government and various stakeholders especially Uganda Revenue Authority-Customs department and Uganda Police Force on how to improve on the prevention and detection systems already in place.

Addressing the above mentioned challenges will improve on the prevention and detection of radioactive sources in Uganda. It should also be noted that the Ugandan government, the IAEA and the various stakeholders will have a role to play in ensuring that this will come to effect.

Abstract ID : 221

Tunisia's Plan to Develop a New Legal and Regulatory Framework for Nuclear Security

Reguigui, N.1

1 The National Center for Nuclear Sciences and Technologies (CNSTN), Tunisia

Corresponding Speaker: N. Reguigui

This paper describes Tunisia's efforts to establish a new nuclear legislative and regulatory frame- work for nuclear Security. In particular, this paper discusses the efforts being made to strengthen the nuclear security regime in the country.

Tunisia has always supported the international community efforts in strengthening the nuclear security regime. However, the current legislative and regulatory system in place does not address nuclear security issues as it should be.

In 2008, the National Atomic Energy Commission took the decision to establish a national legal and technical expert committee in charge of establishing a new legislative and regulatory framework for peaceful uses of nuclear energy. This decision was later approved by the board of ministers.

The expert team prepared and submitted to the government a draft of a comprehensive nuclear law that dedicated a whole chapter on nuclear security. The law provides for the creation of the National Nuclear Safety Commission that will be the new independent regulatory authority in charge of nuclear security, among other responsibilities. This new law will be supported by several decrees and provisions to define obligations, targeted activities, materials, technologies, roles and responsibilities. The decrees of application will provide detailed regulatory provisions that will constitute a clear basis for an effective implementation of a nuclear security regime.

By the adoption of this legal and regulatory framework, Tunisia will be in a good position to align with the international obligations in relation to nuclear security.

Abstract ID : 184

Evaluating Effectiveness: US NRC's review of the radioactive material security regulatory infrastructure and 10 CFR Part 37

Cervera, M. [1]; Smith, G. [1]

[1] Nuclear Regulatory Commission, United States

Corresponding Speaker: M., Cervera

On December 16, 2014, the "Consolidated and Further Continuing Appropriations Act, 2015,"(Public Law 113-235) was issued. Section 403 (a),"Securing Radiological Material," of the law directed, "No later than 2 years from enactment of this Act, the Nuclear Regulatory Commission (NRC) shall provide a report to the Committees on Appropriations of the House of Representatives and the Sen- ate that evaluates the effectiveness of the requirements of 10 CFR Part 37 and determines whether such requirements are adequate to protect high-risk radiological material. Such evaluation shall consider inspection results and event reports from the first two years of implementation of the requirements in 10 CFR Part 37 for NRC licensees."

A program review team (PRT) consisting of staff from the Offices of Nuclear Material Safety and Safeguards (NMSS), Nuclear Reactor Regulation (NRR), Nuclear Security and Incident Response (NSIR), General Counsel (OGC), and Region III (RIII) conducted extensive assessment activities over the course of the program review. Progress of the program review was overseen by a Program Review Steering Committee (PRSC) comprised of Office Directors or designated representatives from NMSS, NRR, NSIR, OGC, and RIII. Three independent assessment consultants were selected to evaluate independent aspects of 10 CFR Part 37; these consultants made recommendations which were evaluated by the PRT and then presented to the PRSC for deliberation.

In order to address the Congressional mandate, the PRT performed an evaluation of the effective- ness of the requirements in 10 CFR Part 37. In addition to the Congressionally-mandated review areas, the PRT expanded the scope of its evaluation in order to perform a comprehensive, integrated review of the rule's effectiveness, and to consider relevant insights and recommendations, such as those made by the Government Accountability Office in its performance audits, GAO- 12-925, "Additional Actions Needed to Improve Security of Radiological Sources at U.S. Medical Facilities"; and GAO-14-293, "Additional Actions Needed to Increase the Security of U.S. Industrial Radiological Sources."

In totality, the "program review" assessed nine areas related to the implementation of the rule:

Analysis of 10 CFR Part 37 inspection results from the first years of rule implementation;

Review of both safety and security events, and reported suspicious activity from the NRC's databases;

Evaluation of the 10 CFR Part 37 trustworthiness and reliability program to counter the insider threat;

Consideration of the definition of aggregation as it applies to well logging and other lower activity sources;

Assessment of the adequacy of the materials security training program for NRC and Agreement State inspectors;

Evaluation of the accounting of radioactive sources in the National Source Tracking System (NSTS);

Comparison between 10 CFR Part 37 and international standards and guidance to identify and evaluate differences;

Assessment of separate, independent aspects of 10 CFR Part 37 by three external independent assessment consultants; and

Consideration of comments, questions, and recommendations made during stakeholder out- reach efforts.

The assessment showed that the requirements in Part 37 are effective in ensuring the security of risk-significant radioactive materials during use, storage, and transport when implemented appropriately by licensees. However, the assessment did identify a number of implementation issues due to licensees' incomplete understanding of differences between requirements in the rule and requirements in the Orders issued by the NRC to strengthen the security of risk-significant radioactive materials after the terrorist attacks of September 11, 2001. The NRC determined that, although substantial guidance has been issued on the new rule and the differences between the Orders and the rule, further outreach is necessary. Additionally, the NRC identified potential enhancements to the rule and guidance that could improve the clarity of the rule and consistency in its implementation. The conduct of the evaluation will be presented with particular focus on maintaining objectivity and ensuring technical quality. The general conclusions of the evaluation will be presented as well, and the ongoing activities will be described.

Abstract ID : 265

Introduction to China's Legal System for the Security of Radioactive Material

Bao, J.[1]

[1] China Atomic Energy Authority

Corresponding Speaker: J. Wang

China has always attached great importance to the role of legislation in maintaining an effective management system of nuclear security. Over the decades, it has established and has ever been perfecting a relatively complete system of laws, regulations, rules, provisions, and other normative documents governing the security management of its radioactive material. This system has been key to China's success in keeping an excellent record of nuclear security. On the level of laws, which are approved and promulgated by the National People's Congress and have the highest legal effect, China has the following pieces of legislation in effect that are relevant to the security of radioactive material: the Law on the Prevention and Control of Radioactive Pollution, the Nuclear Safety Law, the National Security Law, the Counter-Terrorism Law, the Criminal Law, the Law on Penalties for the Administration of Public Security, etc. In addition, the Atomic Energy Law, which is currently in the process of enactment and is to be the fundamental law of China in the nuclear field, has many provisions concerning nuclear security in the draft that comprise the basic legal framework for keeping radioactive material secure. On the level of regulations, which are approved and promulgated by the State Council and are legally binding, these four among others are relevant: the Regulations on the Control of Nuclear Materials, the Regulations on the Safety and Protection of Radioactive Isotopes and Radiation Devices, and the Regulations on the Safety Administration of Radioactive Waste, address the security of nuclear materials, radiation sources and radioactive waste, respectively; the Regulations on the Safety Administration of the Transport of Radioactive Items ensure the security of radioactive material in transport. Furthermore, the forthcoming Regulations on Nuclear Security are expected to considerably reinforce the legal groundwork for the security of radioactive material. On the level of rules and provisions, which are approved and promulgated by the departments of the State Council and are legally binding as well, the security of radioactive material is safeguarded by the following: the Implementation Rules of the Regulations on the Control of Nuclear Materials clarify certain specific issues in the security management of nuclear materials; the Provisions on the Physical Protection of Nuclear Materials in International Transport, the Provisions on the Administration of Road Transport of Radioactive Items, and the Measures for the Supervision and Administration of Safety in Transport of Radioactive Items detail the requirements that have to be met to guarantee the security of radioactive

material in transport; the Provisions on the Supervision and Administration of Safety in Railway Transport of Dangerous Goods among others deal with the security of dangerous goods including radioactive material in transport by particular means. There are a number of other normative documents including standards, guides and administrative measures that prescribe methods and procedures in the security management of radioactive material. They are formulated and published by the China Atomic Energy Authority and other competent authorities. They are not legally binding but are generally followed. They include the Format and Contents of the Application Documents for the Nuclear Material License, the Guide on the administration of Nuclear Material Sealing, the Guide on the administration of Nuclear Material Inventorying, the Guide on the Inspection for Nuclear Material Accounting and Control, the Guide on the Administration of Reception, Shipment and Internal Transfer of Nuclear Materials, the Administrative Measures for Nuclear Material Registration, the Administrative Measures for Inspection in Nuclear Material Control, the Administrative Measures for Reporting in Nuclear Material Control, etc.

Abstract ID : 218

Strengthening the Security of Radioactive Sources in Central Asia

Ratz, L. [1]; Khlopkov, A.[2]

[1] Nuclear Threat Initiative, USA; [2] Center for Energy and Security Studies (CENESS), Russian Federation

Corresponding Speaker: L. Ratz

Central Asia – namely Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan – is a region that is home to thousands of disused, abandoned, or lost radioactive sources from the Soviet era, and experiences a significant amount of illicit trafficking. With Russia to the north, China to the east, the Caspian Sea to the west, and Afghanistan and Iran to the south, the regional security of radioactive sources is of crucial importance. The Nuclear Threat Initiative (NTI) is a key player in a series of workshops in Central Asia focused on the security of radiological sources and the prevention of illicit trafficking of nuclear and radiological materials. NTI, in partnership with the Moscow-based partner Center for Energy and Security Studies, and in cooperation with the International Atomic Energy Agency (IAEA) and the Government of Kazakhstan, hosted the first of these Central Asian radiological security workshops in Astana, Kazakhstan in May 2017. Attended by expert representatives from four Central Asian republics (Kazakhstan, Uzbekistan, Tajikistan, and Kyrgyzstan), the U.S. (including NTI, U.S. Department of Energy, and the U.S. Department of State), Russia (including Rosatom and Rostechnadzor), and the IAEA, this workshop was the first of its kind to bring these actors to the same table to discuss and share national experiences on radiological source security and the prevention of illicit trafficking of radiological sources. This workshop identified 29 recommendations for cooperation in this sphere, evenly split between security and management of radioactive sources and the prevention of illicit trafficking of nuclear and other radioactive materials. These recommendations, as well as additional workshops and input from international partners, will be used to build a regional security environment that is both comprehensive and sustainable. This paper lays out in greater detail the purpose of NTI’s work in Central Asia, discusses some of the high-level recommendations that have resulted from discussions in the region, and explores what NTI sees as the ideal future environment for radiological material security in this important region.

Abstract ID: 342

The Committee on Hemispheric Security and Eventually the Permanent Council of the Organization of American States (OAS) as a Valid Forum for Discussing Nuclear Security of Radioactive Material in the America

Cáceres, C.[1]; Facetti, J.[1]; Castiglioni, L.[2];

[1]Secretaria Permanente Consejo de Defensa Nacional, Argentina; [2] Honorable Cámara de Senadores, Argentina

Corresponding Speaker: J. Facetti

In this article we analyse the importance and role of the Organization of American States (OAS), as a Hemispheric Forum of States to discuss and recommend the implementation of measures to improve Nuclear Security Culture in the Americas. Many members of the OAS has signed the follow international instruments: (1) International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT), (2) United Nationals Security Council Resolution 1540; (3) Convention on the Physical Protection of Nuclear Material (CPPNM) and 2005 Amendment. Every Country in Latin America and the Caribbean has radioactive sources for medical and industrial use: radiotherapy units for medical care are in use; industrial sources for radiography are used annually; irradiator facilities containing radioactive sources for industrial applications are in operation. Strong improvements and advances have been done the last 10 years after the first Pan American Meeting on Nuclear Security organized in Quito, Ecuador in 2006. Many of institutional and legal reforms have been implemented during that period. In the meantime, the IAEA and the Member States have improved Nuclear Security Series Publications including: Fundamentals, Recommendations, Implementing Guides and Technical Guidance. We found that in order to do a more efficient coordination we have to find a common ground where member of OAS and the IAEA can discuss Nuclear Security Series and IAEA NS Plan 2018-2024. In this paper, we explain the proccess to establish a mandate for the inclusion of the topic of NS to be considered in the commissions of the OAS, and eventually in the Permanent Council. Also, we propose the Role for the OAS to promote NS in the Hemisphere. The process begins with the presentation of the proposal by a Member State, requesting that the subject be considered. For that, the State must request that one or more paragraphs be included in one of the Omnibus Resolutions to be approved by the next General Assembly of the OAS. In this specific matter, the Topic "Nuclear Security" should be proposed within the Committee on Hemispheric Security due to the fact that the aforementioned Commission considers and analyzes issues related to Security. To this end, the preparation of one or several paragraphs, including its argumentation

or justification, will be proposed within the Commission to be incorporated into the Omnibus Resolution, prior authorization form the Competent Authorities of the Ministry of Foreign Affairs. Subsequently, the negotiation period with other delegations begins, during which the proposal can be accepted "in totum", amended or eventually rejected, if it does not meet the required supports. The OAS prioritizes the adoption of decisions by consensus, and only in very exceptional cases does it use the voting procedure to adopt decisions. Once the mandate has been included in the Omnibus Resolution, it is forwarded to the Permanent Council, which after considering it, the Council brings it to the consideration and approval of the Regular Session of the General Assembly (Highest Authority of the OAS). After that process, the mandate is incorporated into the Program of Work of the Commission and the date on which it will be considered as an Agenda Item of a session is established. This Agenda and An Action Plan will be under the responsibility of the proponents in coordination with the Presidency of the Commission. They will carry on the necessary steps for the participation of experts from the members of OAS, the proponent country, or other international organizations as the IAEA, NEA/OECD or Institutes as the World Institute for Nuclear Security (WINS). The participation of the IAEA can be informing the: Guidance Development, Physical Protection, Education and Training, Peer Review Missions, Coordination Mechanisms and 2018-2024 Nuclear Security Plan. Considering that NS is a responsibility of a State, the role of the OAS in the future can be: a) to support the adherence to and implementation of international legal instruments related to Nuclear Security; and b) Supporting States, through south-south cooperation, in their efforts to establish and maintain effective nuclear security through guidance, capacity building, human resources development using training centres, peer reviews and advisory services, information exchange and risk reduction.

Abstract ID : 280

Supporting Comprehensive, International Radiological Security through Alternative Technologies

Taalbi, M.[1]; Askin, A.[2]; Elster, J.[3]; Itamura, M.[4]

[1] Office of Radiological Security, Department of Energy, USA; [2] Lawrence Livermore National Laboratory, USA; [3] Pacific Northwest National Laboratory, United States; [4] Sandia National Laboratories, USA

Corresponding Speaker: J. Elster

As part of its mission to prevent radioactive materials from being used in acts of terrorism, the U.S. Department of Energy's Office of Radiological Security (ORS) promotes efforts to reduce the need for high-activity sources by supporting the adoption and development of alternative technologies to replace the most common devices that use high-activity sources. The result is permanent risk reduction through the elimination of risk-significant radioactive materials. This is also a key component of the ORS international strategy to prioritize and accelerate efforts to protect devices containing Cesium-137 internationally due to the increased risk that Cesium-137 poses for use in a radiological dispersal device (RDD), or "dirty bomb."

This paper will summarize ORS efforts to develop an international program on alternative technologies, as a complement to its domestic U.S. Cesium Irradiator Replacement Project (CIRP). ORS is currently engaged in efforts with international partners, including nongovernmental and industry stakeholders, to exchange information on the status of technology, invest in and encourage the improvement of technologies where possible, understand and reduce obstacles preventing implementation, and promote the transition to alternative technologies where feasible.

Consideration of alternative technologies is a crucial part of a comprehensive radiological security strategy. Many countries are starting to move towards ionizing radiation technologies that do not contain radioactive sources, such as linear accelerators for cancer treatment, electron beam sterilization facilities, or x-ray blood or research irradiation. In addition, as the IAEA and other groups have highlighted, there are significant gaps in treatment capabilities and resources for many countries in the areas of radiation therapy for cancer treatment and blood irradiation. The demand and need for these devices – either those with radioactive material or without – significantly outpaces the current availability.

Alternative technology devices, where feasible, can provide both technological benefits for the user, in addition to supporting the overall security posture of the facility and country by lowering the risk of an RDD. Improving the accessibility and availability of alternative technologies should be considered as an option to mitigate future challenges while countries continue to improve regulatory infrastructure, review disposition options for source lifecycle management, and promote training for radiation safety and security.

As an example, the annual meeting of the Ad hoc Working Group on Alternative Technologies provides a forum for interested international representatives to exchange ideas and experiences on the use and consideration of alternatives to high-activity sealed radioactive sources and their integration into a comprehensive radiological security posture. As one of the co-chairs for this group, ORS has seen participation increase yearly from representatives around the world and strongly supports the continuation of this dialogue.

Abstract ID : 284

Implementation for Strengthening National Nuclear Security Regime

Oo, L.[1]

[1] Ministry of Education, Myanmar

Corresponding Speaker: L. Oo

Myanmar is implementing to strengthen its legislative and regulatory framework for national nuclear security regime and it is being developed by coordination and cooperation with relevant ministries and private institutions as national level. To strengthen national nuclear security regime, Myanmar is cooperation with bilateral, regional and international levels mainly with international atomic energy agency (IAEA).

Nowadays, the use of radioactive sources is gradually increased in medicine, livestock, industry, agriculture, educational research institutions in country and all radioactive sources are imported. Government is aware of important for securing of radioactive sources and possibility of threat and risks associated with their use and implementing the security management of radioactive sources consistent with international legal standards. To implement comprehensive ways for necessary nuclear improvement of the State and to provide coordinating and implementing nuclear security regime by the State, Myanmar has been participating in Integrated Nuclear Security Support Plan (INSSP) since 2013.

In 1998, Atomic Energy Law was enacted to promote the peaceful uses of atomic energy utilization and to prevent the effects of radiation hazard on human beings and environment. The existing law will be replaced by new nuclear law to strengthen regulatory framework, ensuring for appropriate independence regulatory bodies, comprehensive implementation for safety, security and safe- guards aspects and to obligate its commitments for international and regional legal instruments. The new nuclear law is in the progress and which consists of the topics for nuclear security aspects as radioactive source, export and import control, nuclear security, physical protection and illicit trafficking, transport of radioactive materials, emergency preparedness and response, administrative penalties and appeals and then prohibition. The regulation for nuclear security is drafting.

At present, Division of Atomic Energy under the Ministry of Education is responsible as regulatory body and also acts focal point for nuclear related activities with local and International organizations. Division of Atomic Energy established a national inventory for radioactive sources using Regulatory Authority Information System (RAIS 3.3) for the whole country and national inventory is made to sure up to date. Periodical inspections are carried out including new licensees or renew licensees and registration, inspection, licensing, notification and law enforcement are implemented in regulatory control system.

To ensure the effective regulatory control and safe and secure use of radioactive sources and its related facilities, there are cooperation and coordination among the regulatory body, license holders and relevant organizations at national levels. The working group for national nuclear security is composed of point of contact persons from Ministry of Health and Sports, Ministry of Defence, Ministry of Home Affair, Custom Department under the Ministry of Commerce, Ministry of Agriculture, livestock and Irrigation, Ministry of Industry, Ministry of Transport and Communication and regulatory body of Division of Atomic Energy under the Ministry of Education. Since 2013, Myanmar is implementing capacity building program for nuclear security. Myanmar Government emphasized awareness, outreach and engagement program for nuclear security culture and a series of workshop and training has been conducted for competent authorities and all relevant stakeholders with the leading role of Inter- national Atomic Energy Agency and also bilateral partners. Workshop and training on Physical protection and security management, Threat assessment and design basic threat, Orphan source search and secure, radioactive waste management infrastructure are conducted to enhance the capacity building for all stakeholders for security of radioactive sources and associated facilities. The emergency and response team for nuclear related activities is established at Division of Atomic Energy in 2017 and the team is participating in regional and international emergency activities for capacity building. In addition, early warning environmental radiation monitoring group was established within Division of Atomic Energy in May, 2018. Moreover, the Government emphasized the important of border monitoring area for nuclear security and the meeting for the development of detection and response capability at borders for Myanmar was held with the assistant of International Atomic Energy Agency(IAEA) for all national stakeholders; the contact persons of Ministry of Home Affairs, Ministry of Defence, Custom Department , Division of Atomic Energy and Union of Myanmar Federation of Chambers of Commerce and Industry. Myanmar has a plan for more effective working group for monitoring area and capacity building program is implementing with the assistance of IAEA and bilateral partners. Myanmar government is implementing to support global security regime through the national nuclear security. This paper is based on Myanmar government's activities for national nuclear security regime and to obligate its commitments for international legal instruments.

Abstract ID: 382

Radioactive Material Security Education and Training in the Context of Global Nuclear Cooperation Regime

Rehman, H.[1]

[1] Center for International Strategic Studies, USA

Corresponding Speaker: H. Rehman

Background

In evolving global security environment, the risk of potential destruction possibility from an improvised nuclear device resulting from a radiological dispersal device is enormous. Since 11 September 2001, the threat posed by non-state actors such as terrorists, extremists, and illicit network groups, a new recognition has emerged regarding the potential for malicious acts involving radioactive material. Recent studies, researches and evaluations of the potential consequences of the use of a radiological dispersal device have identified the necessity to improve the security of radioactive material. It includes the examination and analysis of the supply chain for large radioactive sources specially those which are capable of having serious consequences if used malignly indicates that in certain circumstances these sources may be vulnerable to sabotage or diversion. The areas of concerns include i) protected fixed facilities and ii) means and modes of transportation (import, domestic transport, in-use and export. For the fact, it has high magnitude of causing destruction, and disorder in systems. The legitimate concern is that terrorist organizations might try to get approach to these deadly materials through multiple means including illicit trafficking. This concern became real and significant when terrorist networks, such as ISIS, were found to have intended to attain nuclear materials as a mean for their terror activities. In response, to these existing and emerging terrorism threats, International, multinational, and bilateral nuclear security initiatives have been placed such as the UN Security Council Resolution 1540, the Convention on the Protection of Nuclear Material, Facilities and the Convention to Suppress Acts of Nuclear Terrorism.

Objective

To highlight the interdependent factors of existing measures and mechanism for security of radioactive material and facilities protection and emerging challenges. This paper will dwell into the following queries: What factors are changing environment and increasing the risks of threats? What are the vital challenges and gaps in achievement of the security of radioactive material and facility including safety and security goals? What are the major developments and progress in the measures of prevention and detection of radioactive material? It will also discuss future road map to manage this issue of security of radioactive material in elusive international security environment?

Scope

This study aims to undertake an analysis of existing measures for the primary physical security areas of detection, delay, response, vulnerability assessment and technologies that support to ensure protection of the radioactive material. Including the features; new detection technologies, integration of information technology with physical technology systems, design basis threat analysis, progress in area of research and development (with reference to cyber threats as well). While exploring emerging trends and growing challenges, it would appraise the threat level and loopholes in the existing security and preventive measures at the national and international level. This study will draw attention towards the importance of radioactive material security education and trainings with reference to the future challenges.

Furthermore, it will also discuss regional cooperation possibilities by including factors of porous borders; a unique geographical position with a large coastline; tensions with neighbouring states. It will explore a possibility of proposed multi-level approach of regional cooperation as well which entails cooperation in security measures, in areas of intelligence sharing, border control working groups, bilateral exchange of an incident reports, joint response activities, investigation group for threat analysis, sharing best practices by regional centres of excellence, track II dialogue.

Structure

This paper will cover six sections. The first section introduces the paper by outlining the background of the issue, underlining its objective, and relaying the scope of the paper. The second section provides a better understanding with a more comprehensive examination of the issue, through an analysis of international practices. The third section explains the distinctive features of radioactive material security education and training. The fourth section contains an analysis of the impact of knowledge based radioactive material security education and training, and presents key findings from this study. The fifth section describes challenges and evolving threat perception in global security environment. And the sixth section discuss the way forward and concludes the paper.

The above mentioned concerns will be discussed in the context of global nuclear cooperation regime. The future for protection of radioactive materials safety and security standards and practices can be forecasted by the existing initiatives and more involvement and enhanced role of the IAEA. It will provide broader scope for security of nuclear, radioactive and other sensitive materials by professional and appropriate assistance at multiple levels, while offering reliability, inclusivity for convening secure framework for nuclear and sensitive material related matters. This will also bring like-minded states together to lead towards a long term goal of global security by decreasing the risks of dangers of accessing radioactive materials.

Abstract ID : 180

Assessment of Radioactive Material Security Culture at Universities and Medical Facilities

Harris, J.[1]**; Rane, S.**[1]

[1] Purdue University, United States

Corresponding Speaker: First Initial, Last Name

Securing radioactive sources has become increasingly important given the rising threat of radiological terrorism. While radiation safety has long been established in most applicable industries, the importance of nuclear and radiological source security has lagged behind in non-nuclear material specific industries, such as academic institutions and medical facilities. To evaluate the attitudes and behaviours regarding nuclear security culture, four assessments of nuclear and radiological material practices were developed and conducted. Two assessments were performed each at a comprehensive hospital and a large university with a variety of radioactive sources. The assessments were further broken down to cover radiation users and non-radiation users. The survey portion of the assessment comprised of a series of questions segregated into four categories: pol- icy, enforcement, leadership, and behaviour. Nuclear security awareness questions formed a subset of the questionnaire. Users were classified by their radioactive material experience, where applicable, age, and work classification: student, faculty, or other staff. Volunteers were also interviewed face-to-face to further expand on their views of nuclear security culture. Results of the assessment showed a wide variety of awareness towards nuclear security across all of the user classifications. The response from all groups emphasized the need to enhance threat response preparedness and greater communication among stakeholders. Results, including correlation between user groups and demographics, will be expanded upon after all data is compiled.

Abstract ID : 231

Fostering Security Culture at Facilities Handling Radioactive Material

Umar, M.[1]; Liaquat, M.[1]; Tahir, M.[1];. Sabir, N.[1]; Ali, S.[1]

[1] Pakistan Atomic Energy Commission

Corresponding Speaker: M. Umar

Security Culture is the assembly of characteristics, attitudes and behaviours of individuals, organizations and institutions which serves as a means to support, enhance and sustain Nuclear Security. Lack of cultural awareness in Nuclear Security may be detrimental in strengthening the national nuclear security architecture. Security culture plays a pivotal role in sustaining a nuclear security regime, as identified in IAEA Nuclear Series No. 14: Nuclear Security Recommendations on Radioactive Material and Associated Facilities. The first logical step in implementation of security culture is the performance evaluation of management systems for security of radioactive material and associated facilities.

Management systems at any facility determine the processes and procedures used to ensure that a facility can fulfil all tasks necessary to achieve its nuclear security objectives with continual improvement. An effective management system clearly defines the roles of security, enlists out- comes from successful implementation of correct security culture objectives and strives to uphold management processes through periodic vetting and improvement, on the basis of experience. It also measures progress, assesses compliance and helps configuration management.

The objective of this paper is to use the methodology to identify and share management practices for exchange of experience and best practices adopted to uplift major management systems supporting nuclear security functions at facilities handling radioactive material. To achieve this objective certain management systems are assessed against their international indicators as mentioned in NSS-7: Nuclear Security Culture.

The study is not based on an evaluation technique which emphasizes more on technical items rather than intangible human elements. It invokes personnel to think about how individuals and teams interact with one another, the physical surroundings within the facility, and external environment. Such approaches play a vital role in identifying best practices with reference to implementation of nuclear security culture in a facility.

The consistent use of these indicators, helps management in gap analysis and to chalk out an action plan which has the potential to foster nuclear security culture in a significant manner. Example of best practices include the periodic review of a visible security policy, clear roles and responsibilities, performance measurement, work environment etc. After reviewing these management systems/policies the next step is to ensure that these policies are updated with participation from senior management and is made familiar to working personnel through awareness and training programmes.

Moreover, systems are in place for conflict resolution to ensure that safety and security complement each other in the best possible manner. Assignments are managed in a manner such that participation in nuclear security trainings and qualification is given a high priority and is not disrupted by non-urgent activities. Also a programme exists which supports personnel reporting any concerns related to nuclear security.

In order to evaluate the performance of management systems, a questionnaire has been developed which assists facilities handling radioactive material to track their progress, find out gaps and set out future goals for better implementation of nuclear security culture.

Keywords: Radioactive Material, Security Culture, Nuclear Security Functions, Management Systems, Performance Evaluation, Configuration Management

Abstract ID: 328

Exploring Industry Incentives to Demonstrate due Care for the Security of Radiological Material

Umayam, M.[1]; Rauhut, K.[1]

Stimson Center, United States of America

Corresponding Speaker: M. Umayam

Effective security of nuclear and radiological materials rests on the shoulders of enduring international regimes and robust state-level regulation of facilities. But the nuclear security architecture also relies on licensees – operators, shippers or carriers – as the front-line protectors of these materials. For licensees handling nuclear material, this responsibility has been prominently reiterated in various ways in recent years. Under the newly-added Fundamental Principles of the Convention on the Physical Protection of Nuclear Material and Nuclear Facilities, licensees are specifically charged to give "due priority" to security culture and quality assurance among others, emphasizing that these concepts must be internalized, valued, and demonstrated by the licensee directly. And on the margins of the Nuclear Security Summits, select nuclear power operators formed the Nuclear Industry Steering Group for Security to support activities beyond the Summit process and maintain "high standards of transparency, integrity, ethical behaviour and social responsibility" (Nuclear Industry Summit Joint Statement).

While existing guidance documents and best practices for the security of radiological material – including the IAEA Code of Conduct on the Safety and Security of Radiological Materials, as well as relevant Implementing Guides – also invoke the important role of the licensee, there may be untapped opportunity to encourage direct licensee engagement on security issues. In addition to top-down regulatory compliance, is it possible to initiate licensee-led efforts and norms for radiological material security? In other words, would it be feasible and desirable to develop a framework that incentivizes licensees (particularly transport and storage operators, as well as medical and industrial users) to openly demonstrate responsible and reasonable security over the radioactive sources under their charge? As it stands, radiological materials are widely used worldwide, but do not have the level of controls or standards compared to nuclear materials. And because the international liability regime expressly excludes radiological materials from its scope, a licensee will most likely be required to defend itself against tort claims based on negligence in the event of a security incident. Under a tort claim for damages based on negligence, the licensee is required to exercise a "duty of care" when performing acts that could foreseeably harm others.

This paper outlines the work of The Stimson Center, in partnership with the World Institute of Nuclear Security, to develop an Organizational Nuclear Security Governance Template as a potential framework for licensees to assess and improve security culture in their nuclear facilities. Through a series of questions focusing on (1) leadership and oversight; (2) security risk assessment; (3) security culture; and (4) resilience and continuous improvement, the template encourages nuclear facilities to establish industry-led benchmarks for what constitutes reasonable security by asking senior managers to document and share how they make their security risk management decisions. Adopting the template would help licensees understand in advance of an event and ensuing litigation what duty of care for security will be required of them by their shareholders, their workforce, and the greater public.

The template has gained interest within the nuclear power sector, but there is also potential application to other industry stakeholders, particularly those handling radiological material. This paper explores the concept of duty of care for licensees using radiological material, its potential implications on liability, and how might a modified version of the Organizational Nuclear Security Governance Template apply. The paper posits that a governance template for radiological material could help establish strong industry norms towards establishing a duty of care for the security of these materials; show a public-facing commitment to nuclear security that would elevate public confidence; and demonstrate organizational commitment to a strong security culture.

Abstract ID : 44

The Implementation of Security Culture of Radioactive Source in BATAN's Facility: Applied Sampling Culture Indicator from IAEA CRP JO2007

Khairul, K.[1]**,**

[1] Department of Nuclear Engineering and Engineering Physics, Faculty of Engineering, Universitas Gadjah Mada, Indonesia

Corresponding Speaker: K. Khairul

The implementation of nuclear security culture assessment should consider the characteristics of the nuclear material to improve the security performance. This paper covers the experience of National Nuclear Energy Agency of Indonesia (BATAN) in implementing nuclear security culture self-assessment on special case of radioactive source associated facility. The assessment was limited in a scope of sampling on BATAN's Pasar Jumat Nuclear Facility. The program was carried out to serve as preliminary analysis of BATAN' nuclear security culture, specifically on radioactive sources, and also to serve as the introduction of nuclear security culture self-assessment concept to BATAN's Pasar Jumat Nuclear Facility self-assessment team. The sampling used survey method as one of the assessment tools. The survey used IAEA-CRP JO2007 as the base of culture indicator and with the theme of employee's vigilance towards radioactive source security. A total of ten (10) security culture characteristics and thirty (30) culture indicators are chosen from IAEA-CRP JO2007. Culture indicators were transformed into thirty (30) survey statements prior submitted to respondents as required by IAEA-Technical Guidance of NSS No. 28-T (Self-Assessment of Nuclear Security Culture in Facility and Activities). The survey form are given to 19 respondents from various background at five work unit is located in Pasar Jumat Nuclear Facility, Jakarta, resulting in the average total indicators score of 3.92 out of 5. Early three-tiered outcome model analysis indicated facility's security strength and weakness is balanced. Because of shortage of respondents, therefore further analysis and ¬full-scale assessment is needed to support the result of survey sampling. Keywords: radioactive source, security, security culture, self-assessment. The technical guidance NSS No. 28-T is very important to evaluate the implementation of security culture at facility, in the meantime IAEA-CRPJO2007 is also very useful to contribute culture characteristics and culture indicators for source users when we conduct self-assessment. Self assessment is consider as learning curve that mean we have to continue to have self-assessment after 24 months. In this result we can define the baseline for enhancing future nuclear security culture.

Abstract ID : 165

Radioprotection versus Security: the Necessary Evolution of Protection Measures and Attitude

Hocde, K.[1]

[1] Institute of Radioprotection and Nuclear Safety (IRSN), France

Corresponding Speaker: K. Hocde

The Institute of Radioprotection and Nuclear Safety (IRSN) is the technical support organization for the French nuclear safety and security authorities. IRSN conducts studies related to security of nuclear and other radioactive materials, nuclear facilities and transports. This includes the support to the authorities for the protection of high activity sealed sources.

As the fear of a NRBC attack is more and more stressed out in the news and international debates, the will to protect radioactive materials against malicious acts grows. However, the vast diversity of profiles and uses of radioactive materials concerns a plethoric number of actors, from whom a lot are not aware of security culture.

Therefore, one main challenge to a generic and efficient protection frame is the diversity of radioactive materials. From high activity sealed sources to small, portable, radio-pharmaceutics, all these kinds make it difficult to draw general scenarios of aggression and to define generic rules of protection.

Furthermore, this diversity of materials echoes in the variety of operators that use them. From national laboratories to hospitals, they all have different priorities and different regulatory requirements to which safety, and now security, have to align with.

Thus, confusion between radioprotection, safety and security measures could occur. In different examples, it is possible to notice that measures that prevent work accident or unfortunate irradiation by denying access to radioactive materials could easily be bypassed by a malicious actor. Some examples are presented: the last step of a logical sequence required to access materials could be directly triggered and validated, or sensors could be fooled, or locking systems designed to prevent mistakes could be bypassed. Lead walls are efficient against gamma rays, but not against intruders. Easy access to a crane or other devices might be helpful and time saving for a company, but it also could help a break-in.

These examples point out that radioprotection or safety measures are not tailored to meet the requirements of security. Even some security measures could conflict with safety culture, for ex- ample regarding information access.

In these examples, the operators feel safe, and are right to feel so. However, they are not secured. To non-specialists, the results may appear the same, but radioprotection is not protection against malicious acts, and the ways to stop an intelligent, deterministic threat are not the same than to prevent accidents or unintentional acts.

In order to improve the security of radioactive materials, security measures have to be put in place but also a change in mentality is necessary. This evolution will only be possible if those actors are made aware of malicious acts, and so by an improvement of security culture.

Abstract ID : 125

Public Company "Nuclear Facilities of Serbia" Experience in Strengthening Nuclear Security Culture

Mladenovic, M.[1], Arbutina, D.[1], Milanovic, S.[1]

[1] Public Company Nuclear Facilities of Serbia, Serbia

Corresponding Speaker: M., Mladenovic

Public Company Nuclear Facilities of Serbia (hereinafter PC NFS) is the only nuclear operator in Serbia. It was founded in 2009 under the Law on Ionizing Radiation together with the Serbian Regulatory Body. Since its establishment, PC NFS has continued all nuclear activities previously man- aged by Vinca Institute of Nuclear Sciences; Two research reactors (RA-final shut down and RB- zero-power critical assembly, operational but currently not-licensed), RWM facilities- old Hangars H1 and H2 with legacy waste, new hangar H3 (for the storage of intermediate and low level radioactive waste) together with the secure storage for the high activity sealed radioactive sources, and closed uranium mine Kalna are the part of the Company. In autumn 2015, PC NFS has signed research agreement with IAEA under CRP on Development of Nuclear Security Culture Enhancement Solutions(NSCES) with following research objectives and anticipated outcomes: adoption on nuclear security objectives; defining the key actions that contributes to the strong nuclear security culture; presenting the responsibilities and roles of state, regulatory body, management and individuals in strengthening the nuclear security culture to our employees; establishing system with clear roles, objectives and responsibilities; communicate across organizational boundaries. This paper is a summary of PC NFS implementation of self-assessment methodologies in order to enhance nuclear security culture. Self-assessment surveys were provided to all of our employees (app. 120) with 20 questions (seven grade scale and three tiered outcome model) with key consideration of message given to our employees, assurance of anonymity (our data of interest were age, education and field of work) and explanation of how the results are going to be used. Paper will also describe. We will present the results of the self-assessment surveys, indicators that we recognized as priorities, as well as the new indicators that our team has added to the existing indicators listed in IAEA document: Self-Assessment of Nuclear Security Culture in Facilities and Activities (Draft Technical Guidance NST026), interview groups and methodologies, document review and observations. Paper will present complete interview process that was conducted within PC NFS together with the observations from our psychologist. We will also present the other activities that we took in order to enhance nuclear security culture such as: training, cooperation with other institutions with high knowledge in this field as well as the future steps that we plan to make to put the nuclear security culture to the significantly higher level. Since we have prepared First Report which will be sent to the IAEA for the revision, we will be delighted to share our experiences with the Member States during the Conference(We have indicated that the presentation type will be Poster but we are ready to prepare full paper or the presentation if needed).

Abstract ID : 82

A Systemic Approach to Enhancing Nuclear Security Culture

De Lemos, F.[1]; Mitake, M.[1]

[1] Comissao Nacional de Energia Nuclear (CNEN), Brazil

Corresponding Speaker: F. De Lemos

By definition, nuclear security culture is the assembly of characteristics, attitudes and behaviors of individuals, organizations and institutions that support and sustain the nuclear security. While enforcing those characteristics and attitudes would certainly contribute for the enhancement of nuclear security, by focusing on nuclear security culture indicators only other factors that may affect the nuclear security may be missed. There are many overlaps between safety and security culture as well as with the organizational culture, of which security culture is a subset. We argue in this work that organizational culture, including safety, affect the nuclear security, and therefore, all aspects of the organizational culture should be treated with the same importance as factors that can affect the nuclear security of an installation. A broader analysis can help attaining a more sustainable nuclear security since it will consider not only factors specifically related to nuclear security, but also interactions that could lead to unintended consequences that could lead to vulnerabilities in the system. However, such a comprehensive analysis is not intuitive or straight forward. We need some special tools for that. To that end we apply the systemic analysis methodology STPA – Systems Theoretic Process Analysis. It is based on STAMP – Systems Theoretic Accident Model and Processes, systems theory and systems thinking. In STAMP, accidents are defined as unacceptable losses, which can be loss of money, lives, reputation, for example. Losses are a result of the combination of a vulnerable, or hazardous, state of the system with the worst set of external conditions. By external, we mean outside of the system's boundaries. One of the main assumptions of STPA is that safety, and security as well, is an emerging property of the system, rather than something that can be added to the system. These properties result from the interactions between the components of the system. As a consequence, safety and security are a problem of control over those interactions that, otherwise, could lead to unwanted consequences, and not only a problem of failure of a component. Unwanted interactions can lead the system to hazardous or vulnerable states, which in combination to certain external conditions can lead to accidents. For example, the theft of sensitive information (a loss) will be the result of the information being available for unauthorized access (system's vulnerable state) and malevolent people willing to steal the information (worst set of external conditions). Note that we cannot have control over the intentions of people, but we can have control on the way we treat the information making it more or less available to unauthorized access. It is in this context that we study how culture, in general, could contribute for the deterioration of the control structure of the system and, therefore, leading the system to a hazardous or vulnerable state. This approach allows us to focus our attention on all the interactions between the components of the system and their possible unwanted consequences, i.e. lead the system to vulnerabilities that would enable malicious actions to succeed. This work is a result of the research carried out during the IAEA Coordinated Research ProjectJ02007: Developments of Nuclear Security Culture Enhancement Solutions (NSCES).An example of application to a real case involving an installation for radiopharmaceuticals production is presented. A systemic approach is used to the analysis of all interactions that could potentially lead the system to a state of vulnerability and, consequently, facilitate the action of people with malicious intentions. This work is a result of the research carried out during the IAEA Coordinated Research ProjectJ02007: Developments of Nuclear Security Culture Enhancement Solutions (NSCES). An example of application to a real case involving an installation for radiopharmaceuticals production is presented.

Abstract ID : 85

Strengthening Sustainability for Security of Radioactive Material and Associated Facilities through Interaction with Operators during the Improvement of Normative and Legal Framework

Ivanov, M. [1]

[1] Federal Environmental, Industrial and Nuclear Supervision Service of Russia

Corresponding Speaker: M. Ivanov

Establishment legislative and legal framework is one of the essential elements of the State's nuclear security regime included in the Objective and Essential Elements of a State's Nuclear Security Regime (NSS 20) and Nuclear Security Recommendations on radioactive material and associated facilities (NSS 14). These IAEA's publications contain recommendations to States and their competent authorities on developing of obligatory security requirements based on risk assessment, applying of graded approach when sets of requirements for different security levels are established, implementation of defence in depth concept. Despite all the variety of topics that are usually presented at conferences and seminars on the development of regulatory acts on security area, they are reduced to the list of developed national normative acts, their main requirements and to name of used IAEA's publication. At the same time, the process of developing regulations on security is discussed very rarely. But it is the procedures for developing regulations that determine the involvement of operators (license holders) in the process of drafting (revising) a normative act. Discussion of proposals of the regulatory body to amend the regulatory requirements with the operator, obtaining feedback from operators is the key to successful understanding of new requirements by operators. At the conference and in the paper it's proposed to discuss the issues related to the interaction of the regulatory body with license holders during improvement the regulatory legal framework. In the paper, the author will talk about the experience of Rostechnadzor - the Russian regulatory body for safety and security in the use of atomic energy - to interact with operators in improving the Federal rules and regulations NP-034-15 "Rules for Physical Protection of radioactive substances, radiation facilities and storage facilities", which is a normative legal act of a special series of normative legal acts of Rostechnadzor that establishes mandatory requirements for the safety and security of nuclear energy. The paper will consider the stages of the development of the Federal rules and regulations, and will also discuss how to take into account the operators' opinion and views on the content of drafts of federal rules and regulations. Since the physical protection requirements for radioactive material and associated facilities in NP034-15 are applied to different types of economic activities and to different types of operators, it becomes necessary to explain to operators how to meet regulatory requirements. For these purposes, Rostechnadzor has established a separate series of normative acts with recommendations for operators to comply with certain requirements of Federal rules and regulations – Safety Guides. The paper will consider the procedures for the development of Safety Guides. The examples of Safety Guides that have been developed to facilitate the implementation of the requirements of NP-034-15 which have caused the greatest difficulties for operators (according to feedback from operators and results of the implementation of supervision of physical protection) will also be included in the paper and in the oral presentation. Presentation at the conference and the paper will be of interest primarily to representatives of the regulatory bodies of the IAEA Member States, who are faced with the task of developing regulatory legal acts on security with requirements that will be understood and accepted by operators. Country International Co … / Report of Abstracts Strengthening sustainability for se … Russian Federation Gender Primary author(s) : Mr. Presenter(s) : Mr. IVANOV, Maksim (Federal Environmental, Industrial and Nuclear Supervision Service of Russia)

Abstract ID : 92

Vulnerability Assessment for Radioactive Material

Ek, D.[1]; Snell, M.[1]

[1] Sandia National Laboratories, USA

Corresponding Speaker: M. Snell

The Security of Radioactive Sources, NSS-11, provides suggestions for implementing NSS-14. One of the suggestions is that vulnerability assessments should be conducted to "…help the development of regulations by the State/regulatory body or for demonstrating regulatory compliance of the operator." The vulnerability assessment is a systematic appraisal of the effectiveness of a security system for protection against an assessed threat. However, the approach to conduct a vulnerability assessment is less clear. The term vulnerability assessment in the nuclear security community typically refers to a quantitative measure of the timely detection probability for a given adversary and scenario against a defined security system. The appropriateness of this approach to the radioactive material community is questionable. This is because: 1. the severity of consequences of an RDD is lower than the consequences of an IND; 2. the security sophistication and security culture of operators is typically lower than that of nuclear material. 3. the security environment in which radioactive material is located is vastly different than that of nuclear material; a. access control cannot be implemented to the level of that of nuclear materials as radioactive materials are found in public hospitals, blood banks, and industrial field operations, where access controls are not possible; b. quantified detection, delay, and response information is rarely available c. On-site secure alarm monitoring is not always possible d. but most importantly, response forces are nearly always provided by off-site local law enforcement. This results in most cases that the response cannot interrupt the worst-case scenario in a timely manner. As a result, a graded approach to vulnerability assessment that employs a more appropriate level of rigor is needed for radioactive material. Such an approach would determine effectiveness using less-than-worst-case scenarios. Such an approach would allow decision makers to determine if effectiveness is adequate or if more is needed. This paper will present an approach to vulnerability assessment for the security of radioactive material that will identify vulnerabilities, determine overall security system effectiveness, and facilitate assessing the value of security improvements for radioactive material. This approach would be tailored to users of radioactive material.

Abstract ID: 340

Using Operational Research Techniques to Inform Strategic Investment in Nuclear Security Technology Development

Moore, M.[1]; Wojtaszek, D.[1]; Dimayuga, I.[1]; Leeder, K.[1]

[1] Canadian Nuclear Laboratories

Corresponding Speaker: D. Wojtaszek

A review of current personnel and programs concluded that the nuclear security regime in Canada is strong. This is validated by an independent public assessment performed by the Nuclear Threat Initiative (NTI) in 2016. The NTI Nuclear Security Index, which assesses the status of nuclear security conditions in several countries, ranked Canada 3rd best in nuclear material theft security out of 24 countries with weapons-usable nuclear material, and 3rd best in nuclear facility sabotage prevention out of 45 countries with nuclear facilities. However, opportunities still exist to further improve the nuclear security system within Canada, and ensure it remains effective against future threats.

Initiatives are already underway to address many of these opportunities. For instance, the Defence Research and Development Canada Centre for Security Science (DRDC-CSS) established the Canadian National Nuclear Forensics Capability Project, which demonstrated that it is possible to establish a robust national nuclear forensics capability through a whole-of-government approach involving strong collaboration among nuclear scientists, forensic experts, law enforcement, policy makers, and operational support specialists. This initial effort has spurred a number of follow-on projects that are currently on-going to further develop and enhance the national nuclear forensics capability, including methods for collection and analysis of RN samples as well as a database of well-characterized samples of nuclear materials. Other initiatives in the area of detection of radioactive and nuclear material outside of regulatory control are also on-going, including improvements in detection capabilities at our borders, the study of active interrogation methods using neutrons, x-rays or gamma rays, or employment of stand-off radiation detectors (e.g., Compton imaging) to locate radioactive materials.

A technology roadmap is a strategic operational research tool that can be used to assess all types of investment opportunities and the associated research and development proposals that could advance Canada's capabilities in those areas, against a set of national priorities. It was found that opportunities can be divided into two categories: technological improvements (e.g., improved radiation detection tools), and program improvements, such as more effective communication and coordination among entities involved in nuclear security events.

Abstract ID: 349

Radiological Source Security in Major Urban Areas

Bieda, T.[1]

[1] Ministry of Energy and Mining, Argentina

Corresponding Speaker: T. Bieda

The threat related to criminal or intentional unauthorized acts involving nuclear or other radioactive material out of regulatory control has long been a matter of national and international concern and cooperation. Recent terror attacks in major urban areas across the globe have made that threat more urgent. Developing and enhancing nuclear security detection capabilities within a State's interior are an important component in a national-level defense-in-depth approach.

However, the uniqueness of major urban areas pose a challenge to Member States because it obliges them to integrate these detection and response capabilities into already existing security architecture. Nuclear security in major urban areas is a hard task to accomplish because it does not have a specific (and limit) time and place, as for instance in major public event: is an everyday challenge across the whole city. Also, major urban areas mostly uses regular security forces that operates according to normal procedures on a daily basis. These security forces probably did not had any previous and specific radiological and nuclear training. The organization of such a security operation requires huge amounts of resources and a specific risk assessment, as well as a tailor nuclear security detection and response plan. Security in major urban areas also requires the involvement of all the different stakeholders, including those who are not mainly related to the nuclear or the security field. And it is also creates a challenge when communicating to high authorities because the threat is constant and ongoing, therefore the security operations needs to remain always ignited, and this could generate a conflict with other threats that might seem more "real" and "immediate".

This paper is going to present the main findings, best practices and lessons learn from the Buenos Aires International Workshop on Nuclear Security in Major Urban Areas. The focus is going to be on how raise awareness on this topic, identifying key stakeholders and responsible authorities and providing guidance to high authorities and different stakeholders about the unique challenges of major urban areas. Also, how to share experiences on integrating nuclear security into existing security plans, with necessary customization to major urban areas. Finally, the importance of emphasize nuclear security culture, engaging every stakeholder involved in a major urban area security protocol as a key component to guarantee nuclear security, preparing responsible authorities to address nuclear security events in major urban areas, and suggesting recommendations for training programs.

Abstract ID : 192

Sustainability Challenges and Recommendations for Internationally Deployed Radiation Detection Instruments

Tucker, B.[1]

[1] Pacific Northwest National Laboratory, USA

Corresponding Speaker: B. Tucker

Over the past decade, the US Department of Energy's Office of Nuclear Smuggling Detection and Deterrence has deployed thousands of radiation detection instruments to partner countries for the purpose of detection, location, and identification of radioactive materials at storage facilities, border crossings, seaports, and airports. During this time, challenges have been observed regarding the deployment, operation, sustainability, and repair of these instruments. Specifically, in the areas of sustainability and repair, these challenges have resulted in situations where partner countries lose confidence in the equipment and alter their operations to bypass or discontinue use of the equipment. This presentation will focus on the sustainability challenges encountered, probable causes, and potential solutions.

Approximately fifty percent of the maintenance scenarios encountered involve depleted batteries, incorrect settings, or issues that may be easily corrected with a calibration or background measurement. However, with a lack of knowledge or comfort with performing these basic procedures, operators tend to avoid these tasks and, instead, discontinue use of the equipment. To complicate the issue, many sites experience high turnover of operators with minimal succession, no mechanism for the transfer of knowledge, and no budget for continuous training.

Additional challenges are introduced due to the international nature of the program. Simple tasks such as procuring replacement batteries can be a considerable effort, especially when the components are only available from the manufacturer. In addition, returning faulty equipment to the manufacturer for repair requires a significant amount of shipping and logistics effort as well as expense. Again, these complex processes can result in partner countries abandoning detection equipment.

Many proposed solutions to these sustainability challenges require manufacturer cooperation. Specifically, manufacturer assistance is highly valuable when creating and implementing basic and advanced maintenance training. Additionally, manufacturers can recommend shipping and logistics processes to minimize downtime and costs, possibly by using regional distributors or service centres. By enabling partner countries to perform their own maintenance and providing well-defined processes to obtain replacement parts and/or return non-functional instruments for repair, an in- crease in equipment uptime and longevity may be observed.

More advanced and involved technical solutions will require forward-thinking by manufacturers to design instruments with field-sustainability as a major priority. Instrumentation advancements may include:

- Modular, easily-repairable component design
- Longer battery life for portable instruments (both operational and lifespan)
- Instrument self-diagnostics and state-of-health reports for component failures
- Field-upgradable software/firmware Damage-proof charging and communication ports
- Easily replaceable detectors and electronics without the need for field calibration or additional radioactive materials

Advances in these areas of training and sustainable instrument design will result in more frequent use of equipment for the detection of illicit and/or accidental transport of radioactive materials

Abstract ID : 80

Evaluation of Polyvinyl Toluene Plastic Detectors to Distinguish Man-Made Sources from Naturally Occurring Radioactive Material (NORM)

Alsalman, A.[1]**; Marianno, C.**[2]

[1] Energy and Minerals Regulatory Commission, Jordan; 2 Texas A & M University, USA

Corresponding Speaker: A. Alsalman

Plastic polyvinyl toluene (PVT) detectors are used for detection of radioactive materials across borders as part of the member states' implementation to detect material out of regulatory control. This research focuses on testing the effectiveness of discriminating those materials from naturally occurring radioactive material (NORM). Material response of PVT to gamma radiation is primarily via Compton scattering, and therefore the full energy peaks are not dominant in an energy spectrum. These detectors generate alarms depending on the gross count ratio or on the ratios between energy windows of the detected material compared to the background radiation. As a result, alarms can occur due to natural radioactive material and require secondary inspection activities. In this research to distinguish between manmade sources from background radiation , a PVT detector with a multi-channel analyzer (MCA) was used to obtain the energy spectrum of sealed radioactive sources as well as background. Two methods were applied, the first method applied two energy windows to compare the count ratios for different spectra. The count ratio calculated by dividing the counts in the first energy window on the second window. The second method utilized a net slope difference technique using three energy windows. This was done by normalizing the slope between two adjacent energy windows to the total number of counts in the two windows. A net slope was calculated by subtracting the background slope from the source slope. Experimental results show for the first method that by using two energy windows the count ratios for the Background, Co60 and low enriched uranium sample (1.9% enrichment) spectrums were, 31.58 ± 0.25, 45.87 ±0.40 and 112.42± 0.92 respectively. Alternatively the second method yielded a net slopes for Co60 and the low enriched uranium sample of, 0.34± 0.0021 and -0.01± 0.0019 (low to medium energy windows), and -0.15± 0.0049 and -0.14 ± 0.0049 (medium to high energy windows), respectively. Experimental data shows that there are differences in the count ratios as well as differences in the net slopes. By using both methods with border detection system which use PVT, It could distinguish between man-made radiation sources and background. Systems using this techniques would have a reduced frequency of nuisance alarms.

Abstract ID : 163

Challenges in Establishing Nuclear Security Systems in Uganda

Luwalira, N.[1]

[1] Atomic Energy Council, Uganda

Corresponding Speaker: N. Luwalira

It was until 2008 when a legal and regulatory frame work was established to regulate peaceful application of ionising radiation in Uganda. This was through the enactment of the Atomic Energy Act No.24 of 2008 and establishment of the Atomic Energy Council the national regulatory Authority and as well as the issuance of the Atomic Energy Regulations 2012 to operationalise the Act. The Act had extensively provided for radiation safety and radiation protection against dangers resulting from ionising radiation. However, there are a few provisions regarding nuclear security in both the Act and Regulations not comprehensive enough to cover the whole nuclear security spectrum.

This in one way or the other affects the establishment of a national nuclear security infrastructure if there are no specific legal basis that covers all aspects of nuclear security. However, the few provisions in the legal framework could support the setting up of some nuclear systems to address the security of radioactive sources currently in the country at the facility level. The low levels of nuclear security culture and lack of awareness of the risks associated with inadequate security for radioactive and nuclear materials are some of the challenges encountered in the establishment of a robust nuclear security infrastructure.

Nuclear security systems have been set up at some facilities in the country following graded approach with the support of the United States Department of Energy particularly at the facilities with categories 1 and 2 and at the national radioactive sources storage facility. These nuclear security systems upgrades have not only significantly improved the security of radioactive sources but have also contributed to the safety of the public at these facilities. However, the country has radioactive sources at other operator facilities with generally inadequate nuclear security systems that create a great risk of occurrence of nuclear security threats, incidents and accidents. This is because of the numerous challenges ranging from the inadequate legal and regulatory framework that is currently in force.

The current inventory shows that various radiation sources are being used particularly in the medical and industrial fields as well as in the oil well logging in the prospecting activities for oil and gas resources in the country. The number of these sources is expected to increase with the pace of the economic development of the country for various applications in medicine, industry, agriculture,

research and education. Until 2011, there was only scanty information regarding the quantity of nuclear materials as well as the number and category of radioactive sources in Uganda. An inventory was carried out to establish a national registry which activity was completed in 2018.

There have been incidents of orphan and disused sources out of regulatory control ending up in unauthorized possession. This poses a nuclear security threat in the country that required to be addressed through the establishment and implementation of nuclear security systems and measures. These nuclear materials and radioactive sources if not managed safely and securely protected, pose high risk to human health and the environment. The implementation of nuclear security systems requires the commitment of the state and the involvement of several government institutions at different levels with responsibility for national security. The physical protection of nuclear facilities and nuclear materials in Uganda is considered to be an integral part of nuclear safety. Currently, there are no nuclear installations Uganda. However, with the envisaged plan of considering nu- clear power in the national energy mix and due to the pace of the socio-economic development of the country, nuclear installation are expected to crop up soon or later. This creates a dare need to establish a comprehensive national nuclear security infrastructure for the country. The existence of such facilities demand that Uganda should establish commensurate and appropriate nuclear security systems to protect and control radioactive sources and nuclear material amidst the numerous challenges that could be encountered at the facility and national levels. This is due to the fact that there are a number of reported cases where radioactive sources have fallen out of regulatory control. These cases arose from failed nuclear security systems largely at the facility level. The country's efforts to establish an effective and sustainable national nuclear security regime for the security of radioactive materials and to establish national nuclear security infrastructure related to nuclear and other materials out of regulatory control are encountered by a diversified range of challenges from facility to national level.

Key words: Nuclear security, Systems, Radioactive sources, nuclear materials

Abstract ID : 234

Radioactive Source Security in Nepal: Status, Issues & Challenges

Adhikari, K.[1]

[1] National Academy of Medical Sciences, Bir Hospital, Nepal

Corresponding Speaker: K. Adhikari

Radioactive materials are mainly used in the medical field in Nepal. Small quantities of low radioactive materials are used in research and education. Radioactive sources are also used in calibration of equipment at some institutions. In 2006, 2010 & 2016 Ministry of Education, Science & Technology (MOEST) has completed three projects on inventory of radioactive materials being used in Nepal. Study was designed to find out actual number of radioactive sources which includes date of installation and source number.

As a member of IAEA, the responsibility of Nepal has increased many folds. The UN Security Council Resolution 1540, which is binding on all member states, contains obligations regarding ac- counting and physical protection on nuclear materials as well as commitments to prevent trafficking in weapons-related material and their delivery systems. Radioisotopes in hospitals, academic institutions, research laboratories etc in Nepal comes under different categories as per the Technical Document TECDOC-1344 of IAEA. Now, it is the time for establishing a radiation regulatory body for developing and monitoring of essential Nuclear Security and in the country.

Though, Nepal still do not have any regulatory body or regulation on Radiological Security. But Ministry of Science & Technology (MoST) has issued Nuclear Materials Regulatory Directive on 2015 to manage radioactive materials. Under this Directive there is one ad-hoc regulatory body to manage all nuclear related activities.

As a first step towards securing the radioisotopes in Nepal, Physical Security system has been installed with the help US DOE Office of Radiological Security (ORS) formerly known as Global Threat Reduction Initiative (GTRI) at all category 1 sources. But, still there are a lot of challenges in securing radioactive sources like proper rules and regulations, qualified manpower, maintenance of security equipment

Abstract ID : 285

Security of Radioactive Sources; Gaps Analysis and Recommended Actions

Alzyoud, A.[1]

[1] Jordan

Corresponding Speaker: A. Alzyoud

Radioactive sources are widely utilized today in many fields such as medicine, agriculture, industry and educational institutions. While these sources are utilized for peaceful purposes and are of great benefit that can pose a serious threat if they fall into the wrong hands; they can be exploited to make a dirty bomb because of its high negative impact on the economy and stability of countries. This paper examines the gaps and reasons that may have a direct or indirect impact on the security of these sources in the facilities they use. It also provides an analysis of the factors that contribute to undermining the effectiveness of the physical protection system installed at these facilities. Finally, the paper recommends number of measures that, if followed, can reduce the likelihood that these sources being exposed to acts of sabotage or theft. This paper isn't related to any particular facility or country nevertheless it's an attempt for a better understanding of how possibly the security of radioactive sources worldwide can be strengthened.

The facility policy that utilizes radioactive sources could be one of key foundations stones in in- creasing the effectiveness of security of these radioactive sources. The general policy of the facility should integrate the nuclear security policy as part of its overall policy this means assuring that nuclear security is crucial for the safe and secure operation of this facility. If clear policy doesn't exist in the first place or doesn't give attention to nuclear security issues, this will result a lack of commitment to assign adequate financial resources for an effective protection of these sources from theft or sabotage for example or lack of motivation for nuclear security culture enhancement. The regulatory body shall improve competent human resources that are capable of assuring that these facilities comply with its regulations and instructions. In many cases, the regulatory body isn't yet well developed to regulate to radiological activities and this is a key issue of undermining the security of radioactive sources. The difference in knowledge and experience can be indirectly an influence; more clearly, the institutions that play a role in nuclear security directly such as the nuclear operator or regulator can have a more profound understanding of the threats to radioactive sources more than the other medical or industrial institutions that utilize the radioactive sources.

The level of nuclear security culture of the institutions can be initially dependent on the overall nuclear security culture of the country. This means that some countries need more efforts in developing its nuclear security culture than other countries. Nuclear security culture enhancement requires time, persistence and efforts. One of the factors that could lead to a poor physical protection system performance is the many users of some facilities such as the medical sector. In some hospitals, dozens of patients and clients visit the medical clinics that use radioactive sources for diagnosis or radiotherapy, which indirectly leads to distraction of staff to prioritize the nuclear security issues. Moreover, the absence of nuclear security incidents in the past may establishes the belief of its users that there is a low probability of these sources being subjected to attacks of theft or sabotage.

One of the basic pillars of increasing the effectiveness of nuclear security is to ensure the existence of a unified policy that emphasizes the commitment of the state to nuclear security and reflects this policy on the policies of its institutions. To allocate the necessary human and financial resources for the regulatory body in order to ensure that the institutions comply with nuclear security requirements. To work progressively to promote the culture of nuclear security for the medical and industrial sectors and to ensure that the staff of these facilities has established the belief that the radiation sources may be subject to real threats.

Abstract ID : 191

Radiological Security Considerations in Areas Lacking Infrastructure, Reliable Power, and Resources

Pitts, C.[1]**; Sweeney, D.**[1]**; Wilson, S.**[1]**; Mui, S.**[1]

[1] Lawrence Livermore National Laboratory, USA

Corresponding Speaker: D. Sweeney

Issue – Utilizing technology-based Physical Protection Systems (PPS) poses challenges for some radiological facilities around the world. Lack of supporting infrastructure, reliable power, and resources can make for an extremely difficult and challenging environment to design, install, validate, and sustain a PPS that is reliant on advanced technologies. Installing and maintaining these advanced technologies also may not align with the priorities of site personnel. In these environments, site management teams may view high-tech systems as a significant burden that diverts resources away from many of their operational and programmatic priorities.

Typically, modern PPSs integrate high-tech systems and response forces to achieve a model that is based on three key components: detection, delay, and response. These elements must work together to defeat adversary attempts to infiltrate a denied area and complete a specific task, e.g., theft or sabotage of valuable target material, where the consequence of failure is unacceptable. These PPSs are costly to install and maintain and require a skilled and trained work force to sustain them. To preserve effectiveness over time, these systems also require effective assurance programs to ensure that the systems are functioning properly and performing as designed.

Even at well-resourced sites with continual testing, maintenance, and periodic validation exercises, these systems have been known to fail, allowing significant security incidents to occur. A similar strategy and security system in lower-resource environments is less likely to achieve and sustain an acceptable level of effectiveness, and in some circumstances getting an initial system functioning may be elusive, even after years of effort.

Solution - In environments where infrastructure or resource limitations exist, less reliance on electronic alarm security systems and greater emphasis on low-tech but robust systems may prove superior to the use of advanced technologies. There are several advantages for using low-tech solutions at specific locations. Delay features such as large concrete barriers, jersey bouncers, concertina wire, razor cages, cut resistant cables, A/B locks, and cages present a visible deterrent effect and can prove highly effective with the addition of a trained response force conducting security patrols and inspecting the security of facilities and the integrity of locks and other security features. These features are inexpensive, easily manufactured (often locally), and often require very limited recurring cost for maintenance. These security features can be installed in an expedited timeline as compared to more technology-based systems. Another key element is that these features require only limited training to operate and maintain. Finally, low-tech security systems that are integrated seamlessly and that require a limited amount of maintenance, highly trained technicians, and recurring costs are likely to be viewed and supported more favorably than systems compete with other key mission priorities for resources.

In these environments, additional emphasis should be placed on the response force (RF) because they will be responsible to provide an increased level of detection around the site and key facilities. The RF will conduct regular (although unpredictable) security patrols around the site and priority target facilities. Based on the threat level, the RF may be directly assigned to high-priority facilities. The RF organization (management and RF personnel) should have standardized training and be equipped commensurate to their duties and responsibilities. Even at locations where the RF is not equipped with firearms, the RF should have the requisite equipment (radios, binoculars, flashlights, etc.) to effectively respond to an alarm, establish a containment position, observe and accurately report critical information about the number of perpetrators, their descriptions, activities, equipment, and other pertinent information. Based on the environment, increased emphasis should be directed toward the access control of vehicles onto sites. Proper RF training in vehicle searches and the deployment of low-tech vehicle barrier or denial systems (drop gates, stop sticks, spikes etc.) to deny adversary egress should be emphasized.

To ensure a sustainable system is installed based on factors on the ground, there is a need for an initial site and infrastructure assessment to be conducted. An approach to assessing and implementing these measures will be presented.

Abstract ID : 297

Enhancing of Detection and Prevention Measures of Nuclear and Radioactive Materials in Libya

Abbani, B.[1]; Arrehebi, S.[1]

[1] Atomic Energy Establishment / Nuclear regulatory Office, Libya

Corresponding Speaker: B. Abbani

Effective nuclear security requires a sequence of multi-processes aiming to prevent of, detection of, and response to, theft, sabotage, unauthorized access, illegal transfer or other malicious acts involving nuclear materials, radioactive sources and their associated facilities.

For the purpose of achieving a reliable level of security, a continued reports of illicit trafficking in nuclear and other radioactive materials are required to demonstrate the needs for a given States to address their nuclear security. Nuclear security must also adapt to the potential threat of nuclear terrorism.

To enhance the ability of combating these potential threats, a multilayered defence that includes robust prevention, detection, and response elements is needed. This paper presents the status of nuclear security by identifying the security gaps in place of three different locations (cases) in Libya say: Tripoli Central Hospital (TCH), Tajoura Nuclear Research Center (TNRC), and Natural Uranium Storage in Sabha (NUSS). Site TCH utilizes radioactive sources in diagnostic and radiotherapy, TNRC operates nuclear research reactor and critical facility both fuelled with Low Enrichment Uranium (LEU), in addition TNRC utilizes a cobalt unit for irradiation purposes, while NUSS site contains a yellow cake storage.

The results shows that the level of detection and prevention in these three places is weak, the suggestion of implementing some security measures for the purpose of enhancement were proposed.

Abstract ID : 122

New Approach to Securing Radioactive Materials

Ramakumar, K. [1]

[1] Department of Atomic Energy (Retired), India

Corresponding Speaker: K., Ramakumar

Radioactive sources provide great benefit to humanity, primarily through their use in agriculture, industry, medicine, and research and the vast majority are used in well-regulated environments. However, inadvertent or otherwise loss of control could result in accidents of which some had serious consequences. Also one has to be concerned about terrorist or criminal groups gaining access to radioactive sources and use the sources maliciously. Consequently, there has been a global trend towards increased control, accounting and security of radioactive sources to prevent their malicious use. Recent nuclear security summit communiques also stressed this important aspect. Given the fact that radioactive sources are readily available all over the world, assuring a certain minimum level of radiological security is an important task. A paradigm shift in our approach both in terms of technical, administrative /managerial response is called for as country specific approaches to the security of radioactive sources have their own challenges depending on the extent of usage and a variety of country-specific factors.

A very good opportunity exists for establishing a mechanism to account for the other radioactive material in a State. Custodians may be required to maintain their inventories in terms of radioactivity and not the number of sources, certified by the regulatory agencies from the date of procurement and thereafter on annual basis may be worked out. The information may be shared with the IAEA for transparency to demonstrate State's commitment to nuclear security. Special attention should also be directed at securing high-risk radioisotopes such as cobalt-60, caesium- 137, plutonium-238 and americium-241 require highest safety and security standards.

One important thing to note is so far emphasis has been on having database on either missing or orphaned radioactive sources. But that does not necessarily get translated into the total inventory. The information on the inventory and its periodic verification (after taking into consideration the reduction in the quantity due to radioactive decay) is desirable to fill this important gap. The modalities such as the custodians of this information, periodicity of verification and information sharing with appropriate agencies (both national and international) etc. will have to be worked out.

Abstract ID : 69

Fostering Synergy of Security of Radiography Sources and Radiation Safety in Industrial Applications

Ramamoorthy, N.[1]

[1] Bhabha Atomic Research Centre (BARC), Mumbai (retired)

Corresponding Speaker: N. Ramamoorthy

Applications of radiation are of high interest worldwide and continue to grow in a variety of fields including industry, medicine, research and education. By and large, safety and security of the radioisotope (RI) and other radiation sources involved in such applications are well managed by the stakeholders and national authorities. It is not however uncommon to face challenging situations, be it by the licensee, operators, regulators, or other stakeholders. Two generic cases are discussed in this paper, the first emerging from a gamma radiography incident, and the second arising due to avoidable inappropriate claims of technology advocates and commercial competition. Among the sources commonly encountered in radiation applications, especially, in industrial domain, high-intensity sources, mostly of 192Ir, 60Co, and also of 137Cs, are popular in industrial radiography (IR) and other radiation technology (RT) procedures. By the nature of many industrial practices and procedures, IR use is more common in field work, including in open-site, construction area conditions, and also often involve late hours working including over-night operations. The category of need-based field applications often pose challenges in following the required procedures for ensuring security and safety of RI sources. Further, it is known that industry owner, or a major contractor at an industrial site, would engage many contractors to work, including IR service providers. The operating radiation worker at such site(s) may invariably encounter work pressures from the employer, as well as due to local demands of the entity whom they are serving. In one such instance, there was a work-pressure-triggered inappropriate use of an RI source for a radiographic study at night resulting in radiation overexposure to the main technical staff at site. The traditional root-cause analysis (RCA) of the incident revealed that the basic procedure of ensuring secured access to RI source, which is a requirement to comply with code of conduct of security of radioactive sources, would have prevented this incident of personnel over-exposure. The lesson learnt has been suitably shared with IR fraternity with a view to further strengthening the procedures and practices (SOP), as adhering to the basic measures of securing radioactive sources, such as, locked storage area, access control, will preclude scope for improper or unauthorized use of RI sources at open sites. There is another more important realization from the above RCA. The IR service provider is invariably a registered entity (license holder) with national radiological safety regulatory agency, and in turn, subject to commitment of compliance with existing stipulations of security and safety. However, the entity engaging the radiation-related service provider (called ‘contract-awarding-party (CAP)’ in many cases) has no direct obligations in most cases (if not in all cases) to the radiological safety regulatory authority and to the nuclear security enforcement authority (as there may be different entities in some countries). A corollary lesson is the need for insistence by the IR company, despite any challenge faced due to the site conditions, in availing of suitable secure site for storage of the radiography source containing equipment (radiography camera in this case). The situation gets further complex, when one of the sub-contractors engages the services of the IR company (and not the major contractor or owner of the industry), because it could lead to a larger divide of responsibility for ensuring secure and safe radiation practices at the site. This types of disconnect between the radiation service 'recipient' (non-regulated entity, in most cases) and 'provider' (regulated entity) will naturally endanger both security of RI sources and radiation safety practices. This aspect can be better addressed with the help of an enabling provision to be issued, preferably by the national regulatory authority(ies), in terms of certain specific requirements to be met by end-users requiring to avail of industrial radiography services, or to avail any other form of radiation technology (RT) services (for example, industrial radiotracer study, sealed sources based techniques like gamma column scanning), by the main CAP or any of the sub-contractors. This can be implemented in the form of a binding undertaking - template of statements (to be drafted with the help of professional experts and cited in manuals/guides) to be mandatorily executed by the CAP while engaging IR and other RT services. The bottom line is to enhance the degree of understanding, as well as to enforce accountability cum responsibility to be held for source security and safety by the different stakeholders involved in availing of IR and other RT services. The second case is based on author's observations noticed during advocacy on the choice of radiation source for RT/IR use, namely, gamma radiation from radioisotopes (RI sources) or X-rays from machine-based systems. Due to attached commercial interests, marketing practices by industries often present conflicting claims to the end-users requiring services. Consequently, this has been a referral item to expert consultants and also finds place in many a professional forum for debates. The apparent trend is to overplay RI sources related security risks to claim superiority for the alternate systems, although it is known that international practices of nuclear security measures include inter alia various elements and features covering both options of radiation sources and are thus technology neutral. The need is to urge and foster responsible practices in radiation technology advocacy by the concerned industries. The fact that security of RI sources can be technologically, as well as managerially, well-handled wherever RI sources are required, should not get ignored. The modest infrastructure needed and ruggedness of operation of Cobalt-60 source-based radiation systems (radiography cameras in industries, plant construction sites, etc.; gamma radiation processing plants) are well documented. X-ray units have their own merits similarly documented, while they, especially the ones of variable energy and power, require high-quality power supply infrastructure at the user site, especially for functioning over sustained, long-periods at open-site/field conditions. Assured availability of high-quality power supply is a known issue in many (developing) countries, especially in non-urban areas. National policy makers and end-user stakeholders, including corporate executives, should not therefore have to face an equivocal picture due to competing and conflicting claims by advocates of technology options, but be able to avail of appropriate technical guidance and support in this context. The global experience in dealing with stakeholders covering different industries using radiation applications, has shown the importance of objective, frank analysis of every specific case and of conveying factual information in an unequivocal language. This would lead to a better understanding of the various aspects and factors to be addressed. A technology-neutral approach is imperative to facilitate delivery of the benefits of IR/RT for national industrial development. This is deemed necessary to let the considerable merits of radiation applications being harnessed by interested countries to meet specific national needs and priorities, without compromising security of RI sources and radiological safety.

Abstract ID : 178

Detection of Nuclear or other Radiological Materials out of Regulatory Control as Criminal/Unauthorized Threats to Major Public Events

Buntman, S. [1]**; Maurer, R.** [1]

[1], National Nuclear Security Administration, Department of Energy, USA

Corresponding Speaker: S., Buntman

Abstract

Major Public Events (MPEs), by their nature, draw great public interest and receive intense media attention. They can be anything from sporting events (e.g., Olympics/World Cups) to political summits to large festivals. The threat of nuclear or other radiological of materials out of regulatory control (MORC) during these events is of particular concern. A terrorist could use this material as a dirty bomb to disperse radioactive material in a stadium, or hide dangerous radioactive sources in a garbage can to expose people to harmful radiation, leading to fear and uncertainty. The requirements for MPE security, preparedness, and operational capabilities for nuclear/radiological detection have increased steadily in recent years. Additionally, the International Atomic Energy Agency (IAEA) provides guidance for the detection of radiological materials out of regulatory control through the Nuclear Security Systems and Measures for Major Public Events, IAEA Nuclear Security Series No. 18.

Introduction

The United States Department of Energy/National Nuclear Security Administration (DOE/NNSA) works to reduce global nuclear dangers by engaging countries and advancing capabilities to pre- vent, counter, and respond to nuclear and radiological proliferation and terrorism threats and incidents worldwide. MPEs are attractive to terrorist groups because they have a political or symbolic importance and present an opportunity to inflict mass casualties. An attack with a radiological device, a so-called "dirty bomb" or a radiological exposure device, would cause panic and disruption. Due to this threat, DOE/NNSA and the IAEA have cooperated to provide nuclear security support for countries hosting MPEs since 2006. This support includes specialized training, detection technologies, technical and advisory support, and assistance with procedures to support national infrastructures to detect and respond to criminal and unauthorized activities involving nuclear or other radioactive materials out of regulatory control. The Competent Authority should be prepared to provide the appropriate detection and adjudication capabilities for deterrence and detection of potential nuclear/radiological threats.

Expert Technical Assistance from the Competent Authority

One of the key considerations to effective planning and response is radiation detection equipment. The equipment may consist of various instruments from radiation pagers to backpacks to vehicle mounted detection systems. Not all MPEs are equivalent, and planning will vary based on the potential threats, size, audience, media coverage, public perceptions, international awareness, and politics. The actual setting or venue also varies and impacts planning, detection set up and procedures, and nuclear security response measures. Each setting presents unique challenges and may require specialized training, technical support, and a specialized security assessment to determine the appropriate security measures. DOE/NNSA and IAEA offer training courses, technical, and advisory assistance that focus on nuclear security measures for MPEs. The courses are interactive and include hands-on training on detection equipment as well as field exercises with radiation sources in the event venue or similar venue. DOE/NNSA also offers the potential for technical and advisory assistance; such as detection equipment to augment the Host Countries capabilities, an advisory team to support nuclear security measures; and technical reachback capabilities that can be provided at the request of the Host Country or via the IAEA.

Practical Experience DOE/NNSA and the IAEA have provided nuclear security support for countries hosting MPEs since 2006. This support includes specialized training, detection technologies, technical and advisory support, and assistance with procedures to support national infrastructures in order to detect, and respond to criminal and unauthorized activities involving nuclear or radioactive materials out of regulatory control. The IAEA, in cooperation with Member States, has been working to develop guidelines based on best practices and lesson learned from previous events. Based on these best practices, DOE/NNSA experts that have provided valuable assistance at international MPEs will share their practical experience for the detection of nuclear or other radioactive materials.

Summary

Nuclear security requirements for MPEs have increased significantly in the last decade. Specialized training and detection equipment are available to assist Host Countries in preparing for and enhancing their security posture. The detection of nuclear or other radiological materials out of regulatory control as criminal/unauthorized threats to MPEs is of great concern to countries hosting MPEs. One of many lessons learned is that the nuclear security detection architecture requires interagency cooperation, especially among law enforcement personnel whose work areas may not normally overlap.

Abstract ID : 235

Detection of Radioactive Material in Public Places: Handheld Tele Radionuclide Alarm Device (Tele-RAD)

Jain, V.[1]**; Jain, R.**[2]

[1] ICLES College of Science, Arts and Commerce and La Vastu labh Pvt. Ltd., India; [2] Bhabha Atomic Research Center (BARC), India

Corresponding Speaker: V. Jain

Radioactive sources like Co60, Cs137 etc. with high levels of radioactivity, because of their long life and relative ease of availability, have the potential of being used in radiological dispersion devices (dirty bombs) for panic creation in public places. Looking to the need of the hour, an indigenous, low cost, compact and portable system for detection of radioactive nuclides has been developed. The unit comprises of a compact CsI detector, photo diode and front-end electronics, micro-controller, a GPS module and Blue-tooth connectivity. The application software running on the mobile phone (Android based) provides the interface as well as transmission of data to remote server. This is highly suitable for covert operations. The person, who carries this instrument, suitably camouflaged, also has a mobile phone in his pocket, which is connected to the system via blue tooth. On detection of activity above set limit by the Mobile App, the system generates an alarm (vibration or sound, as per settings) in the mobile phone. The mobile phone can be kept in vibration mode in order to avoid any undue attention. The graphical display on screen of mobile phone provides an indication of activity and the isotope identification. Simultaneously, the mobile phone sends information about the activity detected and source identification automatically along with the location of the instrument (longitude and latitude), provided by the GPS module in the instrument, to a remote server and to multiple designated control room numbers. The remote server provides radiation information on a map with position-coordinates. Based on this, necessary action can be initiated by the security personnel at central control room.

This paper details motivation for designing this system, new approach of radio isotope detection, display and identification of Mobile based Tele Radionuclide Detector System.

Key words: Radionuclide Detector System, Photo Diode, GPS module, Bluetooth Communication

Abstract ID : 261

Georgia Lessons Learned from Deploying Detection Operations in the Interior: Strengthening the National-Level Nuclear Security Detection Architecture

Adams, G.[1]; Makharadze, D.[2]; Volski, S.[3]

[1] Pacific Northwest National Laboratory, USA; [2] State Security of Service of Georgia; [3] Culmen International, USA

Corresponding Speaker: D. Makharadze

Georgia has supported the long-term operation of detection systems and measures at major points of entry and exit as part of the national-level nuclear security detection architecture (NSDA) for the detection of criminal or unauthorized acts with nuclear security implications involving material out of regulatory control. In addition to designing and deploying systems and measures at Georgian borders, systems and measures for detection materials out of regulatory control within Georgia have also been implemented. The paper will highlight the motivations driving the decisions to implement detection operations in the interior. Detecting materials out of regulatory control in the interior poses unique considerations for the design, implementation, and long-term sustainment of such systems.

'This paper will highlight good practices and lessons learned by the competent authorities, including law enforcement and expert support, for detection operations in the interior as part of Georgia's national level approach to an effective NSDA. General considerations for how and when to de- ploy operations in the interior will be discussed, including threat and risk-informed approaches to create flexible operations using different equipment configurations (including mobile vans, handhelds, and backpacks) and the importance of establishing an information sharing network to al- low for timely action regarding information driven detection operations. Challenges and lessons learned will be shared that relate to planning operations, including establishing concepts of operation, standard operating procedures, and technically sound system designs; considerations for the initial assessment of alarms and alerts and the importance of working with expert support; the importance of drawing upon institutional knowledge from Customs/ Border Security deploying operations at State borders, and approaches (using exercise) for incorporating detection operations in the interior into national-level detection coordination efforts.

This paper will be structured into sections. The first section will include an introduction and summary of the paper's major points. Section two will include a discussion of the considerations for deploying detection systems and measures in the interior, including how operations in the interior complement the national-level architecture and strategy. The third section will review the planning process including the competent authorities involved; section four will discuss lessons learned from deploying the systems

and measures. Section five will discuss strategies employed for the long-term operation, maintenance, and evaluation of the systems and measure. And finally, section six will provide a conclusion highlighting on-going cooperation with national, regional, and international organizations.

Abstract ID : 267

Nuclear Security Measures in Tunisia :Prevention and Detection Systems

Slimani, A.[1]

[1] Civilian Protection, Tunisia

Corresponding Speaker: A. Slimani

Introduction

The risk of nuclear material or other radioactive material being used for malicious acts remains real and should be considered as a serious threat to peace and security. The responsibility for nu- clear safety rests entirely with each State. The appropriate and effective national nuclear security system is essential to facilitate the peaceful use of nuclear energy and strengthen efforts to combat nuclear terrorism. Tunisia is preparing to face this global threat in a sustainable, effective and comprehensive manner.

Nuclear Safety and Security

Tunisia has more than a thousand radioactive sources ranging in activity between low and very that are in various peaceful activities such as in health, environment, agriculture, industry and scientific research. Moreover, there is always the possibility of building nuclear power plants to generate electricity in the future. This requires strengthening the nuclear safety and security procedures and human capacity building to have well qualified personal who will bear the responsibility of the proper, safe and secure use of nuclear energy for a sustainable development.

Great efforts are therefore required for the development of the needed capacity and infrastructure in the field of nuclear safety and security of radioactive sources to ensure a high level of security of radiological and nuclear installations. which are the responsibility of the state, and to prepare adequate regulations and control of any practice involving radioactive and nuclear sources.

Legislative and regulatory framework in Tunisia

Treaties and conventions ratified

Convention on the Physical Protection of Nuclear Material (in force since May 1993).

Amendment to the Convention on the Physical Protection of Nuclear Material (CPPNM)

Conventions on early notification of a nuclear incident and on assistance in the event of a nuclear accident or radiological emergency (in force since March 1989).

Convention on Nuclear Safety (in force since July 2010)

Treaty on non-proliferation of nuclear weapons (Law no 70-5 du 03/02/1970).

International Convention for the Suppression of Acts of Nuclear Terrorism (Nuclear Terrorism Convention) (September 2010).

Comprehensive Nuclear-Test-Ban Treaty (ratified in September 2004).

The Conventions or agreements signed

Protocol Additional to the Safeguards Agreement concluded between Tunisia and the IAEA

International Convention against the Taking of Hostages (June 1997)

Convention on the Prevention and Punishment of Crimes against Internationally Protected Per- sons, including Diplomatic Agents (accession January 1977).

The Conventions or agreements that Tunisia must adopt

the conventions on civil liability for nuclear damage of 1963

The convention on the safety management of spent fuel management and radioactive waste safety

Other relevant instruments

Tunisia has expressed its support for the Code of Conduct on the Safety and Security of Radioactive Sources and will refer in the new legislative and regulatory framework to "International Standards Adopted by the International Atomic Energy Agency" in the area of nuclear safety. Tunisia also applies the principles of the Guidance on the Import and Export of Radioactive Sources and has designated the appropriate National Contact Points.

The Tunisian legislative and regulatory nuclear security framework is based on three main acts which, although on the subject of radiation protection, have a direct bearing on the implementation of security standards.

Tunisian laws and regulations relating to nuclear safety

Since 2008, a national group of experts representing all the technical institutions and department There are currently no regulations or legal provisions concerning nuclear security. Regulations

The drafted comprehensive nuclear law includes also the establishment of the National Commission for Nuclear Safety that will carry out regulatory functions in accordance with international standards, and related conventions.

This commission will be an independent regulatory body tasked with ensuring to take all necessary measures. This aims to ensure the safe, secure and safeguarded uses of nuclear energy and techniques in order to ensure the protection of facilities and activities, radioactive sources, individuals, property and the environment in line with the international obligations of Tunisia, especially in framework of the Convention on nuclear Safety.

Prevention and detection

V.1 Organisations involved in radiation monitoring at borders :

The National Commission for Atomic Energy (CNEA)

The National Atomic Energy Commission (CNEA) is under the authority of the Prime Minister and comprises members of various ministries and national institutions. Established in 1990 and modified by Decree No. 95-2566 of 25 December 1995, it is responsible for: the development, promotion and implementation of nuclear technologies, methods and instruments in the country in the areas of agriculture, industry, electrical power, the environment and medicine; the implementation of fundamental and applied research programmes in nuclear technology-related sciences; and the overseeing of technical cooperation programmes, especially with the IAEA. The CNSTN provides the Commission's permanent secretariat.

National Commission for Radiological Protection

it is responsible to provide preventive measures and intervention in cases of radiological risks and to make establishing and maintaining response plans according to the nature of accidents or emergencies that may have radiological consequences. The CNRP is the permanent secretariat of the Commission.

National Commission for Management of Disasters

The Permanent National Commission is responsible for developing the National Plan against calamities, prevention and rescue organization and follow its implementation. The Interior Minister is the chairman of this commission. Civil Protection is the permanent secretariat of the committee pre- pares and coordinates its work

National Center of Radiation Protection (CNRP)

Established in 1981, CNRP acts as the regulatory authority at the national level for all matters relating to the use of radioactive sources and nuclear facilities for industrial, research and medical applications. It is under the authority of the Ministry of Health

National Center for Nuclear Sciences and Technologies (CNSTN)

Pursuant to the provisions of Law No. 93-115 of 22 November 1993 on its establishment, the Centre's remit is to conduct peaceful nuclear research and studies in various areas and to specialize in nuclear technologies and their development and use for the purposes of economic and social development, especially in the areas of agriculture, industry, energy , the environment and medicine, and in general, to carry out any activity aimed at the development of nuclear science, the promotion of its various applications and assimilation of nuclear technologies for peaceful purposes.

The Centre, which is under the authority of the Ministry of Higher Education and Research, is

General Directorate of Customs

The General Directorate for Customs (DGD), a State service attached to the Ministry of Economy and Finance (MEF), is responsible for implementing and enforcing the legal and regulatory pro- visions pertaining to the movement of persons, goods, vehicles and capital entering and leaving the country. Tunisia's customs service has three functions: a fiscal function (collection of customs duties, taxes and excises), an economic function (protection and promotion of national industries and agricultural resources) and a security function (protection of the interests of the State and citizens by controlling the circulation of goods and capital).

As such, it is responsible for customs controls and monitoring at airports and borders, and for judicial proceedings in cases of fraud or circumvention of customs regulations. The customs services operate continuously at airports, ports and border crossings.

National Office of Civil Protection.

An industrial and commercial public institution with financial autonomy and legal personality,

IAEA Incident and Traffic Database

Tunisia has been participating in the IAEA Incident and Trafficking Database (ITDB) since January 2007. It has never reported an incident to the ITDB

Prevention

In coordination with various parties involved in the protection of radiation and nuclear hazards, the National Center for Radiation Protection :

Identify and assess targets, which include strategic locations, based on potential consequences, which require protection from threats at least 13 sites using sources (category I) have been identified - Classify enterprises and establishments according to the category of sources used

Take adequate safety devices for relevant facilities that have contained nuclear or radioactive material, which may pose a risk to nuclear safety.

Determine the need for help and support

Establish a central storage center for radioactive materials are not used, orphan sources and seized materials

With the assistance of the International Atomic Energy Agency, our country has reviewed the level of the physical security approach of the main facilities, taking into account the IAEA's regulatory requirements and recommendations.

Detection

The importance of effective border control measures cannot be overemphasized as a means for reducing the potential for illicit trafficking in nuclear and radioactive material. The goal is to prevent this material from falling into the hands of terrorists or criminals. The emphasis is on detection, identification, interception and investigation of illegal transfers of material.

Tunisia has not yet developed a unified national strategy that takes threat assessment into consideration for the detection of criminal or unauthorized acts with nuclear security implications, involving nuclear or other radioactive material not under regulatory control. Our country should develop a national strategy for the detection , This strategy aims at the establishment of nuclear security systems and measures at all appropriate levels of organization to detect and assess nuclear security events and inform relevant competent authorities so that appropriate response measures can be taken.

Until now each service involved has developed its own strategy based on an analysis of the risk

VIII Design Basic Threat

An assessment of the general threats has been carried out but it does not explicitly cover the Initial Assessment of Alarms and Alerts and procedures The goal of the initial assessment is to determine whether the alarm or alert indicates a possible nuclear security event

Nuclear security event is an event that has potential or actual implications for nuclear safety and that must be addressed

An instrument alarm or information alert will lead to an initial assessment

Proper procedures and protocols must be in place for a prompt determination of potential threat , these Procedures and protocols may be different for alarms and alerts

At the border customs have an internal procedure on what to do in the event of a seizure of suspect nuclear or radioactive material, but they have not been formalized. The detection and response procedures should be written up once the new regulations are in place and summarized as follows

- Use the detection equipment implemented at the duty station
- Respond to detection
- Perform secondary inspection
- Make basic decisions to release or retain (innocent, safe, secure)
- Take a basic decision to characterize the threat (no threat, activate the emergency response plan, inform the regulator) and secure the area if necessary.

A document is being prepared on the roles and responsibilities of organizations involved in detection activities and providing technical support (expertise) for detection at a border crossing.

In coordination with various parties , Customs will redefine and document the procedure to be followed by customs officers when detected at a border crossing.

they will modify the procedure currently in place (which requires a customs officer to contact the CNRP for each detection incident) by defining the decision criteria to be followed directly by the customs officer (for example, for each isotope that can be identified using the available equipment, defining a maximum dose rate at a given distance, below which the object that triggers the alarm can be released), so that the latter would only contact the CNRP in case of doubt or in cases that do not meet these criteria.

Since 2008 , we created mobile team specialized in the radiological interventions (CNSTN, CNRP

Equipment deployment plan

Tunisia does not currently have a national equipment deployment plan based on a defined national detection and response strategy. the Customs recognized the importance of and the need for establishing such a plan prior to the procurement of new equipment based on an analysis of existing and needed capacities, both in technology and expertise.

Up to now, equipment has been sent to the various border posts based on the scale of their activities. Consequently, a certain amount of radiation detection and radionuclide identification equipment has been donated either by the IAEA .

In total, 24 personal radiation detectors (PRDs) and three radionuclide identification devices (RIDs) were distributed to the various border monitoring services. Also, a portal monitor for vehicles was installed at Rades Sea port and commissioned by the IAEA in February 2008 .

The Tunisian Customs has launched a process of acquiring additional portable detectors to equip the border posts which are still deprived of them. Tunisia's customs service has taken charge of radiation monitoring at the country's borders Its goal is eventually to provide all official border crossings with X-ray scanners and radiation detection equipment, in order to ensure that all cargo being transported into and out of the count is screened.

Tunisia will develop a comprehensive national detection strategy based on a multilevel defence in depth approach, within the limits of available resources and taking threat assessment into consideration.

This strategy could include policies on the security of sensitive information, assign roles and responsibilities to the various competent authorities, and include international and regional collabo- ration and cooperation possibilities. Tunisia recognizes the need to establish protocols with neighbouring countries, particularly with regard to the exchange of information concerning the detection of illicit radioactive material at borders and response assistance.

Maintenance plan

At present, there is no national programme for the preventive and corrective maintenance of the radiation detection equipment in use that specifies the regular checks that should be performed and sets out a policy for replacing faulty parts or devices at the end of their lifetime.

The customs administration is responsible for the maintenance of the other equipment used by th

Conclusion

Tunisia is currently in the midst of a transition. It is carrying out an in-depth reform, notably the establishment of procedures to enable the police to react in the event of incidents involving radioactive material (seizures or radiological accidents).

Provide expert services to attend:

- develop a plan and procedures to respond to diversions of radioactive nuclear material
- implement this plan and these procedures
- test this plan to identify any inadequacies and verify its effectiveness
- Provide portable equipment to identify and characterize radioactive sources
- The implementation of the national nuclear security plan

Abstract ID : 268

Investigation of the Suspected Radioactive Contaminated Container at the Kribi Deep Seaport - Cameroon

Beyala Ateba, J.[1]; Simo, A.[1]; Moyo, M.[1]; Geumbou, S.[1]

[1] National Radiation Protection Agency

Corresponding Speaker: J Beyala Ateba

Given the potential growing of the illicit trafficking of radioactive material in the world, Cameroonian seaports inspect a large number of goods entering and exiting national borders. The Kribi deep seaport (in the South Region of Cameroon) is moving toward inspection of all containers crossing the sea borders of Cameroon. These inspections objective was to identify the most important research initiatives and the major policy issues that need to be addressed in order to improve security of imports and export using shipping containers, particularly against the unauthorized importation and exportation of nuclear and radioactive materials, and contaminated foodstuffs. Following the request of the Commander of Kribi deep seaport for the potential presence of the radioactivity in an export container, a fact finding mission was organized by the National Radiation Protection Agency (NRPA) of Cameroon. The process was triggered following two alarms obtained during two consecutive passages of the concerned container to the Radiation Portal Monitor (RPM) whose orders are held by TransAtlantic S.A. A team of experts from NRPA conducted a safety assessment mission around the said container.

The approach involves container isolation, dose rate measurement around the container (horizontal and vertical measurement by scanning), remote process approach (for reduction of the received dose), determination of the hottest points, identification of the source, opening of the container, sampling and laboratory analysis if necessary. The investigation began at the Radiation Portal Monitor command office and continued to the container by raising the dose values at several points of the container. Two situations were then observed when reading the measured data. Firstly, it was noted a distribution of dose rates with average values ranged between 0.06 and 0.14 μSv/h for the upper parts of the suspected container, and secondly an area consisting essentially of the base of the container where the dose rates ranged from 0.10 to 0.24 μSv/h. This last value, although lower than the public dose rate limit (0.5 μSv/h), is higher than the action level, which is three times the natural background. This finding motivated further investigations allowing the following conclusion: The material transported in the container FCIU3774607 subjected to the investigations was not radioactive. The radiation that triggered the alarm came mainly from sludge covering the base of the container. It should be noted that the planned nuclear security measures for the scanning of exports through a coupled system of the Sentry Portal Scanner and the Radiation Portal Monitor allow Kribi seaport to guarantee the export of uncontaminated foodstuffs.

This work identified a sample technical approach that is feasible technically and operationally and involves components already in the early deployment stage by the NRPA. A protocol of similar incidents in the future was write and documented in view of improving nuclear security at seaports in Cameroon. As for Kribi deep seaport perspectives will be a question of making arrangements for set up a mechanism to manage the illicit traffic of

radioactive sources and other nuclear material detected during scanning operations and put in place a mechanism for managing food and other consumer products with radioactive contamination, in partnership with the NRPA.

Abstract ID: 304

Systems for Detection of Unauthorised Movement / Illicit Trafficking of Radioactive Material

Saindane, S[1]; Pradeepkumar K.S.[1]; Murali, S.[1]

[1] Bhabha Atomic Research Centre, India

Corresponding Speaker: S. Saindane

Usage of radioactive material with less security during the field work in industrial applications could result in likelihood of an increase in malicious/adversary/terrorist act or other criminal organization could gain access to the material and develop expertise to design / construct any device to carry out malicious activity. From the Illicit Trafficking Database (ITDB) data, it is understood that such material will be of prime interest and can be viewed as threat based on malicious use. Prevention of any illicit movement of the material leading to malicious activity is very much important at the point of origin. The radiological risks associated with such potential malicious use need to be restricted and radioactive material needs to be protected against any illful activities by the application of appropriate radiation safety integrated with security aspects. During use of nuclear and other radioactive material in any facility, it should be ensured that material is not acquired / stolen by unauthorized persons or organizations. Hence rugged radiation monitoring systems are designed, developed and installed which can detect any incident of illicit trafficking of nuclear and other radioactive material.

These type of radiation monitoring system acquires data using an energy compensated GM detector, which provides radiation background data acquiring at a rate of two minute time interval, generates reliable data for radiation background measurements. Such radiation monitoring systems can be used as installed units and commissioned at places where nuclear and other radioactive materials under authorized conditions are fabricated / handled. The radiation sensors at the entry / exit points of the facility try to detect movement of radioactive materials that can be illicitly brought inside the facility or a person trying to smuggle the radioactive / nuclear material from a facility for malicious use. These detectors can also be used to detect any abnormal increase in the radiation background level at the facility. The methodology adopted by the system is in two modes of operation i.e., routine and emergency mode.

In the routine mode the most important objectives are:

to provide prompt warning in case of detection of source at entry/exit point to assess the normal radioactivity levels and their variability

Analysis of dose rate data acquired during the routine operation help in providing training to the staff engaged in the emergency preparedness and response. The system uses five different communication methods for data transfer to the control centre:

1. using modems under the local telephone exchange
2. using RS 485 technique
3. using GSM / GPRS modem (at the remote locations)
4. using local network (TCPIP)
5. By wire free (wi-fi) technology called zigbee based data transfer

These systems deployed at the entry/exit of nuclear / radiation facilities and can also be operated in Emergency mode to

- quantify the source term
- support dose estimations
- support decision making on protective measures required
- verify and document the efficiency of the protective measures
- provide input to and constraints for prognostic models, which are used to predict the developing radiological situation or to evaluate the efficiency and the consequences of potential counter measures

The systems deployed at nuclear power plant sites also acts as 'Radiation Early warning system' and the scenarios which are covered by the site surveillance system are:

1. Detection of any unauthorised movement of radioactive material from / in the site.
2. Incidents / accidents near or within the site leading to increase in radiation background.
3. Remote possibility of external events affecting the reactor operation / integrity of the reactor containment.
4. Unexpected high discharge through the stack / ground level of the nuclear power plant facilities.
5. Any abnormal event leading to rise in environmental radiation field.

This paper brings out the development work carried out in India for detection of illicit movement of radioactive or other nuclear material in and out of the facility by implementing the nuclear security and safety perspective at the facility. These systems are of low cost, allows the technology that is usage of telephone lines, local network or mobile to be widely deployed in and around the facility to control the movement of radioactive / nuclear source material. These types of systems can also be operated on external power supply viz., battery. The low power-consumption by the systems allows longer life with smaller batteries in case of power failure and the mesh networking provides high reliability and larger range. Moreover in the case of some eventuality of threat or deliberate acts there is a high probability that some or the other mode of detection mechanism may not work while these systems can be electrical powered to be functional on 24×7.

As a deterrent to the malicious acts, a self solar powered gross radiation monitoring sensors (environmental monitoring) has been installed across the vital locations, could lead to information in case of elevated radiation field is sensed by these installed monitors. Entry points to the country viz., sea ports, air ports and border/land crossing points have been installed with plastic scintillator based Limb

Monitors with radiological data feed to the control room. The units would be useful to confirm any suspicious movement of material at vital locations. Besides, the Mobile Radiation Detection System (MRDS) installed at Police patrol vehicles with pre-set alarm level, could be useful for location of the suspected site during any illicit material storage, fabrication of the device or during a post-event demarcation of zone at the affected site for access control. The police patrol teams have been planned to have hand held radiation monitors / sensors to map the radiological conditions prevailing at the suspected / event site. The response agencies viz., police and fire service personnel have been periodically sensitized and trained on response to any radiological emergency: on radiation safety aspects, minimize any radiological / environmental impact, segregation of material, waste management and consequences management. These radiation monitoring systems have been developed for the 23 DAE-Emergency Response centres, installed / deployed at vital locations to ensure detection and prevention, preparedness and response to any potential radiological consequences arising out of any illicit movement of radioactive material.

Abstract ID : 162

Strengthening nuclear security detection capabilities in Serbia

Janjić, V.[1]**; Velinov, S.**[1]

[1] Serbian Radiation Protection and Nuclear Safety Agency, Serbia

Corresponding Speaker: V. Janjić

Control of unauthorized and illegal traffic of radioactive and nuclear materials across the border of the Republic of Serbia is carried out at national border crossings. Direct control of unauthorized and illegal traffic of radioactive and nuclear materials is performed by Customs Administration (customs officers) using portable radiation indicators and stationary radiation monitors. Assistance to Custom Administation is provided by other state authorities, Border police, Serbian Radiation Protection and Nuclear Safety Agency and National inspectorate for radiation protection within the scope of their jurisdiction.

Through every day activities, it is recognized that current detection system should be upgraded

Abstract ID : 216

Developing a Secure Logistics System for Radiological Material

Singley, P.[1]

[1] Oak Ridge National Laboratory, United States

Corresponding Speaker: P. Singley

Moving radioactive material is recognized as one of the highest security risk activities that is routinely undertaken. The process of moving radioactive material, within or between states, is a complex process usually requiring the participation of many organizations both public and private. In addition to engaging many organizations, considerable data, some quite security sensitive, must be communicated between and amongst the organizations. There are numerous ways to enhance the security of cargo during transportation operations, but often the varied security systems, procedures, and processes do not work together with sufficient integration and communication to ensure an unbroken trail of accountability during the entire conveyance. Additionally, in a commercial setting determining which potential commercial partners provide appropriate attention to security can become an issue.

Considering the movement of radioactive material from the comprehensive position of an overall logistics system can provide some insights into improving overall security of radioactive material. Security enhancements can be gained by evaluating security, particularly the ability to detect potential security breaches, from the moment material is to be placed in motion at the origin of a shipment until it comes fully to rest at the destination. This approach expands security planning and evaluation beyond just the transportation component of monitoring materials to include the packaging and warehousing of materials at the shipping point of origin, repackaging and handling at intermediate at-rest/storage locations, and handling/storage at the shipping destination. In addition to the physical dimension just mentioned, the information transfers required to plan and protect a shipment require a secure information transmission and storage system.

This paper considers several security issues that must be addressed to implements a trustworthy logistics system and makes some recommendations on how practitioners can improve the security of their logistics systems. The foundations for these recommendations are formed by the basic trustworthiness evaluations employers are encouraged to perform on their employees. At the next level of evaluation security experts need to be able to evaluate the trustworthiness of organizations that may be employed to carryout aspects of a secure logistics system. Finally, the paper discusses the applications of some more global approaches to system-wide security and detection of security breaches like the application of chain-of-custody approaches that could provide end-to-end visibility of and accountability for packaged materials by seamlessly tracking all packages, and associated security information, from cradle to grave.

Abstract ID : 62

Research on the Use of New Tracking Technologies for Category 2 and 3 Radioactive Sealed Sources in Transport

Duguay, R.[1]; Hynes, C.[1]

[1] Canadian Nuclear Safety Commission (CNSC)

Corresponding Speaker: R. Duguay

ABSTRACT: Lost and stolen radioactive sealed sources may present a risk to safety and security as the source is out of regulatory control and could be used by malicious actors. The popularity of tracking devices is growing, and the technology is evolving, which creates new opportunities to enhance the security of the transport supply chain. The Canadian Nuclear Safety Commission is preparing a research paper to better understand benefits and challenges for licensees and regulators using tracking technologies for industrial radiography and well-logging applications. This study explores current and new tracking systems as well as international regulatory practices related to real-time tracking technologies for these industries. As part of this study, two surveys were distributed to Canadian licensees and international counterparts, including regulators, members of the World Institute of Nuclear Security and other relevant stakeholders to collect feedback, experiences and general stakeholder opinion. As a whole, this research paper intends to explore lessons learned from the industry perspective using tracking technologies as well as experiences with organizations developing or using new tracking technologies. The study will also identify some good practices for regulators in today's threat environment.

SUMMARY: This presentation will provide an overview of the survey results, share the comments received by the industry and identify key findings. The presentation will offer a reflection on the feedback received and the path forward with current and new tracking technologies used for industrial radiography and well-logging transport applications in Canada.

The primary objectives of this research are:

• To research the advantages, challenges, cost and benefits for the use and implementation of tracking technologies, as reported by Canadian licensees.

• To explore new tracking technologies that are being used, developed and implemented by other IAEA Members States and relevant regulatory practices, as reported by the CNSC's international counterparts.

The secondary objectives of this research are:

• To assess whether the requirements outlined in REGDOC 2.12.3 are fit for purpose in regards to the tracking of the transportation of category 2 and 3 radioactive sources.

• To research good practices related to tracking technologies used for radioactive sources during transport.

Abstract ID : 214

Best Practices for Safety and Security Interface in Transport Security

Devaney, M.1; Anderson, K.1

[1] Oak Ridge National Laboratory, United States

Corresponding Speaker: M. Devaney

The national Nuclear Security Administration (NNSA) and the International Atomic Energy Agency (IAEA) have partnered to address safety and security interface. This is being done through the development of a workshop that will be incorporated into the IAEA Transport Security training catalog for member states. This workshop will be used to encourage communication from both disciplines, safety and security.

Historically, the emphasis for transport of radioactive materials has been on safety, but now there is a recognized need to address security as an additional priority. While the safety record for the transport of radioactive materials has been very good, the threat of malicious acts, including sabotage is now more widely recognized. Safety and security both consider the risk of inadvertent human error, however security places additional emphasis on deliberate acts that are intended to cause harm. In the English language, there are two words that describe two distinct items, Safety and Security. In many other languages one word is used for both concepts. The purpose of this paper is to expand upon the nuances necessary to distinguish between the two concepts and explore best practices within the international radiological security. For this paper, the word security refers to precautions taken to protect against crime, attack, sabotage, espionage, theft, and other deliberate actions taken by an adversary against people, materials, and or other assets. The types of security to be explored in this paper include information/cyber, access control, physical security, personnel security and response.

Safety and Security both play a key role in the transport of radioactive material. While most of the time, the two disciplines work together, at times they could conflict. What can be done when this happens and how quickly these issues are identified can ensure success. Ensuring that all parties communicate is most important but also that procedures of both disciplines are followed. Safety and Security professional working together will ensure success. From placarding to emergency procedures, both disciplines should be addressed.

Safety and Security responsibilities and procedures can conflict at times. How is this addressed? In this scenario, addressing the interface between safety and security will ensure materials remain secure while in use, storage or transport.

Abstract ID: 319

ARG-US Remote Monitoring Systems for Enhancing Security of Radioactive Material

Liu, Y.[1]; Craig, B.[1]; Shuler, J.[2]

[1] Argonne National Laboratory, United States of America; [2] U.S. Department of Energy, United States of America

Corresponding Speaker: Y. Liu

The most recent IAEA General Conference resolution on nuclear security (GC[61]/RES/9) calls upon all Member States, within their responsibility, "to achieve and maintain highly effective nuclear security, including physical protection, of nuclear and other radioactive material during use, storage and transport and of the associated facilities at all stages in their life cycle." Resolution GC(61)/RES/9 also calls upon all States "to improve and sustain, based on national security threat assessments, their national capabilities to prevent, detect, deter and respond to illicit trafficking and other unauthorized activities and events involving nuclear and other radioactive material." The resolution further calls upon States "to enhance international partnerships and capacity building in this regard" and encourages States to continue efforts "to recover and secure nuclear and other radioactive material that has fallen out of regulatory control."

Argonne National Laboratory (Argonne) is a pioneer in using radio frequency identification (RFID) technology for the life-cycle management of radioactive materials (RAM) packaging [1–4]. Over the past 10 years, researchers at Argonne—with the support of the U.S. Department of Energy (USDOE) Packaging Certification Program (PCP), Office of Packaging and Transportation, Office of Environmental Management—have developed, demonstrated, and deployed ARG-US (meaning Watchful Guardian) remote monitoring technology that consists of two patented systems: (1) battery-powered RFID surveillance tags and fixed readers to monitor tagged RAM packages in facilities during storage, along with a portable CommBox to monitor tagged RAM packages in vehicles during transportation [3], and (2) a network of wired and wireless sensors that are the basis for Remote Area Modular Monitoring (RAMM) modules for monitoring critical fuel cycle facilities and a battery-powered Traveler for tracking and monitoring RAM transport conveyances [4]. Recently, Argonne researchers have also developed a conceptual design of a compact Type-B packaging for end-of-life management of disused radiological sources, with an attached ARG-US monitoring device to enhance security during storage, transport, and disposal [5]. Continuous surveillance using an ARG-US suite of sensors (e.g., temperature, shock, radiation [gamma, neutron], tactile seal) and their automatic alarms capabilities

should help prevent, detect, deter, and enable quick response to illicit trafficking and other unauthorized activities and events involving nuclear and other radioactive material. This paper will present highlights of recent cases that involve using ARG-US remote monitoring systems in storage facilities and during transportation. Also covered in the paper are the recent addition of digital cameras for the RAMM modules and their use in monitoring and surveillance of Argonne's Alpha Gamma Hot Cell Facility – a Category III radiological facility undergoing decommissioning and decontamination. Finally, summaries about training courses on the next generation of transport security of radioactive materials will be provided, along with lessons learned from the last five annual courses since 2013 [6, 7].

References:

Y.Y. Liu, S. Bellamy, and J. Shuler, "Life Cycle Management of Radioactive Materials Packaging," Packaging, Transport, Storage & Security of Radioactive Materials, Vol. 18, No. 4, 2007.

H. Tsai, Y.Y. Liu, and J. Shuler, "Applying RFID Technology in Nuclear Material Management," Packaging, Transport, Storage & Security of Radioactive Materials, Vol. 19, No. 1, 2008.

Y.Y. Liu, H. Lee, B. Craig, and J.M. Shuler, "Smart Drum Technology for Radioactive and Other Hazardous Materials," Waste Management Symposia, Phoenix, Arizona, March 18–22, 2018.

Y.Y Liu, K.E. Sanders, and J.M. Shuler, "Advances in Tracking and Monitoring Transport and Storage of Nuclear Materials," IAEA International Conference on Nuclear Security: Commitments and Actions, Vienna, Austria, December 5–9, 2016.

Z.H. Han, J. Li, D. Kontogeorgakos, Y.Y. Liu, and J.M. Shuler, "A Compact Type B Packaging Design for Disused Radiological Sources," Institute of Nuclear Materials Management (INMM) 59th Annual Meeting, Baltimore, MD, July 22-26, 2018.

K. Sanders, R. Pope, K. Sanders, and J. Shuler, "Training for Next Generation Security for Nuclear Transport," American Nuclear Society Winter Meeting, Washington, D.C., Oct. 29–Nov. 2, 2017.

R. Pope, Y. Liu, and J. Shuler, "Training on Security during Transport of Nuclear and Other Radioactive Materials," IAEA International Conference on Physical Protection of Nuclear Material and Nuclear Facilities, Vienna, Austria, Nov. 11–17, 2017.

Abstract ID: 324

Security during the Transport of Radioactive Material: An End to End Multi Modal Approach to Vitrified Residue Returns

Officer, R.[1]

[1] International Nuclear Services, United Kingdom

Corresponding Speaker: R. Officer

In order to protect society and the wider environment against malicious actors the principal objectives of a State's nuclear security regime, pertaining to radioactive material, are driven by the requirement to devise paradigms denuding its unauthorised removal, sabotage and/or loss of control.

Protecting against such eventualities during transport brings its own unique challenges when compared to nuclear facilities as it is, by definition, off site and in transit. It is well understood and documented that Radiological Material is a potentially attractive component much desired by malicious threat actors with aspirations to deliver a Radiological Dispersal Device (RDD) or Radiological Exposure Device (RED) either in situ or through removal with a view to delivery elsewhere so as to maximise the Unacceptable Radiological Consequence, effect, and impact upon our environment and societies.

Security of Radioactive Material in transport should in addition to a generic and holistic regime be cognisant of the United Nations Recommendations for the Transport of Dangerous Goods Regulations, which outlines specific modal requirements mandated by international organisations. For maritime transport, this includes the International Ship and Port Facility Security Code (ISPS) and the International Maritime Dangerous Goods Code as it relates to the International Convention for the Safety of Life at Sea (SOLAS).

In order to drive enhanced efficiencies some member states employ the reprocessing of spent fuel to recycle their Uranium and Plutonium into Mixed Oxide (MOX) fuel so that it might be used once more. During this process High Level Waste (HLW) is generated as a by-product and contains nearly the entire radioactivity of the spent fuel (by volume constitutes about 3%). In the UK, this HLW is converted into a borosilicate glass at the Sellafield Waste Vitrification Plant (WVP) yielding a stable and durable waste form suitable for long-term storage and subsequent disposal. As a global leader in the international transportation of Nuclear Material (NM) and Other Radiological Material (ORM), International Nuclear

Services (INS) possesses over forty years' experience of safely and securely shipping a diverse spectrum of materials required to support the civil nuclear sector continuum from 'front end' to 'back'.

The Vitrified Residue Returns (VRR) programme, a partnership between Sellafield Ltd and International Nuclear Services (INS), is a key component of the UK's Nuclear Decommissioning Authority (NDA) strategy to repatriate HLW and see said residues from UK reprocessing services returned to overseas customers in Japan, the Netherlands, Germany, Switzerland and Italy, in support of UK Government policy.

In summary, this paper hopes to share our experiences of transporting securely HLW. It will, inter alia, provide an overview of the nature, complexities, and difficulties inherent with such a multi modal (rail, road and sea) venture, in addition to planning, threat analysis, resource, physical protection measures and force generation required to meet those outlined objectives. It will also discuss realistic and pertinent timelines and provide an insight into the multifaceted layers of engagement required at every level, inclusive of higher level governmental; the requisite interaction and expectation management of all relevant competent authorities; and the liaison with participating security forces, consignors and consignees, in order to better describe and elucidate on how INS ensures end to end security during HLW returns as part of the overarching VRR programme. (Word count 541)

Abstract ID: 367

The H2020 C-BORD Project: Feedback and Conclusion of an Advanced Non-Destructive Techniques to Improve Control of Cargo Containers

Sannie, G.[1]; Boudergui, K.[1]; Carrel, F.[1]

[1] French Alternative Energy and Atomic Energy Commission, France

Corresponding Speaker: G. Sannie

During 42 months the C-BORD project (effective Container inspection at BORDer control points), part of the framework of the 2014 European Horizon 2020 research program, was coordinated by CEA LIST and finalized after the deployment of different techniques in three real environments located in three different countries (The Netherlands, Poland and Hungary).

This project addressed different technological topics, in order to improve the non-destructive control of containers with the final goal to decrease the false alarms. A large set of passive and active non-destructive techniques have been developed, improved and associated. Concerning the passive non-destructive methods, two categories of techniques have been improved and deployed: Evaporation based detection techniques and RPM solutions based on large size plastic scintillators. Concerning the active non-destructive methods, three categories of techniques have been studied: X-ray techniques by Smiths Detection, techniques based on neutron interrogation and advanced photofission techniques.

All these technological developments have been merged in a global enriched end-user interface, based on the X-ray image, in order to constitute an optimization solution to maximize the information level.

The paper integrates all feedback and three field tries results provided from a big port (Rotterdam Site), container terminals (Gdańsk site).

Abstract ID : 171

A Novel Portable Device for Gamma and Neutron Spectroscopy with Special Nuclear Material Identification Capabilities

Mangiagalli, G.[1]; Fanchini, E.[1]; Mini, G.[1]; Stevanato, L.[2]; Morichi, M.[1]; Corbo, M.[1]

[1] CAEN SyS, Italy; [2] Università di Padova, Italy

Corresponding Speaker: G., Mangiagalli

The development of new types of detectors and the increased performance of the electronics have paved the way for developing advanced systems for the measurement and identification of radioactive material that can be involved, for example, in illicit trafficking.

Radioactive isotope identifiers are today commercially available. Nowadays those systems make use of inorganic scintillators as NaI(Tl) or, for enhanced resolution, LaBr3 to identify the gamma emitters through their characteristic gamma lines. The most complete systems usually include an additional 3He proportional counter for neutron detection and counting.

The performance of such devices have to be compliant with standards as the IEC 62327 Hand Held Instruments for the Detection and Identification of Radionuclides. Typical operating times for such devices are 3 seconds for issuing a gamma ray alarm, 10 seconds for a neutron alarm and 1 minute for identification of the gamma emitter.

This paper presents a new type of portable radioactive isotope identifier.

This device, based on an organic liquid scintillator with excellent Pulse Shape Discrimination (PSD) proprieties for the simultaneous detection of gamma rays and neutrons, is able to detect radioactive source as SNM, medical, industrial and NORM.

The main ability of this instrument is not limited to the detection, but also includes the identification of neutron sources with discrimination between fission sources (like 252Cf) and alpha-n type sources (like AmBe) from Plutonium and Uranium through an innovative dedicated algorithm.

A moving average is used to integrate the last three minutes of natural background in order to set individual thresholds for neutron and gamma counts. Alarms are triggered separately when the respective rate exceed the alarm thresholds. These thresholds are calculated to allow detection with 95% detection probability at 95% confidence level for a dose rate on the front face of the scintillator of at least 50 nSv/h.

The liquid scintillator detector is able to discriminate neutrons from gamma rays by using the Pulse Shape Discrimination technique. Such signal processing is currently performed by using complex and expensive read-out systems. Today, thanks to the development of compact and fully digital pulse analyzers, it is possible to design compact systems with enhanced performance.

The system here presented makes use of advanced digital electronics including an MCA and a FPGA running Digital Pulse Processing firmware for PSD.

This firmware allows for online fast discrimination of gamma rays from neutrons thus enabling individual alarms for each kind of particle.

The PSD firmware is based on an advanced online digital dual gate charge integration technique able to sustain high counting rates. It performs input signal baseline calculation, self-triggering, double integration of both prompt and total charge for Pulse Shape Discrimination and pedestal subtraction for energy calculation and pile-up rejection.

Moreover, with a novel discrimination algorithm, a neutron source classification is also possible. The electronics is equipped with two analog inputs and two high voltage power supplies in a very small form factor thus becoming an enabling technology for higher performance yet portable radioactive isotope identifier devices, which can include more detectors and perform data fusion analysis.

The double channel capabilities of the electronics are exploited by adding another detector to the system for improving the identification performance of the gamma emitters. A high-resolution inorganic scintillator, such as LaBr3 or CeBr3, has been easily integrated into the system to perform an enhanced gamma radioisotope identification by characteristic gamma lines recognition. This solution allows for a simultaneous identification of multiple radionuclides, exceeding therefore the limits of gamma identification performed with organic liquid scintillator and Compton spectra libraries only.

The added benefit of this solution is the possibility to detect a masked neutron source through the PSD algorithm performed by the liquid scintillator detector while the inorganic scintillator identifies the masking gamma emitters.

The inorganic scintillator enhances also the neutron source identification. In fact, thanks to the high resolution of the crystal, it is possible to calculate the Pu and U enrichment grade through their characteristic gamma emission rate ratio as well.

Abstract ID : 249

Remote Operated Vehicles for Radiological Emergencies

Vazquez-Cervantes, R.[1]; Ramirez-Jimenez, F.[1]

[1] Instituto Nacional De Inves- Tigaciones Nucleares (ININ), Mexico

Corresponding Speaker: R. Vasquez-Cervantes

In radioactive facilities, physical security covers functions of prevention, detection and response to theft, sabotage, unauthorized access and illegal transfer of nuclear materials or radioactive sub- stances.

Physical security in a nuclear or radioactive facility considers four basic objectives which are: dis- suasion, detection, delay, and response. However, one of the most vulnerable points can occur during transport of these sources from one facility to another or as work routine in the field 1.

Up to now, events that involve theft of radioactive sources arisen in recent years has been motivated by money earning from illicit sale of related infrastructure, (theft of the transportation vehicle).

One of the most relevant cases due to the radiological risk involved was the one of a stolen Co-60 radioactive source, found in Hueipoxtla town, Mexico. The category I radioactive source, 3000 Ci activity was found outside its lead shield in a sowing field.

This event scenario is related to physical security during transportation of radioactive material and response phase of radiological emergency when the theft has been completed and the source is outside the radiological facilities. These scenarios may correspond to categories IV or V of the emergency preparedness 2.

The scenario showed several aspects to consider such as:

The type of terrain, (The radioactive source was lost in a rugged terrain of loose soil with plants and ditches).

The radioactive source was outside its shield and hidden in a sheaf, among many other sheaves.

In order to create methodologies and equipment that provide support to face similar scenarios, ININ has developed prototypes of unmanned and remotely operated vehicles for tasks of searching, locating, recovering and transfer to a shielded container for low-weight radioactive sources. (Up to 20 Kg). See Fig. 1

ININ developed a 6-wheels robot with radiation detectors (1.5 "x 1.5" NaI scintillator detector and an "Ortec Inspector" with a Hyper-pure Germanium detector) to search for radioactive sources. Also ININ developed an 8-wheel robot with lead shielded container of 40 x 15 x 15 cm and 1.3 cm thick wall. The container has a cap that is remotely operated for its opening and closing. Shield thickness guarantees at least reduction in half of Co-60 gamma rays exposure.

The remote operation of both robots is done up to 2 km of distance in line of sight and is instrumented with video cameras for remote visual inspection by using wireless signal transmission of 5.8 GHz in a range up to 450 m.

A source searching strategy is performed with collimated detection and geo-referenced location data of the robot by using a GPS. With two geo-referenced points and the intersection of two direction lines, location coordinates of radioactive source can be estimated. See Fig. 2.

This type of infrastructure can be used for emergency scenarios in category IV and V. With these developed tools we can reduce or avoid radiological exposure of Radiological Safety personnel. Remote operated vehicles take advantage of the distance factor in radiological protection considerations.

References.

World Institute for Nuclear Security. Management of physical security of radioactive sources. 2016

IAEA Safety Standards Series No. GSR Part 7 Preparedness and response for nuclear or radiological emergency. 2015

Abstract ID: 313

Wearable Neutron Detector for Dosimetry and Nuclear Non-Proliferation

Beatty, B.[1]; Huddleston, D.[2]; Mcgregor, D.[2]; Gardner, J.[1]; Whitmore, L.[3]; Henson, L.[3]; Hutchins, R.[2]; Taylor, R.[2]; Fronk, R.[2]; Bellinger, S.[3]; Sobering, T.[2]

[1] Alion Science and Technology, USA; [2] Kansas State University, USA; [3] Radiation Detection Technologies, Inc., USA

Corresponding Speaker: T. Ochs

A Wearable Neutron Detector (WND) has been developed utilizing low-power, low-profile, solidstate neutron detectors for the search and localization of special nuclear material mission space. The WND comprises sixteen Modular Neutron Detectors (MNDs), two Modular Gamma-ray Detectors (MGDs), and accompanying power and communications electronics that interface with a handheld Android device. The WND alerts to the presence of special nuclear material (SNM) by detecting neutrons emitted by SNM either though spontaneous fission or background induced fission. The background level of neutron radiation is relatively low and stable, and neutron emitting isotopes are rare and unique in nature. Therefore, any measurements of neutron activity above the background level is a good indication that SNM may be present. The MGDs provide further source confirmation as one would expect the gamma-ray emissions from SNM to increase the local gamma-ray flux.

The neutron detection technology in the MNDs is the microstructured semiconductor neutron detector (MSND). MSNDs have been developed over the past decade to serve as a low-profile, lowcost, low-power, high-efficiency alternative to expensive and aging 3He gas-filled proportional counters for thermal-neutron detection. MSNDs are vertically-operated pvn-junction diodes with high-aspect ratio, straight trenches etched approximately 400-µm deep into a 525-µm silicon substrate and backfilled with 6LiF neutron conversion material. Charged-particle reaction products emitted following neutron absorption by a 6Li-atom can exit the MSND trench and deposit energy in the silicon fins of device, thereby, creating electron-hole pairs in the semiconductor. The influence of an applied bias then drifts the electron-hole pairs, and the current induced by the charge motion is measured to form a voltage pulse. MSNDs are commercially produced with intrinsic thermal-neutron detection efficiency of 30% for normally incident neutrons.

The MND comprises 24, 1-cm2 active area MSNDs and on-board single processing and communication electronics boards. The MSNDs are arranged in a 4x6 array where four MSNDs make up a single channel on the MND. Each channel has a dedicated preamplifier, amplifier, and pulse-height discriminating electronics. A programmable lower level discriminator is set high enough to limit the gamma-ray sensitivity of the MNDs while minimally impacting the neutron sensitivity. Wired, low-RF, communications can be achieved through CAN-bus or I2C communications protocol or wireless communication can be achieved through low-energy Bluetooth. The MND measures 6.1cm wide by 11.1-cm long and less than 2-cm thick and was designed to fulfil a need in low-power, low-profile neutron detection systems. The MGD is similar to the MND, but instead of populating the detector board with MSNDs, it is populated with seven LND model 713 Geiger-Müller detectors. High-voltage bias supply components were added to MGD electronics package to meet the required operational bias for the gas-filled detectors. A MND or MGD can be operated as a standalone detector or integrated into larger arrays for stationary or mobile detection scenarios.

The WND discussed in this work implemented wired, I2C communications for low RF-transmissions and was intended to be used in covert or overt mobile detection operations. Sixteen wired-MNDs and two wired-MGDs were connected to a central communications and power module. The communication and power module houses two rechargeable Li-ion batteries capable of powering the fully-populated WND continuously for more than 8 hours, and the communication electronics interface between the radiation detectors and user interface on the Android device. The fully populated WND garment weighs approximately 8 lbs (3.6 kg). The WND was mounted on an ANSI

42.53 standard phantom, and the response to bare and moderated 252Cf and AmBe neutron sources are presented in this work. The gamma-ray response to 137Cs and 60Co was also measured. Furthermore, the cross-cutting application of the WND operating not only as tool for search and localization of neutron sources but also as personal neutron dosimeter was investigated through Monte Carlo simulation for neutrons with energies up to 20 MeV. Simulation results are discussed in this manuscript.

Abstract ID: 323

Gamma Cameras as New Technological Developments to Strengthen Nuclear Security Detection Architectures: Emerging Potential Approaches within Regulatory Frameworks and Implementation Practice, Expected Added Value to Existing Measures from Instrumentation-Specific Technical and Functional Characteristics.

Rothan, D.[1]; Feret, B.[1]; Montemont, G.[2]

[1] NUVIA, United Kingdom; [2] French Atomic Energy Commission, France

Corresponding Speaker: D. Rothan

The use of gamma cameras is starting to become standard as a way to localize active areas on nuclear sites, and reduce the dose for the personnel while increasing the overall efficiency of the operations. In this presentation we intend to show how the typical performance of gamma cameras can lead to other applications such as supplementing standard radiation detection devices deployed for nuclear security purposes, e.g. during Major Public Events (MPE). The work performed is based on the technical and functional performance of an available instrument of this type (NuVISION, developed in cooperation with the French Atomic Energy Commission – CEA LETI).

Various types of radiation detection instruments are available and widely used as technical measures integrated into corresponding operational concepts and procedures, providing suitable tools for nuclear security and related areas. Gamma cameras such as NuVISION represent a new type of instrumentation which offers a combination of existing or new functions into a single instrument, with different potential uses and constraints. As such, gamma camera instrumentation is potentially interesting, but currently does not correspond to well-defined and critical needs in the mentioned applications.

Taking into account the overall specificities of the nuclear security applications we explored the capacity of gamma cameras to tackle applications within the nuclear security of material outside of regulatory control, and more particularly for the security of Major Public Events (MPE) and strategic locations (including the related measures for emergency response).

As part of this work, relevant prescriptions from international reference documents issued by the IAEA (Safety standards and Nuclear Security Series), as well as usual practice and user requirements relating to nuclear security measures in the mentioned applications, were reviewed and analysed. Building on this reference environment, an approach for the introduction of gamma cameras into existing detection architectures was defined, by identifying relevant detection targets, as well as areas where the technical and functional characteristics of the gamma camera could bring significant added value to current measures. As a result, the proposed approach suggests solutions to complement existing nuclear security measures and improve the coverage of the most important risks. It makes use of gamma cameras as an additional technical mean, integrated into nuclear security systems and measures, to significantly improve operational constraints in some particular scenarios, and/or to provide an additional layer of protection in "defence in depth" approaches.

The work performed closely relates to several topics of the conference, mainly to the "Detecting radioactive material involved in criminal/unauthorized acts" one, but also to the "Strengthening sustainability and effectiveness of nuclear security regimes related to security of radioactive material and nuclear security detection architecture" one.

In terms of subjects as listed in Appendix I of the conference announcement, the presented work addresses several of the listed subjects, more particularly in the following areas:

- "Current and emerging technologies",
- "Designing detection architecture",
- "Implementation of detection operation",
- "Sustainability and effectiveness of nuclear security systems and measures".

Abstract ID: 363

Environment Insensitive Detection of Fissionable Material with a Short Pulse Neutron Source

Podpaly, Y.[1]; Schmidt, A.[1]

[1] National Nuclear Security Administration, Department of Energy, USA

Corresponding Speaker: Y. Podpaly

We report on a new method for room-independent detection of fissionable material using a Dense Plasma Focus (DPF) as a short pulse neutron source. Fissionable materials are difficult to detect passively, and most active interrogation schemes rely on detailed knowledge of the surrounding materials in the room. In this work, we use a DPF to create a short (<50 ns full width half maximum) neutron pulse with an average energy of 2.45 MeV (D-D neutrons) to interrogate an object of interest and a fast neutron detector to analyze the neutron time of flight signal. If fissionable materials are present in the object, high energy neutrons are created from the fission process, of which a portion then arrives at the detector prior to the source neutrons. This early signal is an unambiguous characteristic of presence of fissionable materials. By only relying on the prompt signal from a D-D source and fission neutrons, scattered neutrons are unable to contaminate the measurement, thus rendering detailed environmental knowledge not critical for this method. A DPF was selected for this work because these Z-pinch like devices are compact and take advantage of a plasma instability to create high intensity, short pulse neutrons with no dark current. We report on Monte Carlo N-Particle (MCNP) modeling of the approach and preliminary experiments performed at Lawrence Livermore National Laboratory using a 1 kJ scale DPF which produces ~107 neutrons per pulse. Lawrence Livermore National Laboratory is operated by Lawrence Livermore National Security, LLC, for the U.S. Department of Energy, National Nuclear Security Administration under Contract DE-AC52-07NA27344; this work was supported by the US DOE/NA-22 Office of Non-Proliferation Research and Development. LLNL-ABS-749891

Abstract ID : 113

Radiological Security through Cesium Irradiator Replacement in the United States

Garrison, L [1]; Galvan, A. [2]; Elster, J.[2]; Gilbert, L. [3], Mr. Baumann, M. [3], Itamura, M.[3]

[1] Office of Radiological Security, Department of Energy, USA; [2] Pacific Northwest National Laboratory, USA; [3] Sandia National Laboratories, USA

Corresponding Speaker: L. Garrison

The cesium chloride (CsCl) used in cesium Irradiators is highly attractive for use in Radiological Dispersal Devices (RDD) commonly known as "Dirty Bombs". This is due to the ease of dispersal of the soft CsCl powder, the inherent bonding properties of CsCl, and the difficulty of decontamination after dispersal. CsCl binds with surfaces and can easily penetrate into materials such as concrete. Given the 30.2-year half-life of the Cs-137 in CsCl, areas directly affected by a release of CsCl would be contaminated for significant amounts of time. Cesium-137 poses a significant hazard to those exposed to it; either through ground shine (i.e., external exposure to the gamma radiation emitted from contaminated surfaces), inhalation, ingestion, or through the skin. Cesium- 137 is circulated in bodily fluids and delivers a whole-body dose to those exposed internally.

This paper will summarize the U.S. Office of Radiological Security's (ORS) efforts to address the risk of Cs-137 through the Cesium Irradiator Replacement Project (CIRP). CIRP is part of the ORS domestic strategy to manage the risk that Cs-137 could be used in a malicious act of radiological terrorism by supporting the adoption and development of non-radioisotopic alternative technologies and thus achieving greater security by reducing the number of high-activity radioactive sources vulnerable to misuse.

Participants in CIRP have an Alternative Technology device installed, and their CsCl irradiator becomes disused. However, risk is not reduced nor security achieved until the disused source is properly dispositioned. ORS ensures risk reduction for high-activity disused sources by federally- funding their removal and disposal through the Off Site Source Recovery Program (OSRP). As of the end of June 2018, forty-two irradiators at thirty-two sites have become disused and then been removed and dispositioned by OSRP through participation in CIRP. In addition, over forty devices are expected to become disused and be removed in 2019 due to established CIRP contracts, and an additional eighty have indicated their interest in CIRP, which will result in additional disused sources.

ORS is further working to address the security concern posed by disused sources by working to in- crease source transportation and disposal capacity to meet the increased demand due to CIRP. ORS and partners are designing and fabricating containers that can be used by industry, research, and government entities to ship additional radiological materials safely and securely. A key example is the ORS-funded development, testing, certification and fabrication of the new 435-B container, which is relatively lightweight, easy to transport, and capable of transporting a wider variety of radioactive sources than other containers. In addition, ORS is fabricating the 380-B container, which will be able to transport unique sources and devices that are very challenging for the containers that are currently available. The 435-B performed its first source removal in March 2018 at a hospital that replaced a CsCl irradiator through CIRP. The 380-B will be delivered in June 2019.

The CIRP approach, reducing risk and achieving greater security by enabling CsCl removal through the promotion of Alternative Technology, can only succeed if source users choose to procure re- placement technology, typically an x-ray irradiator. CIRP incentivizes users to adopt x-ray irradiators and have their now disused cesium sources removed by fully funding the source removal and disposition and by reimbursing a portion, typically 50%, of the cost of the x-ray irradiator.

Abstract ID : 104

Administrative Monetary Penalties in Nuclear Security

Vucicevic, J.[1], Waller, E.[1]

[1] University of Ontario Institute of Technology, Canada

Corresponding Speaker: J. Vucicevic

The paper is based on the research of the Administrative Monetary Penalties (AMP) in Canada and their usage in nuclear security. An AMP is an administrative penalty imposed by the Canadian Nuclear Safety Commission (CNSC), without court involvement. It is used in the case of a violation of a regulatory requirement. An AMP can be applied against any individual or corporation subject to the Nuclear Safety Control Act, which regulates the development, production and use of nuclear energy and the production, possession and use of nuclear and radioactive material. How- ever, AMPs are not the same as criminal offences. They are civil sanctions which try to secure compliance through the application of monetary penalties for non-compliance with regulatory requirements. The AMP program was introduced in 2013 in Canada, and to this date 21 penalties have been issued. In all of these cases, the violations were related to handling and security of radioactive material. Based on these issued penalties research was conducted to discover pros and cons of the AMP system and to recommend improvements for the future. It will also address some of the main concerns of the system, such as the economic aspect of the process, and the other one is related to subjectivity and relative ease of issuing these penalties.

The main goal is to discover whether or not the AMP system is a useful tool in nuclear security. Questions tackled in this paper include: Will AMPs make the nuclear environment more secure? In case of a mistake will employees follow the regulations and pay penalties or try to hide the mistakes and avoid penalties? Will individuals and/or corporations be willing to voluntary report violations without penalties, so that industry can build a body of knowledge and improve nuclear security? Is there a clear advantage in nuclear security with AMPs?

The main goal of AMPs is not to punish, but to promote compliance. In order to improve nuclear security in Canada the regulator has to be aware of possible violations of the Nuclear Safety Control Act and work on prevention of these violations. Current AMP policy does not motivate individuals or corporations to report violations. The paper gives recommendations on modifications which could be implemented to motivate self –

identification of violation, and give significant benefit to the system and therefore, nuclear security.

Other than the issued AMPs, paper will analyze data obtained through the survey conducted on human readiness to self – identify violations in nuclear industry under different circumstances. This should confirm that modified AMP policy would improve body of knowledge and provide significant information on violations of the Nuclear Safety Control Act and improve nuclear security.

Abstract ID : 166

A Graded Approach to Cybersecurity: Smaller Facilities, Temporary Jobsites, or Multiple Authorities

Lukes, K.1; Pantalo, C.1; Purdy, G.1; Cervera, M.1

United States Nuclear Regulatory Commission1

Corresponding Speaker: M. Cervera

In 2013, a U.S. Nuclear Regulatory Commission (NRC)/Agreement State working group, the Byproduct Materials Cyber Security Working Group, was formed to evaluate: (1) the potential consequences that may occur if the availability, integrity, or confidentiality of data or systems associated with risk-significant quantities of radioactive material* were compromised by a cyberattack, and

(2) whether additional regulatory measures or guidance were needed to ensure adequate protection against cyber security threats.

The working group completed its evaluation in summer 2017 and, as a result of its comprehensive analysis, concluded that risk-significant radioactive materials licensees do not rely solely on digital systems to ensure either safety or physical protection. Rather, these licensees generally employ a suite of measures, such as doors, locks, barriers, human resources, and operational processes, to ensure security, reflecting a defence-in-depth approach to physical protection. The working group found that a compromise of digital assets (including only the operability of those systems for which the NRC has regulatory authority) would not result in a direct dispersal of risk-significant quantities of radioactive material, or an exposure of individuals to radiation, without a concurrent and targeted breach of the physical protection measures in force for these licensees. Such a cyber attack alone would not result in any onsite or offsite consequences. Therefore, the working group determined that the current cyber security threat faced by risk-significant radioactive materials licensees does not warrant developing new regulations related to protection of their material against cyber security threats. This determination also aligns with the determination made with respect to facilities (such as non-power reactor facilities and independent spent fuel storage installations) that could have similar resultant consequences from a cyberattack.

Although the working group determined that no regulatory changes were warranted, they identified that it would be prudent to communicate effective practices for cyber security for risk- significant radioactive materials licensees. This is intended to provide licensees a better understanding of contemporary cybersecurity issues and enable licensees to consider strategies to protect digital assets (e.g., computers, digital alarm systems), including those assets used to facilitate compliance with physical security requirements.

This paper will describe the process the working group used in the evaluation. It will also describe the development of the effective practices paper that will leverage existing cybersecurity guidance developed for other classes of licensees, such as for non-power reactors, and guidance developed by other US Government agencies. The NRC will also continue to monitor the constantly evolving cyber security threat landscape and coordinate cyber security efforts such as sharing of effective practices and outreach efforts with US Government agencies, State agencies, and stakeholders.

*Risk-significant quantities of radioactive material are defined as those meeting the thresholds for Category 1 and Category 2 as included in the IAEA Code of Conduct on the Safety and Security of Radioactive Sources.

Abstract ID : 233

State Supervision and Control Over Security of Radioactive Materials

Pashayev, R.[1]

[1] State Agency on Nuclear and Radiological Activity Regulations (Regulatory Authority), Republic of Azerbaijan

Corresponding Speaker: R. Pashayev

The possibility that nuclear or other radioactive material could be used for malicious purposes can- not be ruled out in the current global situation. Given that this problem is global, the contribution of each state is very important for achieving a common goal. Nuclear security is fundamental in the management of nuclear technologies and in applications where nuclear or other radioactive material is used or transported. In connection with this problem, the necessary efforts are being made in the Republic of Azerbaijan to strengthen the protection and control of such material and to respond effectively to nuclear security events. The creation of appropriate regulatory bodies, the improvement and development of legislation and regulations, the introduction of a graded approach to control, as well as participation in various international projects and the development of international cooperation make an invaluable contribution to the development of existing infrastructure. However, as in many areas, along with achievements in ensuring state control and supervision over the security of radioactive materials, there are also difficulties associated with the need to continuously improve the knowledge and professional training of staff, improve the material and technical base, introduce advanced technologies, etc. Taking into account the above, this presentation will consider both the existing practice, and the emerging difficulties and possible ways to overcome them.

Abstract ID: 322

Best Practices and Challenges for Securing Radioactive Materials

Elsayd, R.[1]

[1] Egyptian Atomic Energy Authority, Egypt

Corresponding Speaker: R. Elsayd, Egypt

The terrorist attacks of September 11, 2001, heightened the Nation's concerns regarding the use of risk-significant radioactive materials in a malevolent act. Such an attack has been of particular concern because of the widespread use of radioactive materials in the world and abroad for industrial, medical, and academic purposes. Loss or theft of such materials, in risk-significant quantities, could lead to their diversion for malicious use in a radiological dispersal device (RDD) or a radiological exposure device (RED). An RDD is a device or mechanism that is intended to spread radioactive material from the detonation of conventional explosives or through other means. RDDs are considered weapons of mass disruption; few deaths would occur due to the radioactive nature of the event; however, significant social and economic impacts could result from public panic, decontamination costs, and the denial of access to infrastructure and property for extended periods of time. A best practice is a method or technique that has consistently shown results superior to those achieved by other means and that is used as a benchmark for completing a task. Note that a key strategic talent required when applying best practices to organizations is the ability to balance the unique qualities of an organization with the practices that it has in common with others. The purpose of this paper is to describe best practices available to manage the security of radioactive materials (RAM) in medical centers, hospitals, and research facilities. Overcome of challenges that facing protection of radioactive sources during storage, using, transport and so on, for example:

To harmonize Safety Regulations, (2) To foster education towards the stakeholders, (3) To develop Communication and Transparency towards the public, (4) A proven Emergency Response and Preparedness system ready to be used, (5) To enhance the Permanent dialog between industrials and Competent Authorities. Finally, I will suggest some observations and Recommendations for the best practice securing radioactive materials, There are some challenges facing securing of radioactive material, From my point of view, I will present some recommendations and solutions to these challenges based on my experience, for example incomplete evaluation of area for storage / use of Category 1 or 2 materials. Solution to this challenge

- Limit security to areas of usage.
- Evaluate points of entry (“think like an intruder”).
- Install motion detectors.
- Install surveillance cameras.
- Mitigate possible access points (e.g. install wire mesh above a drop ceiling and I will to share information’s with other counters.

Abstract ID: 327

Assessment and Licensing Mechanism to Ensure Nuclear Security in Malaysia

Rabani, N.[1]; Muhamad, I.[1]

[1] Atomic Energy Licensing Board, Malaysia

Corresponding Speaker: N. Rabani

Atomic Energy Licensing Board (AELB)) is the authority under the Atomic Energy Licensing Act (Act 304) responsible for controlling the atomic energy usage and application in Malaysia. AELB is also a responsible authority for Strategic Trade Act 2010 (Act 708) under the Ministry of International Trade and Industries (MITI). Apart from known stochastic and deterministic effect, it is now of great concern that radioactive sources can also be deployed for criminal and terrorist activities. Acknowledging this threat, AELB introduced nuclear security requirements within the defined three (3) types of authorization mechanism implemented under the Act 304 through a process of licensing, registration and exemption. Assessment and Licensing Division (BPP) is one of the six division in AELB to control for radioactive materials, nuclear materials, prescribed substances, or irradiating apparatus in medical and non-medical application and provide the procedures and information required for obtaining, renewing and amending the license from the Board. In order to properly address the need for physical protection, detection and response of nuclear and other radioactive material and to establish a regulatory programme for radioactive sources, licensee is set into categorization based on its hazard consequences. AELB has enforced for Category 1 to 3 license to have adequate level of the security measures that properly addressed the elements of deterrence, detect, delay and response and security management through submission of security plan. Starting 2016, AELB has fully implemented online application after a gradual implementation starting January 2012 through the Licensing and Enforcement System (e-SPP). AELB also implemented the two-week training course for certification of Radiation Protection Officer (RPO) that incorporated three (3) hours of security of radioactive sources lessons with examination. Authorization process in AELB also addressed import and export activities with integrated online application with Royal Malaysian Customs Department to have coordinated mechanism in controlling for movement of radioactive sources in Malaysia. Responsibilities under Act 708, provided enhanced mechanism for nuclear security control during transport including cross border movement. Malaysia belief that the security control for radioactive required for a proper establishment

of regulatory control with capability through a defined authorization mechanism. Such mechanism will enhance for the safety and security control of radioactive and nuclear material and the first measures to address material out of regulatory control.

Abstract ID : 9

Process Oriented Approach in Updating and Maintaining National Register of Radiation Sources

Samba, R.[1], Mr. Simo, A.[1]

[1] National Radiation Protection Agency, Cameroon

Corresponding Speaker: Mr. Samba, Richard Ndi

National Radiation Protection Agency (NRPA) of Cameroon activities started with inventory pro- gram in 2009 using IAEA Regulatory Authority Information System (RAIS) software version 3.0, as register. Since then, data collections for radiation sources are continuously being done nationwide and registered with the help of migrated RAIS version 3.3 web (2014) and 3.4 web (2016). NRPA was created to carry out activities under Decree No 250/2002 and the register of radiation sources and radiation workers was one of the provisions. Extensive customization of processes to respond to specific needs in the NRPA organizational chart, with due account of legislative and regulatory framework vis-a-vis IAEA standards was necessary.

Cameroon is located at the strategic shipping route in Africa. There is Security instability in the neighboring countries: Boko Haram in Nigeria and Seleka in Central Africa Republic. There are major events like African Nation Cup to be hosted in 2019 and many High Level Official conferences and gatherings. Movements of radioactive sources for the construction of various infrastructures to host these events have increased significantly. Sharing of experiences and challenges in the implementation of the monitoring and tracking of these sources is important to tackle security issues. In updating and maintaining of information, it was discovered that we had to customize RAIS for Inventory, Authorization, Review and Assessment, Inspection, Quality Control and Dose Registry.

In other to establish a better national nuclear security regime, an Integrated Nuclear Security Advisory Services (INSServ) mission took place from 21st to 25th April 2014 which properly positioned the gaps. INSSP follow up evaluation missions took place June 2015 and September 2018. Ratification of the Amendment of CPPNM was enacted in July 2015, which was one of the actions in the INSSP.

Legislative and Regulatory documents (drafts and enacted), 600 X-Ray machines, 400 radioactive sources (sealed sources, unsealed radioactive material and disused radioactive sources), 850 occupational radiation workers, 500 associated facilities and associated activities including transport (Authorization, Inspection, Quality Control, Dose records) are being maintained and recorded with the approach of different processes put in place. NRPA addressed these sources and facilities for the prevention of criminal or unauthorized acts intended or likely to cause harmful radiological consequences by enhancing the policy from cradle to grave. Regulatory peer review and support implementing inspection regimes in accordance with international nuclear security series guidance are done consistently with categorization of radioactive sources in different security levels.

Abstract ID : 87

Improving Global Radiological Source Security: National Legal Frameworks, Penalty Provisions, and Preventive Enforcement

Cupitt, R.[1]

[1] Stimson Center, USA

Corresponding Speaker: R. Cupitt

With tens of thousands of radioactive sources in use worldwide, the potential that such sources would fall into the hands of terrorists or other criminals has attracted increased attention at the highest political levels, notably at the 2016 Nuclear Security Summit and International Atomic Energy Agency (IAEA) International Conference on Nuclear Security. Preliminary discussions with officials from INTERPOL and United Nations Office of Drugs and Crime (UNODC) suggest that an analysis and an open source compendium of laws that criminalize violations of radiological and nuclear security measures would provide helpful guidance to those States seeking to implement international obligations or commitments, such as those found in the International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT), the Convention on the Physical Protection of Nuclear Materials (CPPNM), the Code of Conduct on the Safety and Security of Radioactive Sources and the Guidance on the Import and Export of Radioactive Sources. To that end, the author presents the findings of a study by the Stimson Center on the national legal frameworks for securing radioactive sources and nuclear materials, including managing imports and exports of such items, for all UN Member States. The study has a special emphasis, moreover, on deterrent penalty provisions (e.g., criminal and civil) for violations and preventive enforcement measures. The study, funded by the Government of Finland, relies on the most recent publicly available data produced by the UN Security Council 1540 Committee for all UN Member States on such measures as a base. The study further updates and supplements this base with open source data from the national nuclear regulatory authorities or other bodies of States governing nuclear materials and radioactive sources, as well as data made public by the IAEA and other international or regional organizations, to create a compendium of all national measures to secure radiological sources and nuclear materials, with a focus on the associated national enforcement measures. Using this compendium, the author explores the range of legal approaches States use to secure (and control trade in) radioactive sources and nuclear materials, including: the type of national

laws, regulations and guidance used; how States distinguish between nuclear materials and radioactive sources in their national legal frameworks; the elaboration of control lists; the specific enforcement sanctions employed; and preventive enforcement activities. Drawing on this data and through consultations with officials at the IAEA, INTERPOL, the UN Office of Drugs and Crime (UNODC) and other contributors, the study will generate recommendations regarding optimal enforcement measures for improving global radiological source security.

Abstract ID : 164

Strengthening Security of Radioactive Sources in the Republic of Moldova

Apostol, I.[1]

[1] National Agency for Regulation of Nuclear and Radiological Activities, Moldova

Corresponding Speaker: I. Apostol

During 11 years of its activity, the National Agency for Regulation of Nuclear and Radiological Activities (NARNRA) supported by the Government of the Republic of Moldova, IAEA, other international organisations, US NRC, US DoE, Swedish Radiation Safety Authority and other partners has made all possible efforts for establishing an adequate infrastructure for security of radioactive material. Established infrastructure consisting of human capacities, legal framework, radioactive sources national register, authorisation, inspection, law enforcement and other elements.

In context of uncontrolled by official governmental entities of "Transnistrian region" and the fact of instable situation in the region, strengthening sustainability and effectiveness for security of radioactive material and nuclear security became more actual and needs more efforts to be made by many stakeholders.

With the assistance of US DoE, border crossing points in the Eastern part of Moldova, as well as Chisinau International Airport and first response agencies were equipped with performant detection equipment and personnel are trained accordingly. Conducted in the last three years common exercises involving different national agencies at the level of first responders, mobile expert teams and nuclear forensics lab were highly appreciated by participants, Government and external observers.

In 2007 NARNRA began its activity with inventorization of all radioactive sources throughout the country, which in the end leaded to creation of the National Register of Radioactive Sources. This could be implemented with the assistance of US NRC, using experience of other countries in the region.

Regulatory authority has obtained significant progress in assessing state of radiation safety and security at Ribnitsa metallurgical plant and other main users of radioactive sources in Transtistria. Taking into consideration several confirmed cases of illicit traffic involving nuclear material, Re- public of Moldova promotes the development of a national nuclear forensics capability through establishing of a national nuclear forensics laboratory for performing analysis and characterization of seized nuclear and radioactive material. This laboratory was established in the framework of the STCU project and it is a part of a dedicated regional network aimed to combat illicit trafficking jointly with our neighbouring partners.

During the last four years, the Republic of Moldova has implemented a successful and cost-effective program on orphan sources search and recovering, with the great support of Swedish Radiation Safety Authority. During the implementation of this project we have regained regulatory control under 4000 radioactive sources, 1/3 of which, were brought from "Transdnistrian region". New technics and methods for radioactive source search were used beside to classical ones.

A new ambitious INSSP was elaborated by NARNRA in 2017. Based on risk assessment a range of new measures oriented to strengthening security of radioactive sources and nuclear materials were designed.

Abstract ID : 27

Implementing Strategies for the Security and Safe use of Radioactive Materials at the Centre for Energy Research and Training (CERT), Zaria., Nigeria

Ewa, I.[1]

[1] Centre For Energy Research And Training (CERT),Ahmadu Bello University, Zaria, Nigeria

Corresponding Speaker: I., Ewa

There has been an increase in the use of radioactive materials in the industry and government establishments in Nigeria over the years. This has been sustained due to the national legislative frame work established for the use, control and monitoring of establishments, using radioactive materials in the country. The security and safety of these materials used at the Centre for Energy Research and Training (CERT) are properly guaranteed as outlined in the mandate and Statutes establishing the Centre. Safeguard issues on radiation emitting substances are also included in the National Nuclear and Radiological Emergency Plan (NNREP) which is the bed-rock of the National Policy on the security of radioactive materials in the event of any nuclear or radiological emergency. Nuclear material audit, accounting and licensing of users of radioactive materials is a legislative function of the Nigerian Nuclear Regulatory Authority (NNRA) while the Nigeria Atomic Energy Commission plays a dominant supervisory role on the facilities and establishments using these materials. A temporary 'repository' of spent radioactive materials as well as orphaned sources used all over the country in the form of a radioactive waste facility; with an operational oversight by CERT, gives assurances of the security of these materials from undue public interferences.

1.0 Introduction

Implementation of strategies for the safe use and security of radioactive materials at the Centre for Energy Research and Training (CERT), Ahmadu Bello

University, Zaria, Nigeria; derives principally from the enabling laws 1 and Statutes establishing the Centre, the national legal framework of the Federal Government of Nigeria on radiation emit- ting substances 2 and partly from the type of radioactive materials in use at the Centre. The major research facility in focus involving radioactive materials is the 31 kW Nigeria Research Reactor- 1 (NIRR-1) which basically is a neutron source producing both thermal and epithermal neutrons used for Neutron

Activation Analysis (NAA). The entire spectrum of NAA activities involves the management of high-level, intermediate and low-level radioactive materials.

2.0 Security of Radioactive Materials

The IAEA defines safety requirements with respect to the use of radioactive materials 3 as those that must be met by the State (country) to ensure the protection of people and the environment, both now and in the future; and that these requirements shall be governed by the objective and principles of the State's Safety Fundamentals. It further emphasizes that the flexibility, format and style of the requirements should facilitate their use for the establishment, in a harmonized manner, of a national regulatory framework. By this statement it behooves on States, like Nigeria, the responsibility of developing strategies for the implementation of safety and security measures to protect the worker and public from radioactive materials in use by national establishments.

The types of research facilities involving applications of radioactive materials that require implementation strategies for their security and safety either during their use or storage at CERT include; the NIRR-1 research reactor core, a 14 MeV Neutron Generator, and a 5Ci (Am-Be) neutron source. Others are spent radioactive sources, gamma ray emitting calibration sources (Co-60, Cs-157), re- actor cooling column water and spent raisins. Those stored at the waste management facility include industrially used orphaned spent sources such as those applied in nuclear well logging by oil explorers, and industrial gauges used as Non-Destructive Testing (NDT) materials in the textile industries. The latter groups are temporary stored at the waste management facility under the authorization of the Nigerian Nuclear Regulatory Authority (NNRA). Implementation of security strategies for the security of these sources are further discussed beginning with the highly radioactive reactor core.

3.0 The Research Reactor Facility (NIRR-1)

NIRR-1 is a 31 kW (thermal) nominal power research reactor that became critical on 3rd February 2004 and is still in operation. By now its 347 fuel elements are now highly radioactive. Protection of these fuel elements that constitute the radioactive core is guaranteed by the design- basis shielding of the core in an enclosed stainless steel-lined pool water of diameter 2.7m and 6.5m deep. By this design, threat to the removal of the radioactive core by intruders is highly minimized. The reactor building is externally protected by several installed concrete vehicle-barriers as a security measure against threat-intended collisions with the walls of the facility. With these measures the reactor core as a highly radioactive material is well secured.

4.0 The 'Cradle to Grave' Concept for the Reactor Core

A 'cradle to grave' management agreement was signed by the Nigerian Government and the re- actor vendor - the Chinese Institute of Atomic Energy (CIAE), Beijing as one of the Safeguard measures for the NIRR-1 highly enriched uranium (UAl_4) core after the decommissioning of the facility. Nigeria has neither developed the competence nor the technical expertise in the handling and management of highly radioactive cores alongside its associated spent fuel assemblies; hence the engagement of the strategy of cradle to grave agreement with the vendors in respect to the highly radioactive core after decommissioning the research reactor.

This agreement is one of the best strategies of managing the highly radioactive core during de-commissioning, at the expiration of the effective use of NIRR-1 facility with a Highly Enriched Uranium (HEU) fuel core. It is a decommissioning safeguard security measure against the retention and storage of a highly radioactive core of NIRR-1 in Nigeria, an action devoid of anticipated security risk in the management of radioactive materials.

5.0 Defence-in-Depth Strategy

This is one of the strategies applied as a measure for the physical control security systems safe- guarding radioactive materials at the Centre. Defence-in-depth

control strategies applying intrusion detection, delay and response measures are assured through a multiple barrier system for the screening of staff and visitors approaching the reactor facility. The Centre has three perimeter fencing walls whose access is only possible through three screening gates manned by trained guards for access control logging. Access control is further enhanced through the delineation of boundaries that limit unauthorized access and interferences around the reactor core. Closed Circuit Television (CCTV) networking systems are focused on monitored routes and specific sites, on a 24/7 basis and recorded on split-camera screens. These posts are monitored by well-trained guard-forces at the Control room.

5.0 Guard-Forces

The employment and training of a facility guard force is aimed at both the physical protection of the NIRR-1 facility as well as preventing unauthorized removal of radioactive materials in the Centre. The guard-force is always in continuous surveillance of the facility with the sole objective of:

Implementing protocols for deterring an adversary from creating any possible damage to the facility that may lead to unauthorized removal of radioactive materials. and

Providing initial on-site response from any malicious attack on the facility.

A graded approach is always implemented by the guard-forces in screening and clearance of staff to be allowed into the reactor control room and the counting laboratories where highly radioactive matrices are being analyzed. The guard-force participates actively during the on-site and off-site drills organized as an Emergency Preparedness and Response (EPR) event.

6.0 Regular Drills

Based on the Security Plan of the Centre (CERT), regular on-site and off-site emergency drills are implemented. The objective of these drills includes: Creating a continuous awareness of the on-site guard-force and facility workers commitment towards their physical protection responsibilities as a part of an integral EPR procedure and the

Assessment of arrival times for off-site responders in the event of an unauthorised intrusion by assailants attempting to remove any nuclear material. The off-site guard force includes armed Nigerian Military and Police Forces.

The regular drills also helps in assessing the response behaviour of the guard-force EPR assessment in combating any unauthorized intrusion or a radiological emergency either at the reactor hall or at the waste facility where radioactive materials are kept.

7.0 The Waste Management Facility

The waste management facility is an essential component of the reactor's maintenance and operation system. The facility was built uniquely for the temporary storage of radioactive wastes. Principally, the NIRR-1facility is used for Neutron Activation Analysis (NAA). It becomes obvious that over time there has been a build-up of activated matrices used for NAA investigation, usually discarded when the 'counting' is over. The long-lived species of activated matrices notably from geological materials are usually highly radioactive and could be attractive to terrorists. In order to secure these materials, provision is made by the establishment of a nuclear waste material facility where these induced-radioactive matrices are stored for appropriate cooling periods.

These radioactive waste materials include active spent sources or 'volumes' of waste laboratory materials that have long-lived decaying species considered highly radioactive and are expected to 'cool' for some time before they can be handled. These radioactive materials are of serious safety concern and therefore have to be kept out of reach from the public in a safe enclosure. Such materials are kept within the waste management facility acting as a 'temporary repository'. Other users of radioactive sources within the country who do not have the infrastructure and capacity to keep or store highly radioactive materials are granted the opportunity of keeping their 'hot' sources at the waste management facility. The Nigerian Nuclear Regulatory Authority.(NNRA) authorizes and keeps an inventory of all approvals for the safe custody of these radioactive materials at the waste management facility storage rooms.

Each of the categories of radioactive material require specific management regime for their safe storage. A central alarm system activates any unauthorized intrusion into the access control area of the waste management facility. Specific zones of the waste material facility are properly designated with the three-foil symbol.

8.0 The use of the trefoil radiation symbol

The trefoil emblem is a radiation symbol that is conspicuously displayed where there are radioactive sources to warn laboratory workers and the general public of the presence of radiation emitting substances. At CERT, it is equally used on cordoning tapes in establishing limits for access to a zone where a radioactive material is being kept. It is equally used to label access control limits for the neutron generator room, the Am-Be source or any radioactive material. This is necessary for the security and safety of workers within the reactor and laboratory complexes. They are also used to warn workers of zones that require the use of TLD badges or pocket dosimeters for personnel dose monitoring.

9.0 The WAY FORWARD AND CONCLUSIONS

The Federal Government of Nigeria has already established extant laws for the security and safety of radiation workers as well as provide for the safe use of radioactive materials.[4,5]. In Nigeria this aspect is properly covered by the Nigerian System of Accounting for and Control of Nuclear Material Regulation 2013.

The following are the proposed suggestions for the way forward:

Establishments handling radioactive materials should develop security recovery EPRs in order to track cases of stolen or lost radioactive materials.

Operators dealing with radioactive materials should be encouraged to continuously submit regular accounting of these materials to the NNRA as has been the case in order to reduce the burden of locating and recovery of missing materials.

Emergency Preparedness Response plans of the radiological consequences of the loss of these radioactive materials should be updated regularly to match the new developments in crime technology.

Implementation of compliance monitoring strategies (non- routine monitoring interventions and routine audit should be stepped up.

A graded approach should be used on the safety requirements for the storage of highly radioactive materials. Those with a high-risk potential of radiological consequences to the public due to exposure, loss or damage should be given a higher risk EPR on the security scale.

Revised Security Plans should be proactive to accommodate the changing security challenges of theft of radioactive materials.

Government should continuously take ownership as has been the case, of the responsibilities of physical protection of radioactive materials and should ensure that establishments dealing with radioactive materials take full responsibility in accounting and safety of these materials for the interest of the security of the public. CERT has implemented successfully a robust EPR that has guaranteed its safe operation and security of workers for the last fourteen years of NIRR-1 operation.

Abstract ID: 375

Security of Radioactive Material, Associated Facilities and Associated Activities in Togo

Fiagan, Y.[1]

[1] Interministerial committe-Togo, Togo

Corresponding Speaker: Y. Fiagan

I. INTRODUCTION

The peaceful use of nuclear and radioactive material for commercial, industrial, health or research purposes is worldwide recognized and still promoted by IAEA. But there is a high level risk that nuclear or radioactive material could be used in criminal, malicious purposes or international unauthorized acts, creating the threat to international security. To mitigate the threats, Togo member state of IAEA carries the full responsibility for the Nuclear Security, has approved in 2012 INSSP plan through the Expert mission conducted in April 2012, which resulted in the establishment of a high inter-ministerial committee in charge of Nuclear security, by decree. In addition, it was also approved this year a review meeting for INSSP plan in order to improve nuclear security architecture for detection of nuclear and radiological sources. However, for safety and security purposes, many efforts have been made by inter-ministerial committee to establish and implement security regime such as the draft of national nuclear legislation for implementation of regulatory body which was ready to be adopted by our parliament, as well as, the draft of national regulatory infrastructures for physical protection. In other hand, many nuclear security activities were carried out preliminarily for the preparation of national inventory process such a visit on different sites (phosphate mining extraction, harbor, hospitals, laboratory of physics and agronomy, border, road construction agency etc.) in order to identify the potential target of operators dealing with nuclear and radioactive material, workshops on the awareness raising related to the harmful effect of ionizing radiation sources, and sensitizing of operators about their responsibilities and cooperation during inventory process.

II. OBJECTIVES

- Overview of the inventory process related to nuclear and radioactive sources with associated facilities,

- Evaluating the potential consequences of malicious acts involving radioactive material and associated facilities, development of national detection strategy and response plan,
- Improvement the co-operation and working procedure between the concerning competent authorities.

III. METHOD

Efforts were initiated at the beginning of this year (2018) by the Inter-ministerial committee to conduct a program of inventory process for nuclear and radioactive material at national level in order to establish national register. In addition, the potential operators dealing with radioactive material with associated facilities were identified after workshop organized at national level in 2017 in collaboration with IAEA. A working group was established by inter-ministerial committee in collaboration with different department to locate prominent site of radioactive sources.

IV. RESULTS

The point of contact from different departments involving in nuclear security was nominated. We have a list of embryonic information sources. A data collection sheet has been developed and made available to different ministerial departments. This data sheet includes questionnaires on devices using radioactive sources of all categories 1 to 5, in the fields of medicine, mining, research (agriculture and livestock), industry, and construction. A second step of our study will be the verification through a visit on the site, to identify the sources reported on the survey sheets, and to conduct radiation protection measures and to assess the possible risks of radiation. Some data sheets were collected from operators, revealed that there is presence of radioactive sources of category 1, 2, 3, 4 and 5 in our territory.

V. CONCLUSION

In order to achieve the objective of nuclear security regime, Togolese state should commit the necessary resources, including human and financial resources, to ensure that its nuclear security regime is sustained and effective in the long term to provide adequate nuclear security for radioactive material and associated facilities.

Keywords: radiation materials, associated facilities and nuclear security.

Abstract ID : 117

Practices and Regulation for Effectiveness on Nuclear Security Control of Radioactive Sources at Medical Facilities in Malaysia

Abdul Karim, M.[1]; Kayun, Z.[2]

[1] National Cancer Institute, Malaysia; [2] Ministry of Health, Malaysia

Corresponding Speaker: M., Abdul Karim

Today, Malaysia had thousands of radioactive source that are used throughout medicine, industry, agriculture, academia, and government facilities for a variety of purposes, and recent studies suggest that these materials may be vulnerable to theft or sabotage. Many of which are poorly secured and vulnerable to theft by terrorists seeking to detonate a dirty bomb. The number of radioactive source in medical facilities had increase from time to time due the demanding for di- agnostic and treatment services to the patient. Ministry of Health (MOH) of Malaysia as part of authority agency that controlling the use of radiation activities in medical purposes supposed to strengthen the nuclear security to achieve effective control on nuclear security, physical protection, storage and transport and of the associated facilities at all stages in their cycle. The purpose of this document is to describe best practices available to manage the security of radioactive sources in medical centers, and hospitals. This document also outlines approaches for comparison what level of Malaysia to follow the IAEA recommendations - to share the experiences, including difficulties encountered, lessons learned, good practices adopted and outline the way forward in the implementation of the International Atomic Energy Agency(IAEA) recommendation based on the National Safety Series (NSS). This paper also highlights the key challenges in regulating in nuclear security control and provides an update on opportunities to implement the related recommendations of IAEA to the medical facilities. Proposed country requirement in relevant process work to obtain authorization for replacing the Cs 137 Blood Irradiator to x-ray technologies (non isotropic).

Abstract ID : 276

Challenges in the Elaboration of the New Regulation for Security of Radioactive Sources in Brazil

Roza De Lima, A.[1]; Augusto Da Silva, F.[2]; Monteiro Filho, J.[1]; Alves Tavares, R.[1]

[1] Brazilian Nuclear Energy Commission, Brazil; [2] Institute of Radiation Protection and Dosimetry, Brazil

Corresponding Speaker: A. Roza De Lima

The growing concern of the international community relating to the security of radioactive sources after September 11th, 2001 resulted in a strengthening, at world level, of the application of physical protection requirements for radioactive sources and associated facilities through the adoption of new parameters and methodologies for the design and implementation of physical protection measures and systems. Brazil follows this world concern, since it has a large number of facilities that use radioactive sources. There are currently around 2,500 medical, industrial and research radio- logical facilities, of which almost 500 radioactive sources Category 1 and 2 (according IAEA's Categorization). The practices included in these categories are, among others, industrial irradiators, teletherapy and industrial radiography. Currently, the Regulatory Authority, Brazilian Nuclear Energy Commission (CNEN) has a regulation that establishes the steps of the licensing process for radiation facilities, denominated CNEN NN 6.02, which addresses the issue of physical protection of these, but very briefly and without providing any guidance. In Section III, the CNEN-NN-6.02 requires the licensee to submit a Preliminary Physical Protection Plan to obtain a license for construction and in Section VII, the regulation requires that the licensee submit a Physical Protection Plan (PPP) to obtaining an operation authorization. In both cases, however, there is no clear establishment of any regulatory criteria or requirements for security, making difficult the implementation by the operators (or licensees) of an adequate physical protection system, based on source category and type of facility, increasing the risk of sabotage acts and unauthorized removal of material, compromising the protection of personnel and the physical integrity of facility. It can also impact a detailed assessment of security conditions of these facilities by the CNEN, either through the assessment of PPP's or by regulatory inspections on the facilities. Therefore, to follow the current world situation of radiological threats, and international trend, the CNEN, based on the IAEA recommendations, decided to elaborate and to publish a new regulation, in order to establish the general principles and requirements for security of radioactive sources and associated facilities. A new regulation draft (CNEN-NN-2.06) was recently completed by Study Committee, that will continue the formal regulation procedures until its approval and official

publication. This paper presents the main challenges faced in the elaboration of the Brazilian regulation for security of radioactive source. Study Committee was composed of 25 stakeholders, including nuclear security and safety experts from the regulatory body, research institutes and radiation facilities. Twenty meetings were held between 2017 and 2018. The structure of the regulation has been divided into 6 chapters, defining the physical protection objectives, physical protection system design, responsibilities, physical protection plan, regulatory inspections and transitional arrangements.

The most debated topics on the Study Committee and which became challenges were:

Establishment the position of "Physical Protection Officer" (or responsible)

Definition of the Physical Protection Level (A, B or C) according to the radiological risk grading group or subgroup in which the radiological facility is classified;

Definition who will do the regulatory inspections to establish the inspection process for security requirements in routine basis

Interface between security and safety regulatory area of CNEN during the licensing process of radioactive sources and associated facilities

Measures to ensure the trustworthiness of persons with authorized access to sensitive information or, as applicable, to radioactive sources

Classification of security areas

Each topic obtained a solution implemented based on, among other conditions, observing the regulations of other countries, the experience of each professional and the consistency with regard to safety regulations.

Abstract ID : 12

Design of the French Regulations on the Security of Radioactive Sources - Challenges and Lessons Learnt

Languin, T. [1]

[1] Ministry Of Environment, Energy And The Sea, France

Corresponding Speaker: T., Languin

France has a long experience and a mature regulatory control system over radioactive sources regarding radiation protection. Even if provisions regarding safety may benefit the security of the sources, the protection of the French high-activity radioactive sources (HASS) against malicious acts has to be strengthened.

Those HASS are held by many kinds of users, either small-size business or larger companies, public or private, for varied uses, either medical or industrial, fixed or mobile, etc..

After having assessed the present security level of those sources, the French authorities and experts joined in a national working group to draft regulations to improve the security of HASS. This draft is based on a national threat assessment and an international benchmark focused on sources security regulations developed by our counterparts and on international guidelines, in particular AIEA documents.

The process involved the participation of all stake holders (other French authorities, operators, carriers…) and lead to extensive debates and modifications of the draft. The regulations are now almost finished and should enter into force during 2018.

This presentation aims to give some insight on the way France has designed its regulations, the main issues that were discussed and the solutions that were found.

Abstract ID : 137

Maintaining and Regaining Control of Radioactive Sources: Legislative and Regulatory Approaches

Morris, F. 1; Manion, J. 1

Pacific Northwest National Laboratory

Corresponding Speaker: F., Morris

Regulatory control is fundamental to nuclear security. When a radioactive source present in a State is under regulatory control, the regulatory body can provide assurance of its secure (and safe) management through a system of licensing, regulation, inspection, and enforcement. When a radioactive source is out of regulatory control, this assurance is not possible, and the radioactive source becomes potentially usable in a malicious act. These realities are well recognized in the Code of Conduct on the Safety and Security of Radioactive Sources, which indicates that achieving and maintaining a high level of safety and security "should be achieved through the establishment of an adequate system of regulatory control of radioactive sources, applicable from the stage of initial production to their final disposal, and a system for the restoration of such control if it has been lost."

However, building a system that is highly effective in this regard can be challenging, for several reasons. First, regulatory bodies understandably focus on what are generally viewed as their core tasks of licensing, regulating, and conducting inspection and enforcement in relation to radioactive sources that are already under regulatory control. Second, and as a related matter, when regulatory control never existed or is lost, the regulatory body must often rely on other competent authorities – such as law enforcement, customs and border protection, intelligence, and environ- mental authorities, which have much broader and diverse missions – as well as private parties who may discover an orphan source and be reluctant to report it for fear of being forced to assume responsibility or liability.

While the IAEA and the competent authorities of many States have developed many useful tools and techniques to address these issues, less attention has been devoted to strengthening legislative and regulatory frameworks to better integrate the operations of regulatory bodies and those competent authorities dealing with radioactive material out of regulatory control to support the gaining and regaining of regulatory control in a harmonized manner. This paper is intended to contribute to a discussion on how best to fill these gaps by facilitating more effective communications and incentives in the form of legislative and regulatory provisions, as well as less formal arrangements among regulatory bodies and other competent authorities. The result could be re- vised guidance in the IAEA Nuclear Law and Nuclear Security Series publications.

Abstract ID : 3

Development Of Access Control System (Acs) in the Protected Area (Pa) at Al-Tuwaitha Nuclear Site

Al-Hamadani, H.[1]

[1] Iraqi Ministry of Science and Technology/ Radiation and Nuclear Safety Directorate/ Al-Tuwaitha Nuclear Site, Iraq

Corresponding Speaker: H. Al-Hamadani

The potential of a malicious act involving radioactive material is a continuing worldwide threat. Lessons learned from past global nuclear security incidents indicate that when radioactive materials are left uncontrolled or in unauthorized circulation, they become vulnerable to theft and sabotage.

The purpose of the security system at Al-Tuwaitha nuclear site is to protect the environment, the workers and the public from the radioactive consequences of the theft and sabotage of radioactive materials.

In the present paper, the methodology included a review of the current design of the site's security system with the aim of preventing malicious acts, by raising and stressing the security measures of both pedestrian and vehicles Access Control Systems (ACSs) at Al-Tuwaitha site Protected Area (PA).

The security measures were designed to adequately perform the security functions of detection, delay, and response in order to deter and prevent malicious acts in accordance with the guidance recommended in the IAEA nuclear security series No. 14 (2011) as well as other relevant references.

The proposed design will avoid the site security system from weaknesses in the present design and attempt to strength them, which may result from internal or external adversary by pedestrians or vehicles.

The design of the PA access control system has been reconsidered and upgraded by equipping the personnel and vehicle Access Control Points (ACPs) with modern and developed physical

protection equipment in line with expected security threats to protect radioactive material from sabotage or theft acts.

Abstract ID : 119

Current Status for Radioactive Material "Security" of Japan: Toward 2020 Tokyo Olympic and Paralympic Games

Nishida, R. [1], Furugaki, R.[1]

[1] Nuclear Regulation Authority, Japan

Corresponding Speaker: R., Nishida

January 2011, IAEA published "Nuclear Security recommendations on Radioactive Material and Associate Facilities," called "NSS No. 14."Accepting this recommendations, Nuclear Regulation Authority (NRA), Japan had begun to deal with NSS No. 14.

And finally, April 14, 2017, Japanese Diet promulgated the amendment to the Radioisotope Law demanding for users of not only "Safety" but also "Security" regarding radiation regulation.

The paper introduces current status for Japanese radioactive material "security" toward 2020 Tokyo Olympic and Paralympic games.

So far, NRA have secured only "Nuclear Material" such as Uranium or Plutonium which could be However, in the amendment of April 2017, responding current international threat of "Dirty Bomb Japanese HARSs contain 24 sealed sources referring to IAEA "Code of Conduct," and also around 2

The key point of Japanese radioactive material "Security" is that it secures not only sealed so To prepare law enforcement, currently NRA has been stipulating a government ordinance, a ministry.

The challenges of current Japanese radioactive material "Security" include inspector shortage w

For NRA perspective, the new amendment of the law in which radioactive material "security" is With coming these big public events, the status of radioactive material "Security" of Japan is

Finally, Japan appreciate IAEA's contribution to our preparation for Tokyo Olympic and Paralympics

Abstract ID : 138

A Case Study on a Successful Collaborative Project to Increase Security for a Device Containing Radiological Material

Kuca, M. [1]; Kjall, P. [2]

[1] Office of Radiological Security, Department of Energy, United States; [2] Elekta Instrument AB, Sweden

Corresponding Speaker: M., Kuca

Radioisotopes such as Cs-137 and Co-60 are utilized in various medical, industrial, and research applications. This radiological material can be a theft or sabotage target which necessitates a certain level of security to adequately protect it. The presented work will showcase a very successful collaborative project between Sandia National Laboratories (United States) and Elekta Instrument AB (Sweden) to develop low-cost delay and detection security enhancements incorporated into Elekta's stereotactic radiosurgery system, the Leksell Gamma Knife, to help mitigate the risk of source theft or sabotage. This work was conducted with funding from the United States National Nuclear Security Administration's Office of Radiological Security and will show the value of collaboration between a U.S. national laboratory with decades of security expertise and a private manufacturer. Sandia will discuss the engineering process needed to design such robust security enhancements and Elekta will share their experience and lessons learned in the hope that states, operators, and other manufacturers consider similar approach to addressing radiological threat.

Abstract ID : 258

Introduction to the Graded Approach to the Security of Radioactive Material in China

Wang, L.[1]; Bai, Z.[1]

[1] State Nuclear Security Technology Center, China

Corresponding Speaker: L. Wang

China has consistently payed great attention to the security of radioactive material and has kept a good record on it in the past decades. To this end a graded approach has been developed and applied.

For the purpose of security, radioactive material which includes radiation sources, radioactive waste and spent fuel, etc., is graded into three categories Category I Category II and Category III . And the categorization of their associated facilities is in line with that of those radioactive material contained therein.

Three major factors are taken into account in the grading of radioactive material. The first is the current evaluation of the threat according to the security situation at home and abroad; the second is the nature and activity of radioactive isotopes which means its relative attractiveness; the last is the potential harm (radiation effect) that it would do to human health or the environment if it were released to the environment, accidentally or intentionally. Category I contains the radioactive material which would do the serious damage, such as high-risk radiation sources (Class I), high- level radioactive waste, spent fuel; Category II contains the radioactive material which would do the medium damage, such as medium-risk radiation sources (Class II and III), medium-level radioactive waste; Category III contains the radioactive material which would do some damage, such as low-risk radiation sources (Class IV and V) and low-level radioactive waste. It needs to be pointed out that the classification scheme of radiation sources from Classes I to V according to their potential to cause harm to human health, is similar to that of the IAEA.

In order to protect radioactive material whether it is in storage or in transport, effective and sufficient security measurements are taken according to its category. Holders of radioactive material shall conduct an assessment of threats in the light of the social circumstances and the security situation in the region, and use them as the basis of designing its security system. The holders shall design, build, operate and maintain their security systems in line with the categories of those radioactive material in their possession in compliance with applicable laws, regulations and standards. Especially, for the radioactive material under Category I or II, a dedicated security organization shall be set up; full-time security staff shall be deployed with necessary equipment; security systems shall be evaluated at regular intervals and corrective actions shall be implemented on any weakness. Radioactive material in transport shall be escorted by specially-assigned people. Particularly, radioactive material under Category I or II in transport shall be escorted by full-time security staff.

The general advantage of the graded approach to the security of radioactive material lies in the fact that the resources available to be allocated to meet the ever growing security demand can be divided in such a way that gives more significance to what needs more. Based on this graded approach, China has never lost even one gram of important nuclear material, and sabotage and other ill-meant behaviours involving radioactive material have seldom happened.

Abstract ID : 139

Global Cesium Security Initiative – A Comprehensive Approach to Cesium Security

Elster, J.[1]; Jamison, J. [1], Hazel, M. [1]

[1] Pacific Northwest National Laboratory, USA

Corresponding Speaker: J. Elster

The U.S. Department of Energy/National Nuclear Security Administration's Office of Radiological Security (ORS) cooperates with partner countries throughout the world to enhance the security of radioactive sources used for legitimate purposes. According to the U.S. National Academy of Sciences (NAS), Committee on Radiation Source Replacement, "Cesium-137 in the form of cesium chloride is a greater concern than other radiation sources based on its dispersibility and its presence in population centers across the country." Cs-137 is a radioisotope produced in nuclear reactors that is used worldwide in medical, industrial, and research applications, which provide great benefits to society; however, cesium sources are high priority in terms of potential use in an act of radiological terrorism. The Office of Radiological Security (ORS) has successfully partnered with countries and facilities worldwide, many of which use cesium-137 (Cs-137) and its common commercial form of cesium chloride (CsCl), to complete traditional security enhancements.

To combat the increased threat of cesium-based devices, ORS has launched the Global Cesium Security Initiative (GCSI) to expand and accelerate its efforts to enhance the security of high activity Cs-137 sources. The Initiative is intended to provide a comprehensive approach to security for Cs-137 based devices for medical, research, and industrial applications whether they are in use, in storage, or in transport, and addresses all three technical pillars of the ORS program - Protect, Remove, and Reduce.

Protect efforts focus on completing follow-on site security enhancements and implementing additional measures, such as security-by-design and response planning, required to successfully implement a containment protection strategy at sites that store or use Cs-137.

Remove actions include removal of disused Cs-137 sources from sites either to a secure consolidated storage location or repatriation for disposition of those sources. This may also include considerations for the recycle and reuse of decommissioned sources.

Reduce efforts aim to support the transition from Cs-137 based devices and how we can support the transition to alternative non-radioisotopic technologies, where feasible.

This paper will identify a prioritized and comprehensive approach for protecting high activity Cs-137 sources/devices using additional Protection strategies, Removal efforts or Reducing the threat through the use of alternative technologies when available and feasible. The discussion will highlight lessons learned from ongoing cooperation and past deployments, and provide insight from industry experts who have been involved in the Protection, Removal or Reduce (alternative technology replacement) of cesium devices.

Abstract ID : 45

Infusing Nuclear Security Topics into Present Nuclear Engineering Curriculum in Universitas Gadjah Mada : an International Cooperation, Local Action and International Impact

Putero, S.[1]; Prabaningrum, N.[1]; Sihana, S.[1]

[1] Universitas Gadjah Mada, Indonesia

Corresponding Speaker: S. Putero

In Indonesia, nuclear engineering curriculum is only run in Universitas Gadjah Mada since 1977 to prepare Indonesian human resources in operating nuclear power plant. Nuclear security was introduced to the department in 2011 by an International Atomic Energy Agency (IAEA) expert as a new international issue in nuclear technology utilization. The paper would like to describe the department experiences in infusing nuclear security topics into the present curriculum through the international cooperation. To understand better about nuclear security, the faculty members attended several international meeting, conference, workshop and Professional Development Courses (PDC) held by IAEA, Partnership for Nuclear Security USA (PNS), and King's College London UK. In 2013, several faculty members visited 6 universities in USA to study how nuclear security incorporated into their curriculum. Some workshop, PDC and course development grants were also run supported by international experts. The developed nuclear security incorporated courses were shared and disseminated in INSEN meeting, and international conferences. In cooperation with Indonesia Nuclear Energy Regulatory Agency (BAPETEN), the department had been conducted nuclear security training for national front line officer. Optimizing international and national cooperations and experiences, 3S based curriculum has been legally offered by the department since 2016. Several studies related to nuclear security was conducted and internationally published to improve the department participation to the world in order to promote nuclear for peace.

Abstract ID : 54

Security of Radioactive Material and Human Resource Development: Sri Lanka Navy's Effort Content Security of Radioactive Material and Human Resource Development: Sri Lanka Navy's Effort

Dassanaike, H.[1]

[1] Sri Lanka Navy

Corresponding Speaker: H. Dassanaike

INTRODUCTION Sri Lanka is an island nation situated in South Asia. Country is a developing country with a population of around 22 million and the Gross Domestic Product is US $ 86 billion approximately. Sri Lanka has a known history of application of radiation and radioisotopes, mainly in industries, agriculture, health care and education. Transportation of these required radioactive material take place through Port of Colombo being the main sea port of the country situated in the Western Province. Sri Lanka Navy is a main stake holder in providing security to the Port of Colombo. Recently with the assistance of Atomic Energy Regulatory Council, Atomic Energy Board, National Authority for Implementation of Chemical Weapon Convention in Sri Lanka and Country Office of World Health Organization, Sri Lanka Navy has established CBRN First Response Team in Western Naval Area where the Port of Colombo is situated. Sri Lanka Navy is a key stake holder in fulfilling relevant provisions in the Sri Lanka Atomic Energy Act No 40 of 2014 and Sri Lanka Disaster Management Act No 13 of 2005. Sri Lanka Atomic Energy Regulatory Council is in the process of completing the National Radiation or Nuclear Emergency Management Plan (EMP) and Sri Lanka Navy is a stakeholder for EMP. This National Nuclear or Radiological Emergency Management Plan is drafted taking in to account the requirements of 'International Atomic Energy Agency (IAEA) safety standards for preparedness and response to nuclear or radiological emergency general safety requirements (GSR) part 7'. OBJECTIVES The objective of this paper is to present Sri Lanka Navy's effort in developing its human resource to ensure radioactive security in the country mainly focusing on the major sea ports. HRD POLICY The availability of skilled and competent staff is the basis of the sustainability of radioactive material security aspects. Despite in very early stage, Sri Lanka Navy's Policy on Human Resource Development (HRD) focusing on Security of Radioactive Material is encouraging. The Policy is based on following main areas: a. Recruiting and retaining quality workforce. b. Grooming

individuals and team within the organization. c. Common Understanding, Awareness, Education, Training and Qualification of quality workforce. d. Encouraging a conducive organizational culture to make positive impact on workforce. e. Sound retirement and succession plan for sustainability of the endeavour. HRD PROGRAMME The Sri Lanka Navy envisage that structure of the HRD programme should provide both long term and short term education and training for the workforce from various organizations such regulatory bodies, universities and Research and Development activities in Sri Lanka. Further Sri Lanka Navy understands that breach of security in radioactive material may stretch national capabilities to their maximum extent. Education and Training activities will be mainly based on following: a. Information gathering, assessment and dissemination. b. Regular awareness programmes and exercises. c. Nuclear Technology. d. Collection base line data. e. Radioactive waste. f. Nuclear and radiological accidents. g. Short and long term health effects. h. Nuclear disaster early warning system. i. Emergency Response Plan. CONCLUSION In ensuring safe and secure handling of radioactive material Sri Lanka Navy has been making every endeavour to strengthen the awareness and infrastructure for radioactive material safety. Sri Lanka Navy has a big challenge to perform as a key stakeholder to ensure radioactive material safety in the country and also to develop workforce in the field.

Abstract ID : 70

Brazilian Seminar "Safety and Security: Harmonization and Action": a tool for Human Resource Development

Augusto Da Silva, F.[1]; Barcellos Razuck, F.[1];

[1] Institute of Radiation Protection and Dosimetry, Brazil

Corresponding Speaker: F. Augusto Da Silva

An international concern about radioactive sources after the September 11, 2001 event has led to a strengthening of security. There is evidence that the illicit use of radioactive sources, such as, "radiological terrorism" is a real possibility and may result in harmful radiological consequences for the public and the environment. There are in Brazil about 1800 medical, industrial and research installations with radioactive sources and 400 are IAEA Category 1 and 2. Industrial gamma irradiators and industrial radiography occupy a prominent position due to very high radioactive sources activities. Safety conditions are well established in these facilities, due to the intense work of regulatory authority in the Country. But security conditions, according to the basic concepts of Deterrence, Detection, Delay and Response are not yet fully established and incorporated in medical and industrial installations. The main cause observed was the workers' lack of knowledge on safety concepts that must be established at the facility. With the objective to contribute to human resource development, the IRD Postgraduate Courses prepared One Day Seminar on "Safety and Security: Harmonization and Action", in August 10, 2017. This Seminar aimed to present the main concepts related to security applied in radioactive sources and installations, to discuss the applicability of these concepts in the industrial and medical areas and to propose actions to harmonize the workers' performance in relation to safety and security. The Seminar was intended for the following participants: undergraduate and postgraduate students in nuclear and radiation protection areas; radiation protection officers; industry and medical radiation workers; security workers and general workers. For this challenge, because it was the first general Seminar about security, special lecturers were chosen to talk about the main security aspects. Seven lectures were given:

- • New Global Scenario of Radiological Threat and its Potential Consequences: Rex Nazaré Alves, former CNEN President and Professor of Military Engineering Institute.
- The Importance of Physical Protection from Radioactive Sources: Josélio Monteiro, Head of Physical Protection Office/CNEN.

- International Consensus and the CNEN Physical Protection Office: Luiz Fernando Torres, Physical Protection Office/CNEN.

- A New Brazilian Regulation for Security of Radioactive Sources: Alexandre Roza de Lima, Physical Protection Office/CNEN.

- Definition of Threats and Conception of a Physical Protection System: Renato Alves Tavares, Physical Protection Office/CNEN.

- Safety and Security Concepts applied to Radioactive Sources in Medical Facilities: Lídia Vasconcellos de Sá, Professor of IRD Postgraduate Course.

- Radiological Accidents with Radioactive Sources Involving Security: Francisco Cesar Augusto Da Silva, Professor of IRD Postgraduate Course.

The Seminar had a total of 151 participants divided in 26 undergraduate students (medical and industry radiology); 51 postgraduate students (nuclear engineering; medical physics; radiation protection, radiotherapy, dosimetry; security of radioactive sources) and 74 workers of radioactive installations (industry; medical, occupational safety engineering, radiation protection, radiological and nuclear defence, dosimetry, metrology, nuclear area). Some conclusions wrote by postgraduate students about the Seminar are presented as results:

- "Safety and Security are current issues with international priority. Ensuring public security and ensuring that there are no unnecessary radiation doses are the goals of regulatory authority. The Seminar was important for updating nuclear workers on concepts, definitions and requirements of safety and security".

- "The importance of security was well explained and emphasized by several lecturers. They explained how the security lack entails accidents and other damages, not only for radiation workers but for members of the public, such as Goiania accident. The workers learning and capability in security area were presented as very important aspect to implement security concepts".

- "The Seminar was enlightening and fundamental for learning about safety and security of radioactive sources, and met my expectations". As this Seminar was the first on security, the main objective of presenting the concepts of safety and applicability in radioactive sources and installation was fully met.

Abstract ID : 89

Penn State Nuclear Security Graduate Education Program: Nuclear Security System Design

Unlu, K.[1]; Turso, J.[1]

[1] Pennsylvania State University, USA

Corresponding Speaker: K. Unlu

Educating the next cadre of specialists and thought leaders on nuclear issues – including nuclear security, nuclear energy, and nuclear nonproliferation—has become a critical national security imperative in the U.S. These workforce challenges are not unique to the U.S. nuclear sector. Addressing this critical shortage in the nation's nuclear workforce and responding to emerging nuclear challenges confronting our national security will require considerable investments in nuclear-related education programs across the nation. These workforce challenges are particularly acute in the field of nuclear security. To enhance skills and knowledge of the next cadre of specialists in nuclear security, the Pennsylvania State University jointly with Massachusetts Institute of Technology and Texas A&M University launched a nuclear security education program in 2010, with an initial contract from the U.S. Department of Energy's Global Threat Reduction Initiative (GTRI) program. The three universities and GTRI collaboratively developed a list of courses for the nuclear security education program. This collaborative, multi-year effort formed the basis of specific courses designed to educate the next generation of students who plan on careers in nuclear security with both a domestic and international focus. The nuclear security education program offered at Penn State consists of five core courses:

- Nuclear Security: Threat Assessments and Analysis (NucE 441)
- Detectors and Source Technologies for Nuclear Security (NucE 542)
- Nuclear Security Education Laboratory (NucE 543)
- Global Nuclear Security Policies (NucE 544)
- Nuclear Security System Design (NucE 442)

Nuclear Security System Design (NucE 442) studies the science and engineering associated with the design, evaluation, and implementation of systems to secure nuclear and radiological materials, and focuses on the characterization of the adversaries and targets, the consequences associated with failure to protect those targets, detection and delay technologies, on-site and off-site response strategies, evaluation of insider threats, and mathematical methods for evaluating risk due to the threat and the security system design. Methods for risk minimization and system optimization will also be studied and implemented using state-of-the art computational nuclear security analysis tools. Students completing this course should have a broad picture of nuclear security components and their interconnections into a sustainable nuclear security program, and of the planning of nuclear and radiological security activities at both the State and facility level. After completing this course, the students are able to: • Analyze motivations and capabilities of adversaries (terrorists, criminal groups, protestors, etc.) and be able to characterize a Design Basis Threat (DBT) that can be used to perform a threat informed security evaluation. • Describe and explain the operation of detection, delay, and response technologies. Understand how to complete a performance evaluation of these technologies. Implementation and deployment of technologies (or desired research-driven technologies) is significantly more difficult without an industrial-grade, computational tool. • Evaluate insider threats to nuclear and radiological facilities and incorporate the insider threat in a DBT. • Formulate different response strategies (including deterrence, denial, containment, pursuit, and recapture) for different facilities and considering on-site and/or off-site response. These strategies are straightforward to introduce conceptually, however implementation and deployment with available technology (or desired research-driven technologies) is significantly more difficult without an industrial-grade, computational tool. Given an adversary can infiltrate a facility via a variety of methods and paths, development of a practical set of defense strategies necessitates more computationally-intensive (and numerous) analyses. • Use nuclear or radiological material facility characteristics and a DBT to design a performance based security system for a facility that will be threat-informed, provide defense in depth, and achieve balanced protection while minimizing risk to an acceptable level. The previous offering of this course incorporated the AVERT Modeling and Simulation Tool, which students rapidly mastered and applied to real-world nuclear security scenarios. • Apply engineering principles to produce a cost/benefit analysis for upgrade options for an existing nuclear facility. • Understand the unique security characteristics associated with transportation of nuclear materials, smuggling of nuclear materials, and protection of major public events and be able to apply a risk- and performance-based engineering approach to security systems for these scenarios. • Understand nuclear forensics as a component of a nuclear security system and be able to use nuclear forensics interpretation of measured data to predict infer actor involvement in a nuclear security incident. • Discuss and critique the deterrence characteristics of nuclear security systems. An overview of the Penn State Nuclear Security Graduate Education program, specific details of the Nuclear Security System Design course, and successful application of the AVERT computational security system design tool as an essential component to the course will be discussed.

Abstract ID: 303

World Institute of Nuclear Security (WINS) Programmes for Sustainable Radioactive Source Security

Evans, R.[1]

[1] World Institute of Nuclear Security (WINS), International

Corresponding Speaker: R. Evans

For many years the focus of nuclear security was principally the physical protection of nuclear material and nuclear facilities. The earliest guidance of the IAEA for nuclear security was in relation to nuclear material and nuclear facilities and the only binding international legal instrument that is solely concerned with nuclear security is limited in its scope to consideration of nuclear material and nuclear facilities . However, Member States of the IAEA, recognising the widespread use of radioactive sources in medicine, agriculture and industry, have taken steps to ensure that radioactive source security receives equal attention. The International Convention on Suppression of International Terrorism criminalises malicious acts involving radioactive sources including radioactive devices, addressing directly the threat of Radioactive Dispersal Devices (RDD) and Radioactive Exposure Devices (RED).The Code of Conduct on the Safety and Security of Radioactive Sources published by the IAEA in January 2004, while non-binding as an international instrument, is highly effective as a tool for guiding member states in the establishment of effective regulatory infrastructure for the safety and security of radioactive sources. In addition, the four nuclear security summits held between 2010 and 2016 brought together heads from approximately 60 countries to find ways to strengthen global nuclear security and reduce the continuing threat of nuclear terrorism. An important focus of the later summits (2014 and 2016) was the recognition of the need to prevent unauthorised persons acquiring radioactive materials that could be used in an RDD or RED. At the last summit in 2016 a gift basket: Strengthening Security of High Activity Sealed Radioactive Sources was agreed which committed signatories to increase their efforts to manage high activity radioactive sealed sources throughout their entire life cycle. The gift basket has now been circulated to all IAEA Member States as Information Circular 910.

The vision of the World Institute of Nuclear Security is that: “all nuclear and other radiological materials and facilities are effectively secured by demonstrably competent professionals applying best practice to achieve operational excellence” and to achieve its mission: “To be the leader in knowledge exchange, professional development and certification for nuclear security management”. WINS has a comprehensive approach to radioactive source security dividing our work into six major subject matter areas: Taking a Whole Life Approach to radioactive sources, Radioactive Source Security in the context of Medical Applications and Industrial Applications, Alternative Technologies to the use of High Activity Radioactive sources; Security of radioactive sources in transport, and End-of-Life Management for radioactive sources. The programme of work in the area of radioactive source security is supporting through our four work programmes: Workshops and Training; Knowledge Centre; WINS Academy Programme and Benchmarking and Evaluation, including peer review services.

WINS is prepared to trial new approaches and test received wisdom on the security of radioactive sources. WINS is constantly reaching out to new audiences to ensure that there is widespread recognition of the importance of permanent risk reduction in relation to radioactive sources, whether this involves enhanced radioactive source security in use, storage and transport or the consideration of alternative technologies to radioactive source security where technically and economically feasible. WINS will be upgrading its WINS Academy programme on the security of radioactive sources in 2019 which will be a stand-alone programme designed for individuals with accountability for the security of radioactive sources in a wide variety of contexts. This programme will contribute significantly to the professional development of individuals with accountability for radioactive source security in a variety of contexts. This work will provide support for the sustainability of the radioactive sources security infrastructure, globally ensuring its effectiveness overtime.

Abstract ID: 349

Radiological Source Security in Major Urban Areas

Bieda, T.[1]

[1] Ministry of Energy and Mining, Argentina

Corresponding Speaker: T. Bieda

The threat related to criminal or intentional unauthorized acts involving nuclear or other radioactive material out of regulatory control has long been a matter of national and international concern and cooperation. Recent terror attacks in major urban areas across the globe have made that threat more urgent. Developing and enhancing nuclear security detection capabilities within a State's interior are an important component in a national-level defence-in-depth approach.

However, the uniqueness of major urban areas pose a challenge to Member States because it obliges them to integrate these detection and response capabilities into already existing security architecture. Nuclear security in major urban areas is a hard task to accomplish because it does not have a specific (and limit) time and place, as for instance in major public event: is an everyday challenge across the whole city. Also, major urban areas mostly uses regular security forces that operates according to normal procedures on a daily basis. These security forces probably did not had any previous and specific radiological and nuclear training. The organization of such a security operation requires huge amounts of resources and a specific risk assessment, as well as a tailor nuclear security detection and response plan. Security in major urban areas also requires the involvement of all the different stakeholders, including those who are not mainly related to the nuclear or the security field. And it is also creates a challenge when communicating to high authorities because the threat is constant and ongoing, therefore the security operations needs to remain always ignited, and this could generate a conflict with other threats that might seem more "real" and "immediate".

This paper is going to present the main findings, best practices and lessons learn from the Buenos Aires International Workshop on Nuclear Security in Major Urban Areas. The focus is going to be on how raise awareness on this topic, identifying key stakeholders and responsible authorities and providing guidance to high authorities and different stakeholders about the unique challenges of major urban areas. Also, how to share experiences on integrating nuclear security into existing security plans, with necessary customization to major urban areas. Finally, the importance of emphasize nuclear security culture, engaging every stakeholder involved in a major urban area security protocol as a key component to guarantee nuclear security, preparing responsible authorities to address nuclear security events in major urban areas, and suggesting recommendations for training programs.

Abstract ID : 72

Security of Radioactive Material in Nuclear Security Training Programmes in Kazakhstan

Izmailova, N.[1]; Idrissova, M.[1]; Norris, S.[2]

Institute of Nuclear Physics, Kazakhstan; National Nuclear Security Administration, Department of Energy, USA

Corresponding Speaker: N. Izmailova

Numerous enterprises in energy, mining, oil and gas industries and medicine in Kazakhstan use tens of thousands of sources of ionizing radiation. Significant economic benefits from industrial and medical applications of radioactive sources are accompanied by risk of their theft and malicious use. Therefore, the prevention of unauthorized access to radioactive materials and ability to respond effectively to attempted thefts of radioactive material is an important component of national security. Kazakhstan needs hundreds of specialists in radiological security. Through a cooperative effort between the Institute of Nuclear Physics (INP) of the Ministry of Energy of the Republic of Kazakhstan and the United States Department of Energy, National Nuclear Security Administration (DOE/NNSA), a new Kazakhstan Nuclear Security Training Center (NSTC) has been constructed and opened in 2017 at the INP site in Alatau, Kazakhstan. The technical base of the Center allows both theoretical and practical training of specialists of services responsible for the secure use, storage, transportation of nuclear and radioactive materials. As a result of joint US-Kazakhstan training needs analysis conducted in February 2018, radiological security was included in the prospective scope of NSTC curriculum. The priority training topics to be developed and/or transitioned in 2018-2019 include physical protection of high activity radioactive sources in use and in storage; securing transportation of high activity radioactive sources; regulatory inspection of source security; preventing the transport of undeclared materials; and maintenance of portal radiation monitors. The premise of this abstract is to share with Conference participants Kazakhstan's process for determining its radiological security training needs, the regulatory and policy basis for radiological security trainings, and initial findings on what the training needs are.

Abstract ID: 307

Human Resource Development, a Key Asset in Detecting Nuclear Other Radioactive Material

Galy, J.[1]; Knott, A.[1]; Krevica, I.[1], Bagi, J.[1], Mayer, K.[1]; Wallenius, M.[1]; Rauff-Nisthar, Nadya.[1]; Pappas, R.[2]; Peper, S.[2]; Forcina, V.[1]; Wojtas, W.[3]; Van Heeswijk, W.4

[1] Joint Research Centre, European Commission; [2] National Nuclear Security Administration, Department of Energy, USA; [3] DG HOME, European Commission; 4 DG TAXUD, European Commission

Corresponding Speaker: J. Galy

There is a clear consensus among security experts that nuclear terrorism is one of the greatest threats to global security and that strong preventative measures are needed to lock down nuclear materials around the world. A strategy to counter nuclear terrorism is founded on measures to prevent thefts of nuclear and other radioactive material and to provide a defence against malicious acts on facilities, supplemented with a range of detection and response measures in the event that prevention is unsuccessful.

At present, widespread use of radioactive materials for medical and industrial applications is associated with the above-mentioned risk of theft of such materials with their potential use in criminal and terrorist acts. An organization's roles and responsibilities during such associated nuclear security incidents shall require interdisciplinary skills and understanding of the technical aspects of radiation. In this context, appropriate and skilled human resources are understood as the most essential asset in strengthening the detection and interdiction of smuggled nuclear and other radioactive material. Retaining and training human resources are thus of major importance to support the States to enhance and upgrade their capabilities in prevention, detection and response of a radioactive or nuclear security event. Training lies therefore in the heart of the nuclear security infrastructure and becomes central in its sustainability.

Training is considered as a systematic process through which a nuclear security organization's human resources gain knowledge and develop skills by instruction and practical activities that result in improved States nuclear security capabilities. In that respect, national and international developments of training programmes shall ideally pattern the training for front line officers, their management, trainers and other experts in the field using adult learning methodologies and providing hands-on training using the actual threat materials and the detection equipment deployed. Consequently, several States and international organizations have launched initiatives in nuclear security training and education assistance as their contribution to enhancing the security of both nuclear and radiological material and know-how. Knowledge and expertise in this specific subject are, nevertheless, not enough to ensure that training is effective, thus focus is put on "train-the-trainers" (T3) sessions. This advanced course is to instruct selected participants on methodology to train pairs on how to best detect and respond to illicit trafficking of nuclear or other radioactive materials. The sessions are designed as strategic measure for cascading nuclear security related knowledge to the competent user groups in the Member States.

With the view to keeping abreast of Member State's needs in this particular area as their programme gain maturity, the international organizations such as the European Commission or the US Department of Energy (DoE) supports training activities in international Nuclear Security Training Centers, such as the DOE Volpentest Hazardous Materials Management and Emergency Response (HAMMER) Training Center, located in Richland, Washington USA or the European Nuclear Security Training Centre (EUSECTRA) operated by the Joint Research Centre of the European Commission. The concept of these has been highly influenced by the cooperative work of the Border Monitoring Working Group and benefited from the experience and support of its members to assist Member States in indigenizing such training activities by integrating these elements into their established law enforcement curricula.

For instance, annually, the EUSECTRA conducts more than 20 nuclear security trainings events for the EU Members States, as well for the non-EU states within outreach activities of the EU under its Instrument for Pre-Accession, Instrument of Nuclear Safety Cooperation, and the CBRN Centres of Excellence (COE) under the Instrument contributing to Stability and Peace (IcSP), for the EU MSs under the support of DG TAXUD (for Customs Officers) and DG HOME (for the law enforcement community), or in cooperation with international partners such as the US/DoE/NSSA/NSDD.

The range, depth and number of training events have continuously increased in the past few years and cover thematic and skills building topics, as well as the full range of national responsibilities for nuclear security. The training, which can be tailored to the needs of the various organizations responsible for nuclear security, can be provided in a national, regional or international setting. Since its inauguration in 2013, more than 80 countries – from the 5 continents have beneficiated from EUSECTRA trainings.

International support programmes have been acknowledged in supporting national human resources in: 1) improving detection/response capability at border crossing points and elsewhere on the external borders and in interior for Radioactive and Nuclear materials; 2) increasing knowledge, skills, and expertise of the front line officers operating RN detection equipment, and for expert on dedicated techniques or procedures; 3) facilitating that best practices are identified and absorbed by the participants in all areas of nuclear security from detection to forensics; 4) maintaining competency, providing national trainers.

The global approach in providing training and expertise dissemination is then expected to better meet the increasing need for human resources related to nuclear security.

Abstract ID : 242

Nuclear Security Continual Improvement

Manion, J.[1]; Gray, P.[1]

[1] Pacific Northwest National Laboratory

Corresponding Speaker: P. Gray

There are three pillars of an effective nuclear security regime: capacity-building, sustainability, and continual improvement of the systems and measures defined in IAEA Nuclear Security Series No. 20, Objective and Essential Elements of a State's Nuclear Security Regime. From a practical perspective, how do you continually improve a nuclear security regime? IAEA TECDOC 1491, Management of Continual Improvement for Facilities and Activities: A Structured Approach, provides a high-level, management view of continual improvement for nuclear security regime, but does not focus on the specific activities needed to achieve that goal. This paper will highlight some best practices for continual improvement within the prevention and detection mission areas of a nuclear security regime as well as the steps the Department of Energy's National Nuclear Security Administration's (DOE/NNSA) Office of Global Material Security (GMS) is taking to implement continual improvement in nuclear security with its' partners.

Over the last 20 years, GMS through its three program offices, Office of International Nuclear Security (INS), Office of Radiological Security (ORS), and the Office of Nuclear Smuggling Detection and Deterrence (NSDD), has worked with over 100 countries around the world to build capacity, sustain, and continually improve partner countries' ability to secure radiological and nuclear (R/N) materials and to deter, detect, and investigate R/N smuggling. The United States Government, through GMS, has made a significant investment in equipment deployment, training, maintenance, and exercises to help partners worldwide build robust and sustainable R/N security capacities:

- to protect and secure nuclear and radiological material;
- detect and interdict material out of regulatory control;
- investigate R/N smuggling through traditional and nuclear forensics;
- reduce the global reliance on radioactive sources;
- remove and dispose of unneeded or unused radioactive sources; and
- deter R/N threat with increased visibility of security and anti-trafficking messaging.

Continual improvement requires the baseline guidance found in statutes, regulations, plans, and procedures (which mandate resource allocation and define performance indicators at the national,

organizational, and individual levels for nuclear security), an assessment tool (a formal exercise program), and a process for implementing improvement plans. GMS is actively supporting regulatory and procedural development with partners in bilateral engagements and regional workshops to assist with national response plans for nuclear security events and organizational standard operating procedures (SOP) for both safety and security. GMS also assists in partner development of their own formal exercise programs to assess both procedures and operations. Employing a formal exercise program to assess performance indicators found in regulatory documents and procedures informs the improvement planning process and allows partners to improve over time.

Specific GMS activities supporting continual improvement:

- Nuclear security regulatory assessments
- Assist development of national response plans for nuclear security events
- Assist development of organizational standard operating procedures
- Assist development of equipment operating procedures
- Facilitate multi-phase workshops to establish partner exercise capacity
- Facilitate drills and field training exercises to assess operator performance

Support development and implementation of event after action reporting and improvement plans.

Abstract ID: 326

Considerations for Newcomers to Strengthen the Security of Radioactive Materials and Associated Facilities

Elhefnawy, O.[1]

[1] Egyptian Nuclear and Radiological Regulatory Authority (ENRRA), Egypt

Corresponding Presenter: O. Elhefnawy

Radioactive materials are used in wide area of applications due to the variety in their physical properties; they have many usages in medical, industrial, research and other applications. Radiation protection is very important to protect operators and individuals from harmful radiation effects, also securing radioactive materials and associated facilities from any malicious acts like unauthorized removal or sabotage hasn't less importance than radiation protection and it is essential in any radiological applications. The security of radiological activities faces many challenges especially in newcomer countries, due to many regulatory and financial requirements. Thus, only few numbers of newcomer countries are sensitive for security of radioactive materials and associated facilities. This paper's intention is to show the Egyptian model for security of radioactive materials and associated facilities and discuss many challenges affecting on the national nuclear security of radiological activities and also discuses considerations for newcomers to develop the security of radioactive materials and associated facilities as following:

Radioactive security culture

The most important consideration in the security of radioactive materials and associated facilities is the security culture. The radiation protection takes much attention and important through the regulatory body, licensee and individual than radioactive security culture. That results delay in issuing security regulations and defining the security requirements, implementing the security requirements by licensee and also designing efficient physical protection systems for securing the materials and associated facilities. Regulatory body need to recognize why they should accelerate in completing the national security regime and licensee should implement the security requirements of the national nuclear security regime. All of them have to adjust their thinking, that the nature of the hazard doesn't comes from their radiological effects only, but also it may be comes from the harmful consequence of lost or stolen the radioactive materials.

Control the Radioactive sources

Control the radioactive sources faces many challenges in newcomer countries due to their multiple applications, there is no single or defined user community for radioactive sources as in the nuclear industry. So there are many styles of radioactive sources with different specification which need different types of physical protection requirements. Also, in contrast to nuclear material, which is often stored in government owned and protected facilities, radioactive sources is often used and stored by the private sector in places with minimal or no physical protection system.

Limited Regulatory Resources

The radioactive materials are used in many applications, so security of radioactive materials and associated facilities and activities needs highly variable regulatory requirements, which costs much money. Also because of the budget of the regulatory bodies are extremely limited in newcomers. They spend their budget for security of nuclear activities rather than radioactive activities.

Safety Orientation of Operators

Safety operators may also work as a security officer, however they aren't qualified in the security of radioactive materials and activities, or it may be an additional task to their safety responsibility. Safety-oriented operators that are newly responsible for security of radioactive materials generally require raising their security awareness and they should be well qualified and adequately trained on implementing nuclear security requirements. Transfer of radioactive sources

The radiological applications are widespread in all countries and frequently involve the cross-border transport of radioactive sources. They are mobile and haven't fixed transfer path either on-site, off-site or outside the countries, so it is a major challenge for many countries to control the multiplicity of transfers of the radioactive sources. Therefore, radioactive sources are particularly vulnerable to theft during their transboundary movement.

Insider threat

The external adversary is not the only threat that should be considered for radioactive materials and associated facilities. The insiders could take advantage of access, authority and knowledge to commit a malicious act. Thus, radiological facilities should implement a type of preventive and protective measures suitable for the nature of radioactive sources.

Considerations for strengthening the nuclear security of radioactive materials and associated facilities:

- Newcomer countries should improve and expand the radioactive security culture between the operators and all other workers in the radioactive facilities and activities.
- The international community should support and cooperation with newcomers to be adviser, technical and financial support for enhancing the security culture.

- Newcomer countries should establish effective nuclear security regime, also classifying the radioactive materials into different categories and obligate the licensee to implement the physical protection system requirements for each category to get the license.

- Newcomer countries should establish a nuclear security regulation deals with transportation of radioactive sources (in-site, off-site or outside the countries).

- Radiological facility should establish an efficient physical protection system depending on the type its activity and according to the regulatory requirements, then it should be approved by the regulatory authority.

- Developing a well qualified and trained security officer in each facility on the nuclear security aspects is very important to implement the security regulatory requirements.

Abstract ID : 238

Sustainability Considerations for Advanced Nuclear Smuggling Detection Systems

Hoyt, J.[1]; Obie, G.[2]; Wadlow, J.[1]; Wright, J.[3]; Maple, S.[1]

[1] Pacific Northwest National Laboratory, USA; [2] Los Alamos National Laboratory, USA; [3] Sandia National Laboratories, USA

Corresponding Speaker: J. Hoyt

Over the past 20 years, the US Department of Energy National Nuclear Security Administration's Office of Nuclear Smuggling Detection and Deterrence (formerly referred to as Second Line of Defense and Megaports) has worked with more than sixty countries to implement technical, operational, and programmatic solutions that enable deterrence, detection, and investigation of the illicit trafficking of nuclear and other radioactive materials. Standardized technical solutions such as radiation portal monitors and handheld radiation detectors have been deployed extensively, and have proven both suitable and sustainable for the majority of operational environments in which the Office and its partners are engaged. However, these same technologies have proven relatively ineffective in more challenging operational scenarios. Container scanning in high-volume, trans- shipment seaports; monitoring of countries' interior regions; and operational models requiring dynamic monitoring locations each necessitate some form of readily relocatable radiation detection solution to accommodate operational constraints while enabling realization of mission objectives. Similarly, locations with relatively-high nuisance alarm rates require a more-efficient alarm-adjudication approach to preclude large operational burdens represented by these frequent events.

To address these architectural gaps, the Office has successfully piloted or implemented several specialized detection platforms that meet mission needs while simultaneously minimizing operational impact. This paper examines four such cases: Mobile Detection Systems, Radiation Detection Straddle Carriers, Mobile Radiation Detection and Identification Systems, and Spectroscopic Portal Monitors. To orient the reader, this paper describes the unique mission prompting development and implementation of each system, the distinctive design elements enabling the system to address an architectural gap, and the general approach to integrating each detection capability into partner country operations. The authors then provide an analysis of the Office's experience in co- operating with implementing partners to build programs that assure sustained operation of these important architectural components. Notable

elements of a healthy, sustainable program include: a clear operational mandate implemented through policies and procedures, effective training for all involved in operations and maintenance, timely and efficient system maintenance, and a strong assessment capability enabling operational coordination and organizational feedback. The strengths and challenges presented by each platform are discussed, as they relate to the ability of partners to maintain efficient, effective, and enduring nuclear smuggling detection and deterrence programs.

A careful assessment of the Office's experience in this area generates numerous important lessons learned. Taken separately, each case analysis offers insight into the sustainable operation of the respective radiation detection platforms. When considered collectively, these experiences can be used to inform future solution development and implementation activities.

Abstract ID : 229

The Importance of National Stakeholders' Involvement and Synergies in Setting up an Effective Integrated System for the Security of Radioactive Material: Kuwait's Approach and Experience

Alawadhi, N.[1]

[1] Kuwait Institute for Scientific Research

Corresponding Speaker: N. Alawadhi

In the context of globalization and owing to the prevailing situation in many parts of the world, nuclear security has increasingly emerged over the past years as one of the most critical issues posing considerable challenges of worldwide, regional and national significance. Nuclear terrorism, with its potential catastrophic consequences on people, national infrastructures and the environment, is one of the major threats facing the world today. Preventing nuclear terrorism is one of the main drivers of the collective efforts of the international community to strengthen nuclear security globally through enhanced cooperation and vigorous international mechanisms.

Consistent with its long standing commitment to the global nuclear security regime, the Government of the State of Kuwait has put nuclear security high on its agenda and accords special attention to the cooperation in this field with the IAEA and with the countries in the region, in particular within the GCC.

The cooperation with the IAEA is guided in particular by the directions and priorities defined in Kuwait's Integrated Nuclear Security Support Plan (INSSP), which serves as the effective implementation framework to address in a systematic manner immediate and future national needs and priorities in nuclear security, and whose implementation over the past few years has proved to be an effective mechanism supporting a holistic approach to nuclear security within the country. The INSSP plays a key role in channelling national efforts towards achieving in the shortest time possible a strong and sustainable nuclear security infrastructure and its implementation makes an important contribution to the overall security in the country through strengthening institutional, human and technical capability in various aspects of nuclear security, including Control and Securing of Radioactive Sources, National Response Plan, Illicit Trafficking and Border Controls. The INSSP's scope covers all required components from the legal and regulatory framework to prevention, detection and response to prevent any unauthorized acquisition, supply, possession, use, transfer or disposal of nuclear and other radioactive material, with or without crossing Kuwait's international borders.

Significant steps have been undertaken to set up an overall coordination and participative mechanism to ensure the continued effective involvement of the key national stakeholders and their sustained contribution to the on-going effort towards building human and institutional capacity in nuclear security, promoting nuclear security culture and strengthening the national nuclear security infrastructure.

The State of Kuwait has ratified or adopted the most relevant nuclear security related instruments, including the International Convention for the Suppression of Acts of Nuclear Terrorism, the Resolution 1540 adopted by the UN Security Council in 2004, the Convention on the Physical Protection of Nuclear Materials (CPPNM) and its Amendment.

Consistent with the national commitment related to the obligations under the CPPNM Amendment, special consideration is being given in Kuwait to strengthening further physical protection in all facilities using nuclear material and enforcing appropriate measures to prevent thefts of nuclear material and any malevolent acts involving nuclear material, as well as establishing an adequate response capacity to deal with any radiological emergencies associated with malicious acts.

The Government recognizes the importance of having comprehensive national legislation in place to ensure the safe, secure and peaceful conduct of activities involving the use of nuclear technology, and is aware of the fact that the effective implementation of the above mentioned international legal instruments resides in the extent to which relevant provisions are incorporated in the national legislative and regulatory framework. Major steps are being undertaken to this effect by the national competent authorities with the active contribution of the regulatory body, the Radiation Protection Department (RPD), Ministry of Health, to strengthen further the national legislative framework and regulatory infrastructure with respect to all aspects related to nuclear security.

The present paper provides highlights of the activities carried out and the progress achieved in this regard, with special emphasis on:

- Improving the national comprehensive legal and regulatory framework for the security of radioactive material;
- Enhancing domestic interfaces, strengthening stakeholders involvement and promoting nuclear security culture for increased security of radioactive material;
- Instituting measures for National Design Basis Threat Assessment, Designing Basis Threat (DBT) for radioactive materials, and developing a roadmap for building a robust Nuclear Security Detection Architecture for Material Out of Regulatory Control;
- Enforcement of effective measures to ensure the security of facilities housing radioactive sources;
- Maintaining an updated national inventory of radioactive material and security categorization of radioactive sources;
- Capacity building activities in support of the national efforts towards setting up and sustaining

a strong and viable system for the security of radioactive material in Kuwait.

Abstract ID : 190

The Exercise Development Workshop: A Suite of Tools for Exercises and Evaluation

Roberts, C.[1]

[1] Pacific Northwest National Laboratory, USA

Corresponding Speaker: C. Roberts

The U.S. Department of Energy's Nuclear Smuggling Detection and Deterrence Program (NSDD) conducts Exercise Development Workshops to aid partner countries in the design, development, execution, and evaluation of exercise activities, as well as the implementation of continuous improvement in their nuclear detection architecture. Exercise activities are a critical component in enhancing radiation detection systems (RDS) capabilities and they play a vital role in improving national preparedness to counter nuclear smuggling attempts. Once a partner country has a documented Standard Operating Procedure (SOP) for detection activities at sites and the capability to execute their own exercises, an Exercise Development Workshop can be a useful tool to ensure the partner country has an understanding of exercise planning, exercise execution, the evaluation process, and evaluation-based continuous improvement. The NSDD Exercise Development Workshop includes a systematic approach to exercise planning and execution that partner countries can use to develop exercise programs or incorporate into their existing exercise programs.

This paper will describe the components and goals of NSDD's Exercise Development Workshop, including a discussion of the systematic approach to exercise planning and execution. The NSDD Exercise Development Workshop aims to describe the importance of an exercise program methodology in building and sustaining a nuclear and radiological detection and interdiction program; to introduce the NSDD Radiation Detection System Exercise Development Guide and tools; to demonstrate tabletop exercises and drills; and finally to employ a building block approach with workshop breakout sessions to plan for future exercises in the participating partner countries. This paper will examine the workshop objectives that help meet the goals described above and highlight recent participating partner countries' experience with the workshop and follow-on activities that demonstrate practical application of skills developed at the NSDD Exercise Development Workshop.

Recent examples of the NSDD Exercise Development Workshop include a session with representatives from Poland and Ukraine in attendance and another session was conducted with representatives from Dominican Republic, Spain, and Panama. A discussion of certain partner countries' experience in the workshop and their follow-on exercise planning and conduct activities will high- light the crucial benefits of exercises in maintaining and improving a robust security detection architecture. Recent experience highlights that NSDD partner countries choose to integrate the tools learned from the Exercise Development Workshop into their national and site-level nuclear detection architecture in

different ways. An exploration of recent follow-on exercise activities be- tween NSDD and its partner countries will provide an opportunity for this paper to highlight best practices and lessons learned in exercise planning and conduct.

Abstract ID : 111

In a New York Minute: Economic Impacts of Radiological Dispersion Device

Trost, L.[1], Vargas, V.[1]

[1] Sandia National Laboratories, USA

Corresponding Speaker: L. Trost

In the Fall of 2015 the Office of Radiological Science (ORS) began working with Sandia National Laboratories (SNL) to use enhanced data, new models/methods, and informal expert elicitation to improve upon past studies and produce a better understanding of the full range of economic consequences of an RDD event. This analysis explores in detail the consequences and impacts associated with an RDD detonated in a major metropolitan area.

A representative (not worst case) scenario was developed to examine the effects of an RDD on populations, critical infrastructure, and buildings were examined in detail. Economic impacts were estimated at the local, regional, and national level based on physical effects, response, remediation, and event timeline. Findings suggest major impacts on society and the economy, however, prior resilience efforts and a prompt, coordinated response and recovery can reduce the effects to the population and the regional economy.

Informal expert elicitations, revealed that local response actions would primarily be focused on maintaining the health and safety of the local population. Actions include: demarcation of a protection zone, shelter-in-place areas, emergency transportation pathways, and identification of populations to be evacuated/relocated.

For this analysis, subway system contamination was much less than initially assumed. New models demonstrated that dispersal did not contaminate the entire system. It was limited to just a few stations with some disrupted because of their proximity to the protection zone. SNL indoor and surface infiltration models (PATH/AWARE) enabled a detailed analysis of infiltration into buildings and indoor surfaces. Results indicate low levels of indoor and surface contamination resulting in limited indoor remediation. The low levels are likely attributable to the built-in resilience of modern HVAC systems and increased performance in air filtering systems. Remediation costs were moderate due to limited replacement of indoor furnishings, fixtures, and equipment.

Modern building construction methods may limit the need for demolition. Many buildings in the event zone have facades, an outer layer, that could be removed and replaced with minimal disruption to indoor occupants. An additional feature of this remediation technique is likely low levels of re-suspension from the event compared to traditional demolition; further contributing to reduced costs when compared to past studies.

Business disruptions are characterized by the loss and the long-term relocation of businesses and residents are relocated within NYC MSA (9/11 findings). Perception effects manifest via worried well populations seeking unnecessary medical treatment and reduced tourism (similar to post- Fukushima). Regional impacts vary tremendously with some positive offsets. First year cost categories had significant down turn, but multi-year (10 years) analysis showed some recovery. With limited national effects found in the analysis. The response protocols, readiness, and action thresh- olds determine cost and human impact to a great extent resilience and preparedness will make a difference and either drive the economic costs higher/lower in a real event.

Abstract ID : 56

BATAN's Practices on Prevention and Detection Measures for the Security System of its Radioactive Material

Hasan, Y.[1]

[1] National Nuclear Energy Agency of Indonesia

Corresponding Speaker: Y. Hasan

The research and development of nuclear science and technology in Indonesia has been operating since the late 1950s, and has contributed in various sectors of life. To date, the nuclear research and development is mainly carried out by the National Nuclear Energy Agency (BATAN). BATAN, which was established in 1958, has several decades of experience in using the radioactive material for many purposes: food and agriculture, health and medicine, natural resources and environment, and industry. Currently, BATAN has been operating some irradiators and radioisotope production facilities located in Jakarta, and Serpong. All nuclear science and technology activities are carried out professionally for peaceful purposes only by taking into account the principles of safety and security, as well as environmental sustainability, in accordance with the provisions of the legislation. To ensure the security of radioactive material and associated facilities from various threats, BATAN has implemented security system of radioactive material according to existing standards developed by the IAEA, and maintained and strengthened the system through security systems measures, such prevention and detection. The paper will give a description of such activities. Indonesia has established and maintained a national legislative framework to govern physical protection of radioactive material and associated facilities. The framework for the regulation of nuclear security within Indonesia consists principally of Act No 10/1997 on Nuclear Energy, and Government Regulation (GR) No 54/2012 on the safety and security of nuclear installations. Other regulations relevant to nuclear security are GR 33/2007 on the safety of ionizing radiation and security of radioactive sources, GR 29/2008 on the licensing of ionising radiation sources and nuclear materials utilisation, and GR 58/2015 on radiation safety and security in transport of radioactive materials, and BAPETEN's Chairman Regulation (BCR) 6/2015 on the security of radioactive sources, and BCR 1/2010 on emergency preparedness and response. The threat of nuclear security is increasingly real. Many events that are related to national security threats have recently occurred at some public areas. The issue of nuclear security is a part of national security. Strengthening of nuclear security implies the need to take the necessary measures to minimize the probability of, prevent the occurrence of, and carry out precautionary actions to mitigate the subsequent damage of, malicious acts

involving attacks or sabotage to nuclear facilities or misuse of radioactive material. Such measures are directed to provide adequate physical protection from attacks and irresponsible hands by prevention and detection. Prevention measures include the establishment of the organization of radioactive source security, training, background checks, information security systems, and access control. For this purpose, BATAN has developed, updated and implemented the radioactive sources security program and its verification report; promoted security culture; ensured that radioactive source security equipments are functioning properly; ensured the availability of radioactive source security personnels, procedures, and equipments; and provided radioactive source security training for personnel involved in the activities. The background check measure aims to assess the trustworthiness of the personnel, establishing access authority to radioactive resources, and identify undesirable behavior. Detection measures include providing detection equipment, and continuous monitoring by the security personnel. Detection equipments include, among others, handy talky, fixed telephone and mobile phone, alarm system, motion detectors, closed circuit television, infrared sensor, and balance magnetic switch, and radiation portal monitor. Radioactive source security system is to prevent unauthorized acquisition and malicious use of high activity, dangerous radioactive sources is a priority matter being addressed by BATAN. For that, all BATAN's nuclear facilities have applied the robust physical protection system. Hence, the radioactive sources located in BATAN's nuclear facilities are considered to be under good control and physically protected.

Abstract ID : 116

Development of an International Security Standard for Devices Containing High Levels of Radiological Material

Nilsson, A.[1]; Valencia, J.[2]; Kuca, M.[3]; Kjall, P.[4]

[1] AN&Associates, Sweden; [2] Pacific National Northwest Laboratories, USA, [3] Office of Radiological Security, Department of Energy, USA, [4] Elekta Instrument AB, Sweden

Corresponding Speaker: A. Nilsson; M. Kuca

Radioisotopes such as Cs-137 and Co-60 are utilized in various medical, industrial, and research applications. This radiological material can be a theft or sabotage target which necessitates a certain level of security to adequately protect it. The presented work will discuss the need for an international security standard for devices used in clinical medical settings, with high activity radioactive sources and the facilities that contain these devices. A standard developed by an international standards organization such as ISO or IEC, intends to complement existing IAEA safety standards and security guidance. However, it serves a very different purpose: to reduce the threat of radiological theft and sabotage at the same time as it takes into full consideration the effect such a standard may have on the patient, for user safety and patient workflow. The contribution of operators, equipment and radioactive source producers and medical staff in the development of the standard will ensure effective security implementation while minimizing unwanted effects of the security measures. The paper will clarify the complementary nature of an international ISO/IEC standard and IAEA security guidance. The proposed new standard will align with existing IAEA security principles of Deterrence, Detection, Delay, Response, and Security Management as outlined in the IAEA's Nuclear Security Series No. 11 Implementing Guide: Security of Radioactive Sources and the IAEA's Nuclear Security Series No. 14 Recommendations: Nuclear Security Recommendations on Radioactive Material and Associated Facilities. While those documents primarily focus on the state, competent authorities, and regulatory agencies, the new standard will address device and facility manufacturers and operators.

Abstract ID : 198

Nuclear Security features for the Interim Radioactive Source Storage Facility in Uganda

Asaba, R.[1]

[1] Atomic Energy Council, Uganda

Corresponding Speaker: R. Asaba

Uganda uses radioactive sources in industry, research, and medical practices. The examples of such practices include industrial radiography (non-destructive testing), level gauging in bottling industries, the density and moisture gauges in road construction, well logging in oil and gas and radiotherapy, among others. The security of these radioactive sources are a national priority.

The disused sealed radioactive sources are currently kept in stores at facility sites which are scattered within the country. This poses security threats to the public and environment in case of loss of radioactive sources since it is difficult to monitor the management of the sources.

In 2015, during routine inspections by Uganda's regulatory body-Atomic Energy Council (AEC) at Kasese Cobalt Company Limited in western Uganda, 2 out of 8 fixed nuclear gauges having Cs-137 were found missing in the abandoned old Cobalt mine. The operator was in final stages of winding up business and the old mine appeared to be partially abandoned with a few security officers on site. A visual and physical search was conducted a week later by the AEC team but no sources were recovered. These radioactive sources went missing even though the facility had some existing security features incorporated into their management system.

The existing legal framework requires the operators to repatriate disused sealed radioactive sources to the manufacturers since there are no facilities and institutions to manage disused sealed radioactive sources. However, some facilities have no return agreements for returning disused sources to the manufacturer and others are unable to return these sources due to the high costs involved in repatriating such sources. Consequently, the government through Atomic Energy Council in collaboration with the United States Department of Energy constructed an interim radioactive source storage facility where the disused sealed radioactive sources and orphan sources will be stored. Uganda embarked on a search and secure exercise of orphan sources in 2015, although none has been secured to date. Currently, AEC is maintaining a database of disused sealed radioactive sources with long and short half-lives and activity ranging from 6.19E-7Ci to 1000 Ci. If these sources are not secured properly, could land in the hands of terrorists who could use them as dirty bombs.

The interim radioactive source storage facility (IRSSF) constructed has been installed with nuclear security systems mainly for detection and prevention of an adversary from accessing the sources stored there in. The nuclear security systems installed at the IRSSF are categorized into two i.e. the closed circuit television (CCTV) systems and the alarm systems. The CCTV systems consist of six cameras covering the left, right, front, back and inside of the IRSSF and the alarm system consisting of vibration sensors, balanced magnetic switch, motion sensors and automatic dialer system, among others. The IRSSF also has an inverter with 200A power back up that can run the security systems for a period of 8-10 hours in the event the hydroelectricity power went off the site. In addition after the inverter switches off, the alarm system is still powered on by another built in uninterrupted power supply (UPS) in the system panel to give back up of 16-18 hours.

The IRSSF has access control systems and other management systems put in place to secure the sources that are intended to be stored there in. AEC is in the process of installing the cages inside the IRSSF for securing small sources that will be stored there in. Furthermore, the management is also considering to chain down big radioactive sources that will be stored there in.

This paper discusses in detail the nuclear security features installed at the interim radioactive source storage facility in Uganda and how they function in order to detect any adversary that could break into the facility.

Abstract ID: 345

Challenges Implementing Physical Security Measures at a Source Manufacturing Facility

Miller, J.[1]

[1] International Source Suppliers and Producers Association, USA

Corresponding Speaker: J. Miller, USA

Implementing physical security measures at a source manufacturing facility is complicated by the dynamics associated with this type of operation. Unlike sealed radioactive sources contained in devices at end users' facilities, radioactive materials and radioactive sources at a source manufacturing facility are found in various stages of production and must be readily accessible, preventing the use of in-device delays commonly found on devices containing radioactive sources. Other measures such as the use of radiation area monitors may not be as effective at the source manufacturing facility where alarm set-points may need to be set at levels much higher than those that would be utilized to monitor and detect the removal of a radioactive source from a device at the end user facility. The source manufacturer must rely heavily on the trustworthiness and reliability of the employees and other administrative controls such as detailed procedures that govern the handling of radioactive materials and radioactive sources, from the time of receiving bulk radioactive materials used in production to subsequent shipment of the product to the end-user.

Abstract ID : 142

Site Security Plans: Best Practices and Common Pitfalls

Manion, J [1]; Almonte de Hernandez, N.[2]; Weise, R.[1]

[1] Pacific Northwest National Laboratory, USA; [2] Dominican Republic

Corresponding Speaker: J. Manion

The US Department of Energy - Office of Radiological Security (ORS) assists partner countries in implementing their security obligations under the Code of Conduct on the Safety and Security of Radioactive Sources. This assistance includes development of security regulations, as well as development of guidance to operators to draft site security plans (SSPs), as recommended in Nuclear Security Series No. 14. To that end, ORS works with regulatory authorities in partner countries to develop “SSP Guidance” used to guide operators in preparing security plans that meet both national and international security requirements. Once a regulatory authority has issued SSP Guidance, ORS also works with operators in drafting SSPs that meet the content specified in the national SSP Guidance. Where a country has adopted radioactive source security regulations, the SSP Guidance is based on those regulations. Where regulations have yet to be enacted, the SSP Guidance can operate as a stop-gap measure to improve security until regulations can be enacted.

ORS has partnered with the Comision Nacional de Energia (CNE), the regulatory authority in the Dominican Republic, for ten (10) years in support of radioactive source security. CNE enacted security regulations requiring operators to draft SSPs in 2013, with input from ORS on regulatory content. In early 2017, ORS conducted a workshop with CNE to develop SSP Guidance for Domini- can operators, and later that year coordinated an SSP “Write-Shop” with Dominican operators to assist them in drafting their SSPs as instructed by the Dominican SSP Guidance document.

This paper will describe some best practices and common pitfalls in issuing SSP Guidance and for regulatory authorities. The paper will rely on the experiences of ORS in assisting multiple countries in drafting SSP Guidance and operators in writing SSPs, and will also draw on the experience of the Dominican Republic in developing its SSP Guidance and working with operators to finalize their SSPs. A few examples of the best practices and common pitfalls to be explored in the paper include the following:

Best practice: The SSP Guidance is based upon and closely follows relevant legislative or regulatory requirements.

Related common pitfall: Security plan guidance does not follow or contradicts legislation or regulations.

Best practice: The SSP Guidance is clear and sufficiently detailed according to experience level with security arrangements in the country.

Related common pitfall: Guidance on security plan is too vague, often because new regulatory bodies are unsure what elements operators should include.

Best practice: Regulator authority has conducted design basis threat (DBT) and has developed process to communicate relevant information to operators about measures necessary to address that threat.

Related common pitfalls:

The regulatory authority has not conducted a DBT.

The regulatory authority asks operators to conduct a threat assessment.

The required security standards are not based on the DBT or threat assessment; it is unclear how necessary threat information will be conveyed to operators.

Abstract ID: 385

Security of Radioactive Materials: the Jamaican Regulatory Authority Perspective

Warner, T.[1]

[1] Hazardous Substances Regulatory Authority, Jamaica

Corresponding Speaker: T. Warner

Unsafe handling of radioactive materials can cause harm to people, property and the environment. With over 300 known users of ionizing radiation and Jamaica's growing interest in applying peaceful uses of the atom, a national regulatory infrastructure was necessary to govern use throughout the entire life of radioactive materials from cradle to grave. The government of Jamaica signed into law, the Nuclear Safety and Radiation Protection Act, 2015, resulting in the establishment of the Hazardous Substances Regulatory Authority (HSRA) in 2017. The HSRA has already commenced activities to reinforce security of radioactive materials in order to ensure sustainability, coordination and formalization of roles and responsibilities. HSRA, through its inspection and authorization processes, is actively developing a comprehensive inventory programme for radioactive materials, in addition to undertaking a feasibility study for siting of a national storage facility for disused sealed radioactive sources (DSRS). The authority will host the national repository for DSRS. This paper seeks to provide information on the activities of the HSRA, address present and foreseeable challenges/concerns such as human resource capacity, adequate training, raising awareness among decision makers, stakeholders and the public and to provide insights on solutions in fulfilling the local, regional and international mandate of actively securing radioactive materials.

Abstract ID : 293

Technical and Scientific Support Capabilities of the Nuclear Security Department (MTA EK, Hungary)

Völgyesi, P.[1]; Kovács, A.[2]; Csöme, C.[1]; Kovacs-Szeles, E.[1]; Almási, I.[1]

[1] Nuclear Security Department, Hungarian Academy of Sciences, Centre for Energy Research, Hungary;
[2] Atomic Energy Engineering Company Ltd, Hungary

Corresponding Speaker: P. Völgyesi

The Centre for Energy Research of the Hungarian Academy of Sciences (MTA EK) has got significant role in assuring nuclear security both in Hungary and in the region based on its more than four decades R&D activities in nuclear physics and chemistry. As one of the Technical Sup- port Organizations (TSO) of the Hungarian Atomic Energy Authority significant expertise and experiences have been gathered in the course of developing the necessary technical infrastructure and human resources in gamma-spectroscopy, neutron measurements and in the detection and characteristic analysis of nuclear and radioactive materials. All these achievements resulted in the delegation of the task of in-field categorization and detailed characterisation of confiscated or found unknown origin nuclear materials to MTA EK by a Governmental Decree (17/1996), up- dated recently (490/2015, XII.30). One of the main activities of MTA EK and its Nuclear Security Department nowadays, is the participation in combating illicit trafficking of nuclear materials and nuclear terrorism, i.e. nuclear forensics.

MTA EK operates the only Nuclear Forensics Laboratory in Hungary carrying out activities connected not only to Response but also to Prevention and Detection of Nuclear Security.

To extend our capabilities a Mobile Laboratory was established with the following functions in the same construction (3-in-1): 1. to find and categorize hidden radioactive materials (control major public events), as well as to categorize confiscated/collected nuclear or other radioactive materials at the scene; 2. to transport the collected nuclear or other radioactive materials from the scene to the nuclear forensics laboratory; 3. to perform environmental monitoring, site characterization and decontamination in accidental situation. This laboratory is equipped with various hand-held detectors (alpha-, beta-, gamma-, and neutron detection and identification), on-line dose-mapping system and in-situ gamma-spectrometer. The extension of its technical capabilities with a high sensitivity remote-controlled detector-system is our significant ongoing task. Our Mobile Expert Support Team (MEST), with significant expertise in practical nuclear physics, has the tasks (1) to perform radiological crime scene investigation and material collection regulated by operation procedures for the request of relevant authorities on the radiological spot and (2) to handle unexpected events being in continuous preparedness service (7/24). All these activities are supported by our Testing Laboratory aiming at to help the development of nuclear instruments and detection systems for nuclear security purposes using dynamic and static tests under controlled conditions. Unique property of the laboratory is the availability of wide scale of alpha-, beta-, gamma- and neutron emitting shielded radioactive sources and nuclear materials in different activities together with shielding materials.

Abstract ID : 174

Best Practices for Security of Mobile Radioactive Devices Commonly Used in the Industrial Radiography Industry

Kluse, B.[1]; Karie, B. [2]; Carr, M.[1]

[1] Pacific Northwest National Laboratory; USA; [2] Acuren Inspection, Inc., USA

Corresponding Speaker: B., Kluse

Radioactive sources are used in radiography to inspect welds or metal integrity across the globe. These mobile radioactive sources are of sufficient curie quantities to be categorized as desirable sources for actors with malicious intent. Understanding the operational use of these sources is critical in identifying a security approach focused on layered security during all phases of use (storage, transit, field). Acuren Industrial Services has partnered with the Pacific Northwest National Laboratory as part of the ongoing efforts of the U.S. Department of Energy/National Nuclear Security Administration's Office of Radiological Security (ORS) to develop a holistic security strategy that addresses all phases of operational use within the radiography industry.

The fundamental challenge of mobile radiological devices is the control and accountability of the source when it is in transit or in use in the field. Maintaining control and accountability of the location of the source and confirming that the source is in fact still in the proper container is critical when addressing this specific security concern. Working with industry, ORS has developed a mobile source transit security (MSTS) system that monitors, records and reports the status of mobile radioactive sources using sensor based, active RFID technology to track the cameras. The MSTS system uses various electronics to provide near real-time status which is communicated from the Master Control Unit through a telematics device to the cloud, providing situational awareness to the partner company. The MSTS system is designed to be integrated into the industries' standard equipment and vehicles and contains an internal radiation detector that can detect the presence of the individual source. In the event of an upset condition (lost or stolen source), an alarm is sent to the partner company for immediate notification of key personnel to the field condition. User Concept of Operations, integrated device tamper alarms, encrypted communication, and state of health communication are additional areas of enhanced security that the MSTS system provides.

This paper will be a collaborative paper between ORS and Acuren and will explore the security best practices for radiography facilities during all phases of operational use as well as the reasoning and desire to integrate tracking type technologies, such as the MSTS system, into daily operations. The discussion will highlight both the ongoing efforts with Acuren as well as the ongoing efforts with key radiography camera manufactures. For Acuren the focus will be on the integration of the MSTS system into their daily operations, the expected impact to the users of the system, and the added internal benefits beyond security that are expected. The focus on the radiography camera manufactures will be on the integration of the MSTS system into their existing camera designs and the desire to transfer the technology to the camera manufactures for broader availability to the radiography industry.

Abstract ID : 176

Best Practices for Security of Mobile Radioactive Devices Commonly Used in the Well Logging Industry

Kluse, B.[1]; Carr, M.[1]; Haddock, S.[2]

[1] Pacific Northwest National Laboratory, USA; [2] Baker Hughes, A GE Company, USA

Corresponding Speaker: B. Kluse

Radioactive sources are used in the oil and gas industry to characterize exploration and production wells providing critical data to exploit geological formations in pursuit of oil caches. These mobile radioactive sources are of sufficient curie quantities to be categorized as desirable sources for actors with malicious intent. Understanding the operational use of these sources is critical in identifying a security approach focused on layered security during all phases of use (storage, transit, field). Baker Hughes has partnered with the Pacific Northwest National Laboratory (PNNL) as part of the ongoing efforts of the U.S. Department of Energy/National Nuclear Security Administration's Office of Radiological Security (ORS) to develop a holistic security strategy that addresses all phases of operational use within the well logging industry.

The fundamental challenge of mobile radiological devices is the control and accountability of the source when it is in transit or in use in the field. Maintaining control and accountability of the location of the source and confirming that the source is in fact still in the proper container is critical when addressing this specific security concern. Working with industry, ORS has developed a mobile source transit security (MSTS) system specific for well logging sources that monitors, records and reports the status of the sources using sensor based, active RFID technology to track the source containers. The MSTS system uses various electronics to provide near real-time status which is communicated from the Master Control Unit through a telematics device to the cloud, providing situational awareness to the partner company. The MSTS system is designed to be integrated into the industries' standard equipment and vehicles and contains an internal radiation detector that can detect the presence of the individual source. In the event of an upset condition (lost or stolen source), an alarm is sent to the partner company for immediate notification of key personnel. User Concept of Operations, integrated device tamper alarms, encrypted communication, and state of health communication are additional areas of enhanced security that the MSTS system provides.

This paper will be a collaborative paper between ORS and Baker Hughes and will explore the security best practices for well logging facilities during all phases of operational use as well as the reasoning and desire to integrate tracking type technologies, such as the MSTS system, into daily operations. The discussion will highlight ongoing efforts with Baker Hughes and will focus on the integration of the MSTS system into their daily operations, the expected impact to the users of the system, and the added internal benefits beyond security that are expected. Highlights and identified challenges that have been overcome as part of ongoing field studies will be identified. In addition, the ORS strategy to transfer the MSTS technology to the industry will be detailed with the end goal of broader availability to the well logging industry.

Abstract ID : 195

A Practical Sharing Experience for Pilot Project in on-line Tracking of Mobile Radioactive Sources in Viet Nam

Phi, V.[1]; Tran, M.[1]; Luu, N.1; Bui T.1;

Vietnam Agency for Radiation and Nuclear Safety, Viet Nam

Corresponding Speaker: V. Phi

Industrial radiography (NDT) is one of the applications of radiation and radioisotopes. According to database of Vietnam Agency for Radiation and Nuclear Safety (VARANS)—the regulatory body of Viet Nam – there are about 60 companies using security-level B radioactive sources. Approximately 40 companies or groups have been given licences for NDT using approximately1300 mobile radioactive sources; 700 of these sources are in use and 600 are in storage. The security of such kind of mobile radioactive sources is highly concerned in the regulatory management of Vietnam

To enhance the capability in ensuring the security of NDT sources, the new technology is considered to apply. VARANS cooperated with Republic of Korea and IAEA to launch a project "Radioactive Source Location Tracking System (RSLTS) in Viet Nam" since 2015. The project is called as RADLOT-VN for a familiar name. This is an activity aimed at implementing the agreement between Vietnam and Republic of Korea at the Seoul Nuclear Security Summit 2012 on building a system to track the location and status of radioactive source following the best practice in Korea. RADLOT-VN is a pilot project that provides the identification of radioactive sources and locates them in real time based on location information obtained from GPS satellite signals and mobile telecommunications networks.

Within the project, Korea will provide equipment and build the RADLOT system in Viet Nam with the support and consultancy of the IAEA.

We have successfully installed the system in Viet Nam throughout all the stages as scheduled. In M1 stage, we designed the CCS system, completed the system function analysis and CCS sync test. In M2 stage, we finished GUI design, developed location tracking function module, developed web server float form and others. In M3 stage, we performed final function tests for CCS and system sync test. This stage was when we completed the development and the final functions. Following M3 stage, in M4 stage, we transferred and installed the system in Hanoi, Viet Nam. In this stage, we finally launched the beta test to check on the functions and had a final check up before the handover in M5 stage.

The training session for Licensees was held on 17th January, 2017 in Vietnam. Total of 10 Licensees from 5 companies national-wide in Viet Nam participated in the training.

The beta test completed in July 2017. We were able to successfully launch the beta test in Viet Nam although there were some difficulties. MTUs were deployed to assigned Licensees in time and were successfully attached. We have also monitored and provided support in real time for both Licensees and VARANS during the beta test.

VARANS accomplished to hand over and deploy 30 equipments to 05 domestic companies to test the reality in 12 months (since September 2017).

After the test, we collected all the MTUs again and checked carefully one by one. As we checked the collected MTUs, we discovered that several MTUs were in defect. The defects include, defect in battery, defect in GM-Tube, defect in modem USIM slot, defect in boards, defect in antenna and others.

Throughout the project, we collected feedbacks from Licensees after the test to make our system more friendly. Consequently, the system has been developed in such a more suitable manner for Viet Nam circumstances.

The establishment of this system in Viet Nam would help enhance the radioactive sources security, prevent unauthorized access, and the loss and theft of radioactive material sources, which would once again confirm our national commitment in the effort to encounter the threat of nuclear terror- ism. Additionally, this project will contribute to the plan to enhance the nuclear security culture in Viet Nam.

This paper describes the current status of, the need for, and new practices to improve the radioactive sources security of used in the field of industrial radiography in Viet Nam.

Abstract ID: 308

Unmanned Ariel Systems as an Enhancement and Threat to Radioactive Material Transport and Physical Security

Aaron, A.[1]; Anderson, K.[1]

[1] Oak Ridge National Laboratory, United States of America

Corresponding Speaker: A. Aaron

Unmanned Aerial System (UAS) Technology has advanced greatly over the last decade. With this advancement, the basic capabilities of UASs could be employed to gain an advantage against adversaries and enhance the security of radioactive material during shipment, storage, and use. UASs may be used for ground surveillance, provide counter surveillance against malicious UASs, add security to shipments, or to physically counter malicious UASs. The greatest limitations to UASs include power requirements, communication availability, laws and regulations, and exploitation by adversaries. With the increase in availability of UASs, adversaries can exploit this technology for nefarious means. Solutions are currently being pursued world-wide to counter UAS threats.

A standard, out of the box UAS can record a HD video feed and transmit lower quality real time video to the pilot or control station on the ground. Equipped with GPS receivers, the UASs can be given a pre-programmed route to follow around a facility, be dispatched to a specific location in response to an alarm, or be told to follow a vehicle during transit. The standard UAS will have one or multiple visual spectrum cameras attached, though other optics could be used to enhance surveillance capabilities. The location and heading of the UAS is easily known and can help ground forces respond to threats at fixed locations, allow a vehicle to be monitored while stopped, or watch for adversaries during transit. With speeds up to 150 km/hr published on current UASs, they would be able to deploy from a vehicle, make observations, and dock without stopping.

To monitor a fixed site, a combination of fixed wing and rotorcraft would de be deployed. These craft would be used to augment the capabilities of fixed camera systems already in existence and to increase the perimeter of facility surveillance. The fixed wing craft could achieve longer mission times by employing a small combustion engine, while the rotorcraft would run shorter missions but gain the ability to hover in place and monitor a fixed location. A small fleet of fixed wing craft could patrol a site, sending camera feeds back to a monitoring station, looking for unauthorized activity. If the fixed wing craft noticed an anomaly, a rotorcraft could be dispatched to further investigate. Using a UAS would allow faster response and minimize risk to personnel. This application would be limited by communications range, power capacity of platform. These could be mitigated with the appropriate infrastructure or use case and selecting the appropriately sized platform for the specific task.

UASs could be developed to enhance the security of radioactive material during transport. Three applications will be discussed in this paper: Stopped vehicle monitoring, panic response, and intransit surveillance. Stopped vehicle monitoring would occur when the driver needs to make a rest stop, for example, when re-fueling. A UAS with a downward facing camera could be deployed to monitor the perimeter around the vehicle. It could be set to alert the driver if unauthorized persons approach. The time period such a system could operate without recharging and the need for reasonable spacing between this vehicle and others around it could limit the applicability of this solution. If a panic response is triggered, a roof-mounted UAS could immediately deploy and begin to monitor/record the vehicle and events surrounding it, transmitting photos, videos, and telemetry back to the dispatcher. The UAS could be equipped with a distress signal that is transmitted from the air above the shipment, avoiding any jamming devices that may be used by adversaries. This UAS would require a clear vertical path to launch and would have limited operation time. If suspicious activity was happening around a moving vehicle, a UAS could be designed to be deployed from the moving vehicle and give the driver visibility of the conveyance and its surroundings. While UASs are currently capable of speeds and performance necessary to perform this task, this application would require significant development to achieve the undocking and re-docking from and to a moving vehicle.

One of the greatest limitations that all UAS solutions will face is laws and regulations that govern the development and use of UASs in different countries. This includes both current laws and ever-changing laws and regulations, a challenge that comes with the development of new technologies. Before implementing or developing a UAS solution, the laws and regulations of the country should be considered, and any licensing or permits should be obtained.

UASs have already been established as a threat to humans, both from a negligence and malicious perspective. Pilots could purposefully operate UASs with malicious intent, and in fact, UASs are being weaponized. ISIS is known to have a commercial UAS weaponizing program that specifically targets their enemy troops. Recently, US allied forces used a Patriot Missile to destroy a weaponized UAS to protect troops in the vicinity. In this case, since there was no viable alternative available to protect these troops, a missile costing between 1 million USD and 6 million USD was used to protect against a modified UAS, which cost less than 1000 USD. Patriot Missiles are not typically available to protect radioactive material against adversarial UASs, so other countermeasures, including counter UASs, are being developed. Other solutions include directional antennas that jam the UAS communication signals, falconry, and thermal laser systems. These technologies will be discussed in the paper.

This paper will also cover a use case for Hungary, where UASs are being implemented to enhance security of radioactive material.

UASs are inexpensive and capable platforms that may be used to enhance the security of radioactive material during storage, transport, and usage. The technology is largely limited by power density of power sources and the laws and regulations of the countries its used in. Countermeasures are being developed to deter and protect against hostile use of UASs. Countries are already considering UAS technology enhancements and are working through the current technology limitations.

Abstract ID : 296

Legal and Regulatory Framework on Security Transport of Radioactive Material

Utami, S.[1]

Nuclear Energy Regulatory Agency of Indonesia

Corresponding Speaker: S. Utami

Security of radioactive sources is a new concept introduced in Indonesia compared to existence of the concept of safety and physical protection for nuclear material and installation that have been implemented through year. Radioactive Sources are being used all cover the world, including Indonesia for many decades to benefit the humankind for various applications, for example to diagnose and treat illness, irradiate food, non-destructive testing, well-logging, etc. Some sources contain relatively large amounts of radioactive material that could potentially be used for malevolent purposes. The Act No.10 Year 1997 stipulated that any activity related to the utilization of nuclear energy is required to be conducted in a manner which observers safety, security, peace, health of workers and the public, the protection of the environment. This requirement is further implemented by Government Regulation No. 33 Year 2007 on Safety of Ionizing Radiation and Security of Radioactive Sources. Indonesia has issued Government Regulation No. 58 Year 2015 on Radiation Safety and Security in Transport of Radioactive Material.

With reference to Article 14 Act No 10 Year 1997, BAPETEN (Nuclear Energy Regulatory Agency) is empowered to control on the utilization of nuclear energy including the utilization of ionizing radiation through regulations, licensing utilization, and inspections. In conducting its tasks, including law enforcement with regard to security of radioactive sources as well as radiation safety. The basic principles of nuclear energy regulate on practice in Indonesia set out in the law provide that control of any nuclear energy utilization is aimed to:

- Assure the welfare, the security and the peace of people;
- Assure the safety and the health of workers and public, and the environmental protection;
- Maintain the legal order in implementing the use of nuclear energy;
- Increase the legal awareness of nuclear energy user to develop a safety culture in nuclear field;
- Prevent the diversion of the purpose of the nuclear material utilization; and

- Assure for maintaining and increasing the worker discipline on the implementation of nuclear energy utilization.

The Act stipulated that any activity related to the utilization of nuclear energy is required to be conducted in a manner which observers safety, security, peace, health of workers and the public, the protection of the environment. This requirement is further implemented by Government Regulation No. 33 Year 2007 on Safety of Ionizing Radiation and Security of Radioactive Sources. As part of the nuclear regulatory control, an export-import authorization system of radioactive sources are founded in article 61 to Article 65 of the Government Regulation No. 33 Year 2007. Article 61 states that prior to consigning radioactive sources category 1 and category 2, the importer shall ensure that domestic users already obtained license from BAPETEN as well as the exporter. Besides, the exportation requires: exporter shall have obtained licensee from BAPETEN and ensure that importer for radioactive sources category 1 and 2 also holds license from the regulatory authority 2. The aim of the regulation is to ensure the safety, security, peace and health of the workers and people and to protect the environment. The national strategies to minimize the likelihood of a loss control based on the Government Regulations. The regulations have provisions for authorization for receipt, possession, use, transport, import, export and disposal of radioactive sources; to obtain a license, the user must meet certain requirements which are stipulated in Ref.

BAPETEN perform main task to assure safety, security and safeguards during transportation of radioactive material as stated in the GR No. 58 Year 2015 on Radiation Safety and Security in Transport of Radioactive Material.

BAPETEN perform main task to assure safety, security and safeguards during transportation of radioactive material, as stated in the GR No. 58 Year 2015 on Radiation Safety and Security in Transport of Radioactive Material. In this regulation cover all aspects to regulate the safe trans- port of radioactive material which cover licensing, role and responsibility shipper, receiver, and regulatory body, transfer cask, radiation protection program, quality assurance program, qualification of radioactive material, and emergency response. BAPETEN evaluates and reviews all permit application document transportation of radioactive material. Validation of any certificate is one of important step to assure the safe transport of radioactive material. All data submitted to BAPETEN shall be verified by inspection in appropriate way in order to conform completeness and correct- ness. For international transfer of radioactive material via any border of neighboring country, the specified custom body in the border will take offer this task to verify all transport document validation including license to transport of radioactive material issued by BAPETEN. The challenges in the transport programme were due to the geographic position of Indonesia (domestic and international issues), the utilization of radioactive material and frequency of transport increase, the lack of infrastructure to monitor and control (fund, inspector, procedure, coordination, etc.) and the fact law enforcement mechanism for non-compliance have not established or implemented. The compliance assurance programme of Indonesia includes the establishment and implementation of national regulations in transport of radioactive material, implementation of the shipment approval system for each transport activity, and of validation system for design certificate of package, installation of radiation protection monitors (RPM) in some ports, conduct of inspection with priority for high activity of radioactive material and for nuclear material (especially SNF) and coordination of emergency drills and exercises routinely. Pertaining to the regulatory control of radiation safety and security, BAPETEN has successfully established an information system on licensing and inspection for radiation facilities and radioactive sources, this model is called B@LIS (BAPETEN Licensing and Inspection System). The B@LIS Export/Import is on-line with the Indonesian National Single Window (INSW).

REFERENCES

[1.] Act of the Republic of Indonesia Number 10 of 1997.

[2.] Government Regulation No. 33 Year 2007 on Safety of Ionizing Radiation and Security of Radioactive Sources (2007).

[3.] Government Regulation No. 58 Year 2015 on Radiation Safety and Security in Transport of Radioactive Material (2015)

[4.] Code of Conduct on the Safety and Security of Radioactive Sources, IAEA/CODEOC/2004,

IAEA, Vienna, 2004

[5.] Chairman Decree No.6 Year 2015 on Security of Radioactive Sources, BAPETEN, Jakarta

Abstract ID : 10

Prioritizing Security Risks in Research Reactors

Sfetsos, A. [1], Tsourounakis, I. [1], Varvayianni, M.[1]; Catsaros, N. [1]

[1] INRASTES, NCSR DEMOKRITOS, Greece

Corresponding Speaker: A. Sfetsos

Two main elements of the proposed approach include:

The successful attack depends upon two elements 1) the Facility, which can be further expanded to its (1a) attractiveness as a target and (1b) its identified vulnerabilities that could be exploited ; and 2) the adversary, that has the (2a) capabilities and (2b) the desire / motivation / intension to carry out the attack

The impacts are determined hierarchically for the following : 1) Asset operation (disruption of service, damages, costs, and loss of NM) , 2) Facility level operation (loss of services, loss of NM, human losses, reputation, safety/security performance degradation), 3) External to the facility (material released to the environment, health, economy, environmental impacts, and societal response to the incident)

The present work introduces a proposal on how to quantify security risks on which Research Reactors are exposed to, with consequent task of prioritizing amongst identified threats. The proposed work is the starting point of trying to identify the constituent elements of a risk assessment as introduced in IAEA documents (NSS No. 11, 13, 14, 24).

According to proposed approach, risk is quantified as the likelihood of a successful adversary act and the level of consequences it has. The determined risk levels could be used for effective design and improving of security measures.

The proposed approach is implemented in the following steps:

1) Identification of RR critical assets based upon weighted criteria both quantifiable (NM available, cost) and expert defined (importance to facility)
2) Define threat scenarios from DBT
3) For each of the identified scenarios
4) Determine the likelihood of a successful attack, using a weighted combination of the elements determined in –I– above, based on expert opinion

5) Define the impacts –II– again using an expert elicitation from the defined categories and a weighted average
6) Determine risk level from a risk matrix
7) Comparison of different threats

Additionally, the work will perform a short sensitivity study on the relative importance of the defined weights to examine their influence of risk ranking. A case study on HYPOTHETICAL ATOMIC RESEARCH INSTITUTE (HARI) will be discussed.

This work is part of Coordinated Research Project (CRP) on "Nuclear Security for Research Reactors and Associated Facilities (RRAFs)" – J02006

Abstract ID : 65

Radiological Threat, Where We've Come From and a Path to the Future

Potter, C.[1]

[1] Sandia National Laboratories, USA

Corresponding Speaker: C. Potter

Following the attacks on US high-profile targets in 2001, a focus on analysis of a spectrum of threats was undertaken to include the possibility of the use of radiation sources by a terrorist adversary. At the time, little attention was paid to the security of sources, although personal attacks in the form of poisonings or exposures had occurred several times around the world. Between 2001 and 2008, research on how sources might be used to cause havoc and harm and the associated causal effects was undertaken. A seminal work in this area was published by the US National Research Council entitled Radiation Source Use and Replacement. This report described the particular danger presented by the use of radiation sources in many activities including radiotherapy, blood irradiation, sterilization, industrial radiography, well-logging, and others, the danger being the presence of unsecured sources in highly-populated areas. The IAEA has taken a leading role in the protection of radiation sources. In 2004, the Code of Conduct on the Safety and Security of Radioactive Sources was published, encouraging member states to secure and protect radiation sources that could be used for physical, psychological, or economic harm. This was followed by documents in the Nuclear Security Series including the recommendations published as NSS 14, Nuclear Security Recommendations on Radioactive Material and Associated Facilities and the associated implementing guide NSS 11, Security of Radioactive Sources. The US has instituted a multi-agency effort to enforce radiation source security, provide guidance on security systems and source replacement, detect the presence of sources outside of regulatory control, and respond to events where a radiological exposure device, radiological dispersal device, or radiological poison have been detected or employed. A remaining constraint is in the perception of the risk of radiation exposure. The linear-nonthreshold concept of radiation effects was introduced in the late 1940s and has persisted to this day. This has driven guidance for evacuation, relocation, and cleanup standards that could result in additional harm to individuals and debilitating costs for response and recovery. There is a movement within the scientific community to replace this concept with a threshold of at least 0.1 Sv below which deterministic effects from radiation have not been observed and additional stochastic (e.g., cancer) risk cannot be differentiated from normal

occurrence. The importance of this is twofold. First, the spread of contamination without reaching a level at which actual harm could occur would be a minor event, rather than resulting in extended quarantine and escalating the cost of cleanup. This could deter a perpetrator in that true economic harm would not be achieved. The second is implicit in the previous, in that the cost to a government to recover from such an event would be reduced and normality allowed to resume over a shorter period of time. It is therefore important that actual risk be incorporated into evacuation, relocation, and cleanup standards to ensure that actions post event are actually protective and increase the safety and security of affected individuals and economies.

Abstract ID : 94

Risk Informed Approach for Nuclear Security Measures for Radioactive Material Under Regulatory Control

Ek, D.[1]; Snell, M.[1]

Sandia National Labs, USA

Corresponding Speaker: D. Ek

The International Atomic Energy Agency (IAEA) Implementing Guide, NSS-24-G, describes a very important risk informed approach and methodology for development of nuclear security systems for Material Out of Regulatory Control (MORC). As NSS-24-G points out the publication does not address threat and risk assessment for material under regulatory control. This paper is meant to address that omission, to explain how facility-level physical protection effectiveness approaches can be incorporated into nuclear security risk-informed approaches in a way that is consistent with the approaches and methods adopted for MORC. The paper will focus primarily on qualitative approaches and methods described and used in IAEAs Nuclear Security Assessment Methodology for Regulated Facilities (NUSAM) Coordinated Research Project, but the paper will briefly address on how to incorporate physical protection evaluation quantitative data into nuclear security system risk approaches.

Abstract ID : 108

Risk Context for Radiological Material: How to Assess Threats and Consequences

Ladd, M.[1], Potter, C.[1], Wallace, E.[1]

[1] Sandia National Laboratories, USA

Corresponding Speaker: M. Ladd

Military and civil defence planners are increasingly concerned about the threat posed by the malicious use of radioactive materials. In 2003, the international community responded to this concern when it strengthened the Code of Conduct on the Safety and Security of Radioactive Sources. Since then, numerous conferences have been held to increase radiological security awareness and make the security of radioactive sources a global priority. A significant component of radiological security is the risk-based analysis, which seeks to understand the specific threats and consequences associated with radiological material.

Sandia National Laboratories conducts assessments of the malevolent use of radiological materials using this risk-based approach to evaluate the likelihood of malevolent use and the associated consequences. Elements are identified for each of the factors to develop a more complete model. The likelihood of malevolent use examines the perpetrator's motivation, the vulnerability of the material, the capabilities of the perpetrator to develop and assemble an attack method, and, lastly, the perpetrator's ability to successfully deliver and deploy the attack method. The consequences of an attack evaluate the health effects, the psychosocial effects, and the economic losses. The U.S. National Academy of Sciences used this same framework for its 2008 Radiation Source Use and Replacement Study, one of the early reports that used a risk model to assess the potential malevolent use of radiological materials and recommend solutions to reduce the risk, such as phasing out the use of CsCl.

This presentation will provide an overall context for the national security risk associated with radiological materials and help address the rationale for security measures needed for these sources beyond safety-related security requirements. The presentation will:

- Examine different attack methods and highlight the radiological dispersal device (RDD) as the attack method with the highest malevolent risk potential.

- Discuss device detonation effects, radioactive cloud creation, and identification of the contamination zone, with a focus on the contamination zone since its identification is a public policy decision and economic consequences are highly correlated to that decision.
- Review consequences using radiological accidents.
- Discuss the likelihood of malevolent use using open source data to assess intent and capabilities to develop and deploy an RDD. Proxies or related capabilities will be identified given the lack of data for actual RDD attacks.

Abstract ID : 205

Malicious Use of Radioactive Materials as Radiological Dispersion or Radiological Exposure Devices: A Historical Review

Adduci, J.[1]

[1] Argonne National Laboratory, United States

Corresponding Speaker: J. Adduci

More than one hundred ten (110) historical cases involving actual, attempted or intended use of radioactive material for malicious purposes were identified based on unclassified and open source information through 2017. This study is a review of historical events where the intent was to use radioactive material for malicious purposes, as reported in open source literature. Its purpose is to better understand the nature of past malicious use attempts and the threats/vulnerabilities they reveal to better guide security activities aimed at reducing the terrorist threat posed by the malicious use of radioactive material. The information collected and aggregated in this study is not intended to investigate case specifics (open source reporting often gets details wrong), but is being utilized to reveal broad trends related to these events. While not necessarily predictive of the types of terrorism attacks that might occur in the future, these cases do provide a rich information source from which lessons can be gleaned pertinent to the potential security and public safety threats posed by commercial radioactive material. These include:

There has been a sharp and sustained increase in the number of terror-motivated cases in the last 20 years. This increase demonstrates that aspirations remain present.

There has been a corresponding decrease in the number of incidents motivated by personal motives or for extortion purposes. This likely reflects increased regulatory controls present on the commercial use of radioactive material worldwide. The drop has been particularly significant in the last ten years, which corresponds to the implementation of enhanced regulatory and security practices for most of the world.

The increase in terror-motivated cases reflects plots and attempts in countries where one would expect such activity, including the U.S.

To date, despite aspirations, would-be terrorists have had little success in mounting a successful attack using radioactive materials. This lack of success reflects disruptions early in the planning process, the apparent inability of terrorists to obtain significant quantities of radioactive material, and a lack of technical understanding of what radioactive material would be of the greatest value in a radiological attack, where to obtain such material, and how best to use it.

However, there were a number of successful attacks by perpetrators motivated by personal agendas. These attacks have included at times significant quantities of radioactive material (Category 2 or greater amounts) and have resulted in target casualties.

For personal attacks/extortion, where the radionuclide was known and an attack mode other than poisoning was used, the primary radionuclides used in attacks were 137Cs and 192Ir. The majority of non-poisoning attacks that caused casualties were also typically based on 137Cs or 192Ir. Nearly all of the cases with Category 2 quantities of material involved 192Ir.

In contrast to individuals with personal vendettas, would be terrorists exhibited a fascination for nuclear facilities such as nuclear power plants or fissile weapons facilities and uranium. The former are difficult targets while the latter is actually of little value for a radiological attack.

There were four dominant sources of radioactive materials used in attacks – medical facilities, research facilities, fuel cycle facilities, and mobile sources such as radiography cameras and oil and gas exploration.

Abstract ID: 377

National Threat Assessment for Radioactive Materials

Cervera, M.[1]

[1] United States Nuclear Regulatory Commission, USA

Corresponding Speaker: M. Cervera

One of the basic principles of the Code of Conduct on the Safety and Security of Radioactive Sources is (paragraph 16) that 'Every State should define its domestic threat, and assess its vulnerability with respect to this threat for the variety of sources used within its territory, based on the potential for loss of control and malicious acts involving one or more radioactive sources.' Thus the development and use of either a national threat assessment (NTA) or a design basis threat (DBT) as described in NSS 10, as per the guidance in both NSS 14 and NSS 11 (both the original and proposed revised versions), is important and useful to use as a basis to develop and maintain adequate regulatory control of radioactive material within a State. The United States Nuclear Regulatory Commission (NRC) does maintain applicable DBTs for power reactors and some fuel cycle facilities, but has determined that the threat assessment process was more appropriate for the myriad facilities that use radioactive materials.

Since many States have requested information on how to determine whether a DBT or NTA is appropriate, and then how to actually conduct the threat assessment the NRC determined that there may be value in sharing our process. Therefore, this presentation will cover the process, described in NSS 10, that the NRC uses to conduct and maintain the threat assessment that forms the basis for the physical protection measures that are required of licensees in the United States. The discussion will include: 1) general basis for the determination that NTA was the appropriate vehicle for radioactive materials facilities, 2) the necessary and continuing national cooperation between the NRC and other Federal agencies to gather relevant information, 3) types and sources of information that may inform the NTA, and 4) how the NTA is communicated at various levels for both national assurance and implementation of physical protection. Further information on the practical application of the NTA to physical protection regulation in the United States is then displayed in a separate presentation by the NRC.

Abstract ID: 325

Threat Assessment and Development of DBT in Croatia

Medić, M.[1]; Medaković, S.[2]

[1] State Office for Radiological and Nuclear Safety, Croatia; [2] State Office for Radiological and Nuclear Safety, Croatia

Corresponding Speaker: M Medić

Synopsis: Pursuant to the Act on Radiological and Nuclear Safety (OG 141/13, 39/15 and 130/17), article 66, and the Ordinance on Nuclear Security (OG 36/18), the State Office for Radiological and Nuclear Safety (SORNS), as the state administration body, is the competent authority for all activities related to the physical protection of nuclear and radiological material. This includes the development of the Design Basis Threat. The provisions related to the Threat Assessment and development of Design Basis Threat have been introduced in the new amendments of the Act and in newly pronounced Ordinance in accordance with the provisions of the Code of Conduct, the recommendations of IAEA NSS 11 and the Implementing Guides NSS 10 and 14. According to the same Act state administration bodies competent for internal affairs, defense and national security, based on regulations regulating police affairs and the security and intelligence system in the Republic of Croatia, are obliged to prepare and periodically review a threat assessment specific to the regulation of radioactive and nuclear materials.

As a way of implementing threat assessment in the regulatory framework, we decided that the assessment of threats specific to the radioactive and nuclear materials should be the basis for DBT development which then becomes the basis for the development of Nuclear security plans for Category 1 sources, all nuclear material categories and all radioactive waste management facilities. We have chosen the approach that we have estimated to be best suited to the number of sources, the facilities where they are used and the temporary stored and the planned radioactive waste management facilities in Croatia. So far, in Croatia there have been no incidents that would lead to attempts of malicious use of radioactive material, but the security situation on the European and world scene shows that the risk of theft and malicious use of radioactive material or sabotage of related facilities is present and growing.

Despite the obligation of the competent state administration bodies, for the time being, they have not shown great willingness to cooperate. Given that the legal deadlines for development of the DBT, and then the alignment of nuclear security plans with it, are relatively short SORNS has decided to take the

initiative and start drafting a threat assessment based on the publicly available data and Incident and Trafficking Database (ITDB). This approach requires a great analytical work for which SORNS has very limited resources and a small number of people who are able to undertake such activities. In collaboration with Sandia National Laboratories we have also conducted a very successful workshop on "Understanding and Development of a Threat Assessment and Design Basis Threat for Use in the Protection of Radiological Material" where we received an excellent response and a different look at the assessment of the threat and the DBT but unfortunately, we still have no confirmation of cooperation of competent authorities.

The problems we encounter in threat assessment and DBT development process points all the shortcomings of insufficient co-operation between state administration bodies in small countries where the nuclear safety culture is still developing.

Abstract ID : 73

Regulatory Inspections of Radioactive Materials-Relationship with Licensing and Enforcement Process

Shah, S.[1]; Abbas, M.[1]

[1] Official, Pakistan

Corresponding Speaker: S. Shah

Regulator performs various functions to discharge its responsibilities related to security of radioactive sources such as development of regulatory requirements, review and assessment, conducting inspections and taking enforcement actions. All regulatory functions are interdependent and could not be performed in isolation. Issuance of authorization/license to radiation facilities depends upon inputs from other regulatory functions because authorization/license is issued after fulfillment of regulatory requirements which are verified by the regulator through review and assessment of licensee's submission as well as conducing verification inspection. Pakistan Nuclear Regulatory Authority (PNRA) is an independent regulatory authority in Pakistan responsible to regulate all matters related to ionizing radiations. PNRA has well established mechanism for licensing of nuclear installation as well as radiation facilities. PNRA Ordinance empowers the inspectors to conduct inspection at all reasonable hours at any premises for the purpose of satisfying that provisions of Ordinance are being complied in consonance of the laws of land. PNRA has promulgated regulations on licensing of radiation facilities (PAK/908) which is used to regulate safety and security of radiation facilities. The regulations on licensing of radiation facilities covers radiation generators and radioactive material. After issuance of authorization/license different types of regulatory inspections e.g. announced, unannounced inspections etc. are performed to verify compliance to regulatory requirements and appropriate enforcement actions are being taken in case of non-compliance to regulatory requirements and license conditions. Announced inspections are those carried out in fulfillment of, and in conformance with, a structured and largely pre-arranged or baseline inspection program developed by the regulatory body. Announced inspections are linked to operator schedules for the performance or completion of certain activities at all stages of the authorization process. Unannounced inspections are usually performed in response to an unexpected, unplanned or unusual situation or an incident, in order to assess its significance and implications and the adequacy of corrective actions. In case of non-compliance to regulatory requirements, PNRA has well established enforcement mechanism including enforcement

regulation (PAK/950). Under the enforcement mechanism, the authority gives show cause notice and opportunity of being heard to the licensee and may take enforcement decision about suspension and/or cancellation of the licence/authorization based upon significance of violation affecting effectiveness of physical protection of radioactive material. As a last resort criminal proceedings are initiated in the court of law in case of persistent non compliance. The violator could face penalties such as fine and/or imprisonment from court of law based upon severity/significance of violation. This paper will address in detail Pakistan's case for relationship of regulatory inspection with licensing and enforcement process at radiation facilities.

Abstract ID : 96

Sudanese Development of Sustainable Nuclear Security Detection Capability

Mogahed, M.[1]

[1] Sudanese Nuclear & Radiological Regulatory Authority

Corresponding Speaker: M. Mogahed

Introduction To Development of Sustainable Nuclear Security Detection Capability in Sudan normally starts by identifying strategic and sensitive locations to combat illicit trafficking of nuclear material, long transit by road ,social challenges, nuclear and other radioactive material are wieldy used in regional instability, the National Detection Goal to specify role and responsibilities of each Sudanese competent authorities for nuclear security detection to protect the safety and security by the detection nuclear and other radioactive material out of regulatory control before it used for malicious purposes. And ability to detect illegal shipments of nuclear and other radioactive material out of regulatory control transiting by road, sea and air, however our domestic Security. In this paper we outline the Development and sustainability of nuclear security detection a by strengthening national capacities Sudan has specific elements of the nuclear security detection architecture including (e.g. competent authority, coordination body and the importance of a possible partnership between, institution and the regulatory authority and another stakeholder with nuclear security responsibility to strengthen the nuclear security regimes, risk informed approach, detection strategy, Human and technical resources etc.) established capabilities are to remain effective, they should be developed systematically and sustained detection capability over the long term by the State. The Development nuclear security Detection capabilities in Sudan as well as international cooperation and the effort cooperation between stakeholders. Moreover the where the Sudan to Developing Nuclear Security detection capabilities identify gap by Sudan using (NUSIMs) IAEA data basis and use also to testing the system, the challenges to the Development and implementation of an detection Capability Sudan.

Abstract ID: 337

Enhancing National Regulatory Frameworks for the Security of Radioactive Material in Africa

Gizowska, P.[1]

[1] International Atomic Energy Agency

Corresponding Speaker: P. Gizowska

Strengthening national regulatory frameworks against threats from malicious acts involving radioactive material lies at the foundation of a State's nuclear security regime. A robust national legislative and regulatory framework sets an appropriate basis for the establishment or identification of competent authorities, the assignment of nuclear security responsibilities, as well as for the subsequent adoption of adequate nuclear security systems and measures for the prevention and detection of nuclear security events involving radioactive material.

The last decade has seen a considerable expansion of nuclear security assistance. International efforts have for a long time focused on the development of nuclear security capabilities and security systems and measures, rather than ensuring there is an adequate legal framework for these efforts. This is due to a number of reasons, including a very different pattern of development of nuclear security as compared with nuclear safety. Nuclear security measures cannot, however, be established in a vacuum. Since there are no legally binding international instruments providing a comprehensive framework for radioactive material security to draw from, States have to deploy considerable efforts to establish their national requirements… while often facing a variety of other security challenges, conflicting priorities, limited resources and scarce expertise.

In 2017, the International Atomic Energy Agency (IAEA) launched a project to assist African States with developing nuclear security regulations. The project supports States in Africa in assessing the gaps in their regulatory frameworks, establishing implementation plans for the development of technical regulations for the security of radioactive material in use, storage and transport, as well as assisting in the drafting process of these regulations. Three regional workshops were organized and attended by a total of 143 participants from 39 African States. National events and reviews of draft regulations were also conducted. Through new tools and processes currently being developed, it is planned that the project will now focus on providing tailored individual assistance to States so as to best respond to specific country needs. Based on requests, a dozen countries are foreseen to benefit from this support in 2018.

The paper will focus on the ways to develop and enhance regulatory frameworks for nuclear security in Africa, the challenges faced and possible ways forward. It will describe the integrated efforts towards a harmonization of methodology and approach to support the development of regulations for the security of radioactive material. While developing and sustaining national nuclear security regulatory infrastructures is a daunting task requiring time, resources and expertise, the paper will demonstrate that with an innovative inter-regional approach, the right involvement and cooperation between neighbouring States, as well as with adequate support, this exercise can be done more efficiently and easily.

Abstract ID: 318

Criminalization and its Impact in the Egyptian Nuclear and Radiation Law

Elsisi, F.[1]

[1] Egyptian Nuclear and Radiological Regulatory Authority

Corresponding Speaker: F. Elsisi

Security systems should be designed to perform basic security functions: deterrence, detection, delay, response, and security management to protect radioactive sources from an adversary intent on committing a malicious act.

Deterrence occurs when an adversary, otherwise motivated to perform a malicious act, is dissuaded from undertaking the attempt, so criminalization of all malicious acts involving radioactive materials, associated facilities and associated activities in addition to imposing appropriate sanctions to such acts, can be considered as one of deterrent measures that might be used to dissuade the adversary from undertaking the attempts and to support the performance of security system functions.

Before issuance of the current Egyptian nuclear and radiation law no. 7 of 2010 and its executive regulation which regulating all nuclear and radiation activities, Egypt had two laws to regulate activities and practices that emit ionizing radiation. But both of them didn't cover all aspects of nuclear and radiation activities such as nuclear security, nuclear safeguards, import and export of radioactive materials, as well as the sanctions imposed in these laws for criminal acts involved radioactive materials were commuted, not appropriated to the severity and consequences of the criminal act or to purposes of offenders as the sanctions did not exceed three years in prison.

Therefore, the Egyptian legislator decided to issue a comprehensive law to regulate all aspects of nuclear and radiation activities including a set of special provisions for criminal liability which are different from those stipulated in the Egyptian penal code or any previous laws, taken into account some important factors such as purpose, time and consequences of committing the criminal act as well as the measures and procedures adopted in the relevant international legal instruments.

The Egyptian legislator tried, in this law, to increase the scope of punitive acts through criminalization of all malicious acts involving radioactive materials, associated facilities and associated activities that might adversely affect the security of such materials and facilities, and to impose appropriate sanctions for such acts as a legal mechanism to deter adversaries and reduce potential threats in this field.

The actual impact of the law is reasonable compared to the date of issue, especially in reducing insider threats who represent the greatest threat in this field.

This paper will address criminalization and its impact in the Egyptian nuclear and radiation law as a legal deterrent measure to achieve deterrence, reduce potential threats in nuclear field and to support the performance of security system functions.

Abstract ID : 140

Eliminating the Target – Regulatory Incentives for Alternative Technologies to Radioactive Sources

Donnelly, D.[1]; Morris, F. [1]; Elster, J.[1]

[1] Pacific Northwest National Laboratory, USA

Corresponding Speaker: F. Morris

Protection of targets against nuclear security threats is perhaps the most fundamental purpose of a nuclear security regime. But what if there is no target? Then the need for protection (against nuclear security threats) is not just reduced; it is eliminated. This result is recognized to a limited degree in IAEA guidance. For example, Nuclear Security Series No. 14 indicates that the State should consider ways of reducing the nuclear security risk associated with radioactive material, particularly radioactive sources, by encouraging the use of non-radioactive technology (among other alternatives). And in fact, many States have found it practical to substitute non-isotopic technologies in various applications (such as linear accelerators for teletherapy units and x-ray devices for blood irradiators). It is also widely recognized that alternative technologies are not al- ways acceptable substitutes and so the relative merits must be evaluated. Nonetheless, considering the benefit – reduction of the security risk to zero – this option should receive greater attention in international guidance and national practice as potential elements in a State’s nuclear security regime.

This paper identifies a set of incentives that regulatory bodies could adopt to encourage greater consideration of alternative technologies. (There could be non-regulatory incentives as well, such as holding operators clearly liable for damages resulting from nuclear security breaches, but they are beyond the scope of this paper.) Such regulatory incentives could have two important effects. First, they could help create a demand for alternative technologies on the part of operators. Second, they could help create supply (capability development) by technology vendors to meet the demand. Such regulatory incentives could include:

The regulatory body could assemble information on alternative technologies (features, costs, advantages, etc.) and make it available to licensees.

The regulatory body could adopt a general policy (with no teeth) that licensees should consider replacing devices using radioactive sources with devices using alternative technologies.

The regulatory body could adopt a program of public recognition for adopters of alternative technologies (analogous to the United States Environmental Protection Agency's ENERGY STAR program for energy efficient products).

The regulatory body could build incentives for adoption of alternative technologies into its basic regulatory functions (such as less frequent inspection of LINACs or x-ray devices compared to devices using radioactive sources, or lower licensing fees).

As part of the licensing process the regulatory body could require that applicants consider and document possible use of alternative technologies (like an environmental impact statement).

As part of the licensing process, the regulatory body could require that the applicant "justify" the use of a radioactive source instead of an alternative technology (demonstrate conclusively that use of the radioactive source is essential).

As of a certain date, the regulatory body could ban the further use of radioactive sources in a practice in which the regulatory body has determined an alternative technology is feasible.

In many cases, regulatory bodies would likely need new legislative authority to adopt such incentives, but, again given the potential benefits, that should not be an insuperable barrier.

Abstract ID : 1

Reglementation of radioactive materials in Niger

Hassane, H. [1]

[1] Ministry of Mines, Niger

Corresponding Speaker: H. Hassane

The security of radioactive materials has become a major concern around the world. Therefore, urgent necessity has been raised up for the protection of these materials. For this, as member Sate of IAEA, the Government of Niger through the Ministry of Mines has set up some laws and regulations which are monitoring and controlled by the Ministry of Mines and other related institutions such as the Higher National Autority of Nuclear Energy (HANEA), the National Agency of Nuclear Security (ARSN), the National Center of Radioprotection (CNRP) etc. . . .

Through this coordination, the division of Mining exploitation which is under my responsibility conducts the followings activities: the control and monitoring of laws and regulations, the protection of radioactive materials and non radioactive materials, the respect and implementation of rules and regulations related to these materials. The storage and transport of radioactive materials such as: yellow cake, radioactive sources and waste equipments are done in Niger under the strict application of laws, rules and regulations in accordance to national and international laws and regulations.

The aims of all these efforts are to achieve and maintain highly effective nuclear security (NSS); these could not be attempted without improving and sustaining national security threat assessment. Also, to achieve this aim, there is need for national and international structures to join hand together through the sharing of experiences. It is also important to know how to recover and secure nuclear and other radioactive materials which are out of regulatory control.

For this, the presentation on:" Reglementation of radioactive materials in Niger", will be focused on the laws, the rules and regulations, experiences learned, the type of radioactive materials and the type of accident and criminality actions encountered. So, the main objective of my participation to this conference is to share experiences of my country and learn about other participants in order to see how much member states progress and fall in the nuclear security systems.

This conference will be an opportunity to inter-change informations in-between participants in order to strengthen the effectiveness of nuclear security measures and systems, such that the security of radioactive materials will be guaranteed around the World. Because without peace any development can’t be achieved.

Abstract ID : 278

Main outcome of the Fierce Falcon GICNT Radiological Source Security and Theft Response Workshop organized in Hungary

Kovacs-Szeles, E.[1]; Viplak, A.[1]; Vincze, A.[1]; Bieda, T. [2]; Molnar, G.[3]; Fourcade, M.[2]; Stefanka, Z.[4]

[1] Centre for Energy Research, Hungarian Academy of Sciences; [2] Ministry of Energy and Mining, Argentina; [3] Ministry of Foreign Affairs and Trade, Hungary; [4]. Hungarian Atomic Energy Authority

Corresponding Speaker: E. Kovacs-Szeles

From 10-12 April, the Government of Hungary, under the auspices of the Global Initiative to Combat Nuclear Terrorism (GICNT), hosted Fierce Falcon, a radiological source security and theft response workshop, in Budapest. The three day workshop focused on developing on the best practices for strengthening radiological material security and theft response capabilities in order to prevent radiological terrorism. The workshop emphasized the comprehensive range of functions and capabilities aimed at securing radiological material, detecting acts of radiological material theft, and the immediate response actions to theft. The workshop primarily addressed those activities and agencies responsible for protecting radioactive material at civilian sites and those best practices associated with an immediate site and local law enforcement response to an attempted or actual theft of radiological material. Over 90 participants from 25 countries and two observer organizations, Interpol and IAEA, participated in the workshop.

Therefore, in this paper we will discuss the three lessons learned and best practices recognized during the Workshop. In this regard, some key factors must be highlighted. For example, the importance of personal relationships or networks to reduce reaction time to an R/N event. It is also important to analyze the structure of decision making to face such an event. As a third discussion point, we will address the coordination of law enforcement and technical experts on the ground. In this regard, we will also discuss vertical as well as horizontal coordination. Furthermore we will address the importance of bilateral training and exercises together with interagency training. Finally, we will discuss media usage and the understanding of the national framework to respond to a R/N incident.

Abstract ID : 298

Proposing an Informal Radioactive Communication Network on Voluntary Basis between Counter-Terrorism Officers and the License Holders

Ishak, N.[1]

[1] Royal Malaysian Police, Malaysia

Corresponding Speaker: N. Ishak

As a law enforcement division dealing with terrorism issues, the safety and security of the public is a paramount concern to our workforce. This concern is no longer perceived as "if it happened" but moving towards "when it happened". Trained as counter-terrorism practitioners, we always want to prevent any untoward incident from happening because it is universally proven prevention is always better than cure. On that basis, we want to prevent any malicious act from happening and tackle it at the source of the threat. We understand there are hundreds of licensees in Malaysia handling more than 5000 radioactive sources for industrial, manufacturing and construction sector regulated by the Atomic Energy Licensing Board (AELB), not to mention sources for medical sec- tor regulated by the Health Ministry. Not knowing exactly who owned these sources and where they are scattered around the country is enough to create anxiety for our practitioners. At the very least, we will feel better if we have the licensees' addresses and the tabulated sources throughout Malaysia. However, at the same time we cannot burden our workforce just to oversee the safety and security of these radioactive sources because we have to prioritize our work and monitor the threat situation based on daily intelligence and development on the ground nationwide, within our region and also what is happening throughout the globe. Terrorism is a global issue. Though the Islamic State (IS) is definitely losing ground in Iraq and Syria, but virtually they are still breathing over our necks and is making impact now and then whenever possible. From a physical battle zone, they have change tactic to insurgency while globally inducing many lone attackers to react for the loss of physical caliphate and uphold the glory of distant victory. In August 2017, IS-affiliated group in our neighboring Indonesia had experimented to extract thorium from petromax lamp mantle using hydrogen peroxide solvent. Even though their plan is not feasible from the amount of thorium that have been extracted and the difficulty of the extraction process, but the formation of an idea to use radioactive material to cause harm through "dirty bomb" is something we cannot write off after their arrest by the Indonesia anti-terror unit. This is because through the virtual world and the sophistication of online communication technology, these radicalized individuals will be

talking to each other, comparing notes, sharing experiences across nations especially be- tween Malaysia, Indonesia and the Philippines. The idea about "dirty bomb" must be suppressed from these militant groups and at the same time creating awareness among license holders to be aware of the threat landscape in the region as well as within Malaysia. The only way that we can keep abreast of the current happening is through the formation of informal group of contacts be- tween the police counter-terrorism division and designated point of contacts among the licensees on voluntary basis especially those license holders who possess dangerous radioactive material in big amount. We can organize them by state and engage with our regulator according to their regional office. The counter-terrorism division also have representatives at state level and they will be the information conduit to our headquarters. This informal group is a win-win double edged sword to achieve our desired counter measure against terrorist threat while licensees will benefit in terms of valuable threat updates and advisory services from time to time. If the need arises and the situation warrant us to discuss thing more formally either side can make a formal request for special briefing or special inspection all on mutual ground. It will not involve any cost except for nominal refreshment expenditure during meeting as the group is localized. However and everything will be on mutual basis. Knowing the authorities and the life line to get help will boost the confidence of the licensees while the authorities will be well connected when the situation arise to take preemptive measure and react or respond to the situation. Either ways, both parties will benefit from this simple informal grouping or point of contacts. In order to pursue this vision, the assistance of our regulator is needed to create or propose this informal group at state level. State counter-terrorism officers are already linked to the headquarters. Therefore, they are the frontline officers to be contacted by licensees in that state to report or seek advice. As mentioned earlier it is on voluntary basis and affiliation is not mandatory but licensees can join anytime. We understand officers are bound for transfer, but once the network is establish it is the matter of keeping the right personnel or designated personnel in the loop. Since it is an informal group only unclassified matters can be shared in the group, all other confidential matters related to licensees can go through personal messaging in private. It is a simple proposal but it takes effort by all stakeholders to realize it.

Abstract ID : 172

Effective Inter-Organizational Coordination for Response to Nuclear Security Events Involving Radioactive Sources: Exemplary National Practices

Donnelly, D.[1]; Jamison, J.[1]; Manion, J.[1]; Kolbas, P.[1]; Quran, S.[2]

[1] Pacific Northwest National Laboratory, USA; [2] Jordan Energy and Minerals Regulatory Commission, Jordan

Corresponding Speaker: D., Donnelly

Establishing a robust security posture for sites where radioactive sources are used or stored typically requires multiple stakeholders acting in concert. Regulatory bodies normally set requirements for operators to install, operate and maintain security systems to detect and delay attempts to steal or sabotage a source. However, operators are typically not in a position to hire, train and equip guard staff who would reliably be able to respond to disrupt and neutralize a dedicated adversary before such an attempt succeeds. Instead, operators generally rely on external responders, such as local or national police or gendarmerie, interior ministry, national guard force, or some comparable organization. Operators and regulatory bodies with responsibility for setting security requirements for radioactive source facilities typically lack the authority to require specific actions by such external response organizations. Effective coordination between regulators, operators and responders thus becomes critical to ensure reliable and effective response to attempted theft or sabotage of radioactive sources.

This paper highlights select cases where States have put in place dedicated processes to ensure coordination among relevant organizations in the security incident response process. In particular, the paper describes initiatives in this area by Jordan. Jordan has established two leading bodies, a National Nuclear Security Committee and a National Radiological and Nuclear Emergency Response Committee, which guide and harmonize inter-organizational efforts on nuclear and radiological security. This paper reviews the design and results of these initiatives, emphasizing aspects that could inform efforts by other States to develop their own mechanisms for coordination of multiple competent authorities in response to nuclear security events involving radioactive sources.

Abstract ID : 299

Malaysia's Experience in Enhancing National Concept of Operation to address Cross Cutting Nuclear Security Needs

Bakri, N.[1]; Gan, P.[1]

Atomic Energy Licensing Board (AELB), Malaysia

Corresponding Speaker: N.Bakri

Nuclear Security in Malaysia is developed and implemented through the Integrated Nuclear Security Support Plan (INSSP) that determines roles, responsibilities and planning for national capacities. Learning from experience in strengthening nuclear security capabilities in Malaysia since 2006, the Atomic Energy Licensing Board (AELB) plays a vital role in coordinating implementation of nuclear security capacities identified through the INSSP. To precisely capture the needs, AELB uses observation gathered from working experiences in conducting authorisation, inspection, detection and response to nuclear security in Malaysia. From these observations, there is a need to harmonise areas within the nuclear security framework e.g. radioactive and nuclear materials under regulatory control and those that are out of regulatory control. To address this need, AELB and the Royal Malaysia Police (RMP) have jointly developed a national Concept of Operation (ConOps) for prevention, detection and response to nuclear security event. With the assistance and support from the International Atomic Energy Agency (IAEA), two national work- shops were conducted in drafting the ConOps and related Standard Operating Procedures (SOP). The workshops used security events that have occurred in Malaysia as a basis to analyse gaps that exist and to propose necessary enhancement mechanisms. Legislations and regulations related to national security in Malaysia were extensively referred to. During the workshops, AELB and RMP also studied the interface between two agencies in terms of roles and responsibilities within the nuclear security framework to ensure the development of an effective national ConOps. The major outcome of the workshops were the completion of a draft ConOps and SOPs, they were presented and awaiting approval from top managements in AELB and RMP. AELB and RMP's collective effort is very timely as this is in line with the national policy decision to consolidate and manage the broad spectrum of national security issues cohesively.

Abstract ID : 264

Impact of Nuclear Information and Cyber Response Team Building on the Security of Radioactive Materials

Hossain, M.[1]; Imtiaz, A.[1]; Alam, M.[1]

[1] Bangladesh Atomic Energy Commission

Corresponding Speaker: M. Hossain

Nuclear Information and Cyber Response Team plays a pivotal role in preventing and detecting cyber threats to the security of radioactive materials in use, transport and storage. Hence, building a nuclear information and cyber response team is an indispensable part of the national nuclear security regime of its digital critical infrastructure assets as well as radioactive materials in use, transport and storage which are vulnerable to cyber threats. However, currently, there is limited exploration of the activities of nuclear information and cyber response team in this aspect and also its activities are limited to extend for the establishment of nuclear security detection architecture for nuclear and other radioactive material out of regulatory control. Because, the existing practices and literature on building nuclear information and cyber response team are largely unstructured and still considered being in the early phase of development. Furthermore, member states and other stakeholders follow the IAEA guidance outline mirroring NSS 17, national and international tradition to build nuclear information and cyber response team as a regulatory requirement. In the light of these documents, the existing practice for building nuclear information and cyber response team seems a bit static in nature that depends on educational prerequisites, certification etc. Therefore, this study aims to explore the impact in building nuclear information and cyber response team and propose a nuclear information and cyber response team of Quadruple Helix (QH) exposure involving nuclear industry, university, government and IAEA (I-U-G-I). This QH collaborations involving I-U-G-I provide a networked infrastructure of nuclear information and cyber response team for shaping the dynamic fluxes of knowledge base of innovations locally and these fluxes remain emergent within the domains. These collaborative and interactive network effects impact on improving the knowledge base of innovations in addressing the cyber threats related to the security of radioactive material under regulatory control in use, transport and storage, and to the detection of nuclear and other radioactive material out of regulatory control. Consequently, QH of nuclear information and cyber response team expedites the adequacy of interdisciplinary expertise through exchanging information related to the use of a threat-based, risk-

informed approach for the protection and detection of cyber threats as its centre of gravity is shifting through the convergence of responsibilities between physical security, information security and nuclear information and cyber response team, and an increased commitment to staffing-up of dedicated cyber defenders. Finally, the findings reveal a holistic approach to develop a QH of nuclear information and cyber response team plan and policy reformulation for member states. The findings also shed new light on expediting cooperation among all competent authorities and relevant stake- holders at the national and international levels; promote international nuclear security guidance and its use by member states. Finally, the study implications preside over in establishing national nuclear security regimes and expedite innovation in nuclear cyber security information flow and knowledge sharing culture among the nuclear organizations.

Abstract ID: 305

Communication Strategy following Radiological Threats / Emergencies

Seshadri, M. [1]**; Pradeepkumar K.**[1]

[1] Bhabha Atomic Research Centre, India

Corresponding Speaker: M. Seshadri

Radiation threats/events or emergencies are low probabilistic in nature, generate lot of anxiety and fear in the minds of public. Safety and security of nuclear or other radioactive materials are requirements for prevention, preparedness and response aspects like effective implementation of protective actions during any radiological threat or that could lead to any radiation emergency. The onus on ensuring the safety, security of nuclear and other radioactive materials, prevention, preparedness and response, sharing expertise in the modes of communication with strategy lies with the state authorities. Communication with the public and media about radiation (nuclear and radiological) threats / emergencies is a challenge felt globally, which demands coordinated action among like-minded global users / participants in their planned uses of radiation technology. Proper communication would support the ease of management of consequences of radiological aspects, help in deriving support from stake holders during any nuclear or radiological emergency in public domain to minimize fear, enhance the efficacy of response mechanism and involvement of public. Aspects of communication such as producing the right message and disseminating to the appropriate audience using the social / electronic / print media or relevant television channels at the right time requires planning. Communication strategy needs development of ready / preprepared message, identified modes of communication, robust training, planning and nomination of trained nodal officer with an identified alternate person for carrying out communication.

The safety and security of radioactive materials is ensured well at operating / handling facilities by robust regulatory framework. As a mandatory regulatory requirement, planning and preparedness activities are ongoing in India, for response measures through trained central police forces – national disaster response force (NDRF) – which is trained (under training of trainers ToT courses) on technical arena by Department of Atomic Energy (DAE) on procurement of radiation monitoring devices, development of monitoring procedures, large scale decontamination, medical management, waste segregation and management, networking the response agencies, communication modes, usage of media while interacting with public, psychological counselling aspects and in establishing their emergency response centres (NDRF-ERCs). The standard operating procedures (SOP) for response to any radiological emergencies in public domain is prepared and being put in use by the response agencies during the conduct of periodic training and drills/mock-exercises.

The paper would brief about the Indian experience on the communication methodology presently followed, imparted training for the response forces to improve their communication and developed strategy on communication in a nuclear or radiological threat or emergency.

Abstract ID : 181

Training Project for First Police Response to Chemical, Biological, Radiological or Nuclear Threats

Naranjo, J.[1]

[1] Police Risk Management Department, National Police, Ecuador

Corresponding Speaker: J. Naranjo

General Management of Operations - National Police of Ecuador The National Police of Ecuador, through the Risk Management Department belonging to the General Management of Operations, has proposed a Training Project that seeks to strengthen police officers, the first response capabilities in situations of chemical, biological emergencies, radiological or nuclear, as well as the coordination between emergency institutions of the Ecuadorian state.

The training aims to carry out simulation exercises, with imaginary scenarios, to face chemical, biological, radiological or nuclear threats, reinforced with practical exercises coordinated by experts in the handling of these events, through examples with improvised devices, to present procedures in the fields of personal protection, detection, sampling, identification and transportation, where experiences are also shared with students and instructors from different national and international organizations that participate in the training.

The trainings will be received at the facilities of the Ecuadorian Police Academy, which will make it possible for the different student promotions for Police, to continue applying for the training as a promotion requirement at their higher hierarchical level.

One of the main components of this initiative is to provide the police institution with personal protection equipment and the necessary technical equipment to handle the first response to this type of emergency.

Another component seeks to make effective the application of an “action protocol” designed by the Department of Risk Management, before any possible chemical, biological, radiological or nuclear threat, which a police unit must face in the national territory. The protocol allows the police officer to act in the same way, regardless of the origin of the threat. The objective is to control public order and establish clear procedures for action, use of logistical means and attention to the affected population.

A procedure before an emergency directed by the National Police of Ecuador is based on the methodology of the Incident Command System and the collaboration of other state institutions such as the Fire Department, the Red Cross, the Risks Secretariat, the Armed Forces, among others.

The initial action will depend directly on the first police officers who arrive at the site, their mission will be to evict the people present in the affected area to a safe area and establish security limits for operational action.

The security limits will be established in two work areas formed by concentric circles of approximately 100 and 200 meters radius. Each work area maintains a police officer in charge, there being permanent coordination between them, for their performance.

The control of the first area is carried out in the specific place where the specialized technicians will operate. The police officer in charge of the area, will use adequate personal protection equipment and a radiation detector to measure the exposure, then establishes the relevant security measures until the arrival of the technical specialists who will have the mission to completely neutralize the material found. Only after checking the secure site, it will allow the passage of necessary units to serve the possible affected, such as ambulances, firefighters, personnel of the Secretary of Risks, etc.

In the second area, which is 200 meters away from the object found, a police officer will be in charge of the Public Order Control and Citizen Security device, being responsible for the control.

Abstract ID : 287

Human Resource Development

Perera, P.[1]

[1] Sri Lanka Army

Corresponding Speaker: P. Perera

1. Introduction:-

Sri Lanka is a country exposed to different kinds of natural and man-made hazards. As direct or indirect effects of these hazards, disasters and emergencies are experienced leading to much human suffering. Ionizing radiation sources are widely used in Sri Lanka in the medical and industrial sectors for socioeconomic development in the country. Loss or misuse of ionizing radiation sources, or nuclear reactor accidents in a neighbouring country could result in unnecessary radiation exposure and some other non-radiological effects to the public and the environment. It also can give rise to contamination of people and the environment and burden their day today life. In extreme cases, the radiation emergencies can result in severe deterministic health effects and severe contamination of environment.

Sri Lanka Armed forces are the large number of human resource in the country. Specially Sri Lanka Army is capable to deploy its troops to any disaster situation with in very minimum time period as first responders. Therefore, it is imperative needs to develop and strengthen the capacities of human factor to meet the future challengers in the country.

In this context, Crops of Sri Lanka Engineer Regiment in Sri Lanka Army has raised a CBRN Response Regiment to deploy its troops as first responders at any kinds of CBRN nature and specially mitigate and prevent risk from radioactive incidents. In order to fulfill this mission, CBRN Regiment on their way to develop the capacities of human resources to provide security to its people and also for Sri Lankan territory.

Aim. Is to discuss how Human resource were developed under the present mechanism of Sri Lankan Army CBRN Regiment and future requirements in order to reduce the vulnerabilities / impact of Nuclear and Radioactive materials.

Human resource were trained as per this Mechanism under the CBRN Regiment.

Present Status.

The CBRN Response Regiment consists with one CBRN responder squadron and all troops in the squadron were trained as first responders. Those troops are deployed in close distance to capital city of Colombo. Further, we have divided country into four theaters and consider numbers of Field Engineer Troops were trained in these theaters(since, Crops of Sri Lanka Engineer Regiment has 13 x units including CBRN Response Regiment and they are deployed all parts of the country. Deployment map of 13 x units is shown below as figure 1) as first responders in order to pay more alertness on radiological threats which can be occurred at vulnerable locations in the country.

Identified the possible CBRN threats and earmarked troops to response in emergency situations.(As per the contingency plans)

- Conducted mock drills according to contingency plans.
- Conducted awareness programs.
- Coordinated with stake holders and obtained effective training and advices.

Figur 1: Deployment maps of Engineer Units in Sri Lanka

Future strategies for developing the Human Resources.

- To enhance the human skills with international technical knowhow.
- To train more Army troops and conduct awareness program to react any unforeseen.
- To conduct awareness program to community those who are living in more vulnerable locations. To conduct mock drills at vulnerable locations and earmark safe location.
- To coordinate with other arms and conducting joint exercises.

Future Challenges. Under mentioned challenges are restricted to develop human resources:

- Humans were trained thus; no proper equipments were given to the Regiment. Therefore, it is imperative needs to fulfil the necessary equipments /PPE as per the require scale.
- Lack of professional trainers.
- Lack of community participation for mock drills and awareness programs.
- Lack of funds.
- Coordination in between stake holder organizations.
- To prepare security plans for national level up to grass route level.

Summary

Sri Lanka is an island in the Indian Ocean. It is started rapid development including high technological industries and yet to be arrived many of these. Also it has a very prominent sea routes and a large scale destination harbor in capital of Colombo. Therefore, it must have a very strong prevention and detection system in order to overcome any future eventualities in the country. In this context, it is imperative needs to develop the human resources effectively to gain the desire results and goals and also finally glimpse a sustainable country.

In view of the above, The Corps of Sri Lanka Engineer Regiment in Sri Lanka Army has looked forward and opened a specialist unit to response such disasters for preventing and protecting the people lives by developing human recourses effectively.

Abstract ID: 361

Knowledge Management: the Tool of the Conceptual Map in the Evaluation of a Seminar on Safety and Security

Barcellos Razuck, F.[1]; Augusto Da Silva, F.[2];

[1] IRD CNEN, Brazil; [2] Institute of Radiation Protection and Dosimetry, Brazil

Corresponding Speaker: F. Barcellos Razuck

Human resource development

This work aims to show the application of a knowledge management tool to evaluate a Seminar on Safety and Security in the area of Radioprotection, offered to the students of the Postgraduate Educational Course in Radiation Protection and the Safety of Radiation Sources (PGEC) offered by the Institute of Radioprotection and Dosimetry (IRD) in partnership with the International Atomic Energy Agency (IAEA). The tool in question was the Conceptual Map. Conceptual Maps are a tool that can gather knowledge of individuals and groups, facilitating the process of knowledge creation, acting as a tool for discussion and communication, and assist in the distribution of knowledge and learning processes within an organization. Immediately after the seminar, a class on Conceptual Maps was given, since most of the students did not know the tool. The students were then asked to give a summary of the seminar as well as a conceptual map of the seminar, in order to verify if they had identified the main concepts discussed, as well as the relation between them. It was then verified that they were able to understand the applicability of the tool, and many of the students will adopt the Conceptual Map as a learning tool.

Introduction

It can be said that the population, in general, has already heard or even used equipment that involves the issue of Nuclear Energy. However, the majority of the population does not understand the effects generated by Nuclear Energy on living organisms, especially on humans, thus showing the need to build a more accurate and informed knowledge about radiation in a formal learning situation. Therefore, there is a growing need for the nuclear area to promote a more open dialogue with the public, increasing public acceptance, mainly due to the fact that it is a risk technology 1.

Therefore, all risk technology refers to risk communication, which is directly associated with risk perception, considering the difference between how the risk is perceived by the public versus how the risk is effectively assessed and measured by the specialists. In fact, the purpose of risk communication is not to force a shift between the divergent views of the specialist and the public, but it is a matter of developing an understanding of these factors so that they can be considered and treated 2.

One possibility that opens to realize this communication of risk, as well as for a better understanding of the uses of Nuclear Energy, would be through Knowledge Management (CG). This is because the CG has been applied in order to create the necessary conditions for greater access to communication in a clear and rich way. Therefore, knowledge management aims to promote an integrated approach to identifying, capturing, evaluating, retrieving and sharing information, which in this case may be databases, documents, policies, procedures and an institution [3].

The tool in question was the Conceptual Map. Conceptual Maps are a tool that can gather knowledge of individuals and groups, facilitate the process of knowledge creation, function as a means of discussion and communication, and help in the distribution of knowledge and learning processes within an organization [4].

Method

The Institute of Radioprotection and Dosimetry (IRD), an institute linked to the Brazilian Nuclear Energy Commission (CNEN), responsible for radioprotection procedures, has been carrying out various teaching activities to improve the understanding of nuclear energy concepts, as well as offering continuing education courses for professionals in the area.

One of these activities is the Postgraduate Educational Course in Radiation Protection and the Safety of Radiation Sources (PGEC), offered by the Institute of Radioprotection and Dosimetry (IRD). The course is free and has been designed to meet the needs of professionals with higher education equivalent to the university degree in physics, chemistry, health and earth sciences or engineering and have been selected to work in the field of radiation protection and safety of sources of radiation in their countries. The course provides the basic tools needed for who will become instructors in their area (train multipliers). Divided into modules, it includes theoretical part and practical training, with demonstrations, laboratory exercises, case studies, technical visits, simulation exercises and workshops. Some theoretical topics and exercises use the virtual classroom of the course.

One of these modules in question is a workshop offered annually, always with topics that are relevant to knowledge in the nuclear area. In the year 2017, the theme was "Safety and Security: Harmonization and Action". At the workshop, the main concepts related to radiological and physical safety applied to radiative installations were discussed, discussing the applicability of these concepts in the industrial and medical areas and proposed actions to harmonize the performance of professionals, as well as presentations on the issue of radiological threat and its consequences potential, and the Brazilian structure of radiological safety and physical security.

Immediately after the seminar, a class on Conceptual Maps was given, since most of the students did not know the tool. The students were then asked to give a summary of the seminar as well as a conceptual map of the seminar, in order to verify if they had identified the main concepts discussed, as well as the relation between them.

Results

The students of the PGEC then made an evaluation of the Workshop, giving a summary of each presentation, as well as a Conceptual Map relating the main concepts. In discussion with the students, one can verify the importance of the Workshop. For example, for the student T. "Participation in this seminar has contributed positively and enrichingly to knowledge related to radiological and physical safety. It was possible to have an overview of what has been happening in Brazil and in the world in relation to aspects of radiological safety and to know a little more about the experience of the lecturers in their areas of practice. It is extremely important that events such as these can be perpetuated by professionals in the areas, in educational institutions, organizations, regulatory bodies, facilities, etc. so that there is a constant dissemination of knowledge". With respect to the Conceptual Map, we show a model below:

Conclusions

It is possible to verify the importance of the workshop, with the participation not only of the students of the PGEC, but also of external participants. Regarding the students' learning, it was verified that many did not know some concepts discussed at the event, showing the importance of discussing topics relevant to the area. About Conceptual Maps, students understood it as a powerful tool for the concept learning process.

References

PRESTES, M.; CAPPELLETTO, E.; DE CASTRO KURTZ DOS SANTOS, A. Concepções dos estu-

dantes sobre radiações, XI Encontro de Pesquisa em Ensino de Física, Curitiba, (2008).

IAEA; ELETRONUCLEAR. Comunicação com o público em uma emergência nuclear ou radiológica. Rio de Janeiro: Capax Dei, (2013).

KOENIG, M. E. D. What is KM? Knowledge Management Explained. KM World. Available in www.kmworld.com/Articles/Editorial/What-Is/What-is-KM-Knowledge-Management-Explained-122649.aspx. Acess in April, (2018).

Abstract ID: 374

The EC-US 2018 Counter Nuclear Smuggling Workshop in Karlsruhe – Outcomes and Findings

Sonderman, R.[1]; Proveaux, A.[1]; Galy, J.[2]; Fendrich, S.[1]; Mayer, K.[2]

[1] Department of State, USA; [2] European Commission / Joint Research Centre, European Union

Corresponding Speaker: S. Fendrich

The ongoing occurrence of the smuggling of nuclear and other radioactive materials (R/N), as reported to the International Atomic Energy Agency's (IAEA) Incident and Trafficking Database (ITDB), indicates that such materials continue to be encountered out of regulatory control.

Despite the significant progress the international community has made to secure R/N materials at facilities of origin, the continued occurrence of R/N materials trafficking underscores that our work is not yet complete. Since 2016, governments have reported more than 300 incidents involving radioactive and nuclear (R/N) materials detected outside regulatory control to the International Atomic Energy Agency's (IAEA) Incident and Trafficking Database (ITDB) program. In parallel, since INTERPOL first established Operation Fail Safe in 2010, participating countries have shared details on numerous suspects connected to nuclear trafficking, including criminals convicted of trafficking Highly Enriched Uranium (HEU). The names of these suspects joined INTERPOL's system of 6,000 profiles of foreign terrorist fighters and nearly 500 profiles of individuals sanctioned by the U.N. Security Council. Such complementary international information-sharing capabilities demonstrate great strides the international community has made in recent years to strengthen capabilities to investigate and counter nuclear smuggling activities.

Additionally, expanding international mobility and improved communication networks mean that the world today is smaller and more connected than ever before. In parallel, transnational terrorism and criminal activities, both in traditional and cyber realms, continue to pose a serious threat to global security. This growing interconnectedness means that countries must continue to work together to strengthen global security and counter transnational criminal activities that span across countries and regions.

In this context, the European Commission's Joint Research Centre (JRC) and U.S. Department of State jointly organized the third Counter Nuclear Smuggling (CNS) Workshop in May 2018. More than 70 experts from 22 countries and international organizations gathered in May 2018 at JRC Karlsruhe, Germany, to share lessons learned and consider innovative approaches to countering the smuggling of R/N materials. The 2018 CNS Workshop was designed to further strengthen CNS capabilities by demonstrating tangible, hands-on methods to detect R/N materials, investigate smuggling activities, and conduct nuclear forensic analysis. Building on the outcomes of the 2014 and the 2016 CNS Workshops, this event was structured to highlight the following areas:

- Strengthening international capabilities to counter R/N material smuggling and reduce the threat of nuclear terrorism;
- Addressing R/N material smuggling via the dark web;
- Considering legal and prosecutorial elements in relation to R/N smuggling;
- Detecting R/N materials out of regulatory control – specifically masked and scam material, and analysing seized material to trace its illicit movement;
- Strengthening inter-agency coordination in the areas of radiation detection, law enforcement investigations, and radiological crime scene management;
- Applying nuclear forensic analysis and interpretational techniques to support a nuclear smuggling investigation and identify similarities across cases;
- Establishing information-sharing mechanisms to counter smuggling of nuclear and other radioactive material; and
- Identifying resources and efforts to sustain CNS capabilities.

Through a series of presentations, demonstrations, and expert panel discussions, participants reviewed international guidance on these areas and discussed how countries might incorporate them into their national efforts. The workshop also provided participants a unique opportunity to put some CNS strategies into practice – specifically in the context of smuggling which occurred via the dark web and in territories outside of government control. As part of an interactive exercise, participants reviewed a fictional R/N material smuggling scenario to identify potential challenges and solutions related to investigations. . The paper will present the outcomes of the 2018 CNS Workshop and outline the needs and next steps identified by the workshop participants through their (anonymous) feedback.

Abstract ID : 76

Pakistan's Approach for Development of Human Resource for Secure Management of Radioactive Sources

Khan, I.[1]; Iftakhar, N.[1]; Ahmad, T.[1]

[1] Official, Pakistan

Corresponding Speaker: I. Khan

In Pakistan, radioactive materials and sources are used for multiple peaceful purposes. The national nuclear regulator, Pakistan Nuclear Regulatory Authority (PNRA) ensures and verifies, through an effective regulatory framework, that activities related to nuclear and radioactive material are performed in full compliance with the regulatory requirements. To ensure secure use and management of radioactive material and sources, qualified and trained manpower is required. Thus, importance of a sustainable human resource development for secure management of radioactive sources is undeniable. Pakistan realized this importance as early as in 2005 when cooperation was started with International Atomic Energy Agency (IAEA). Under this cooperation, IAEA supported national efforts to strengthen Pakistan's capabilities in the area of nuclear security. IAEA played pivotal role for development of human resource by providing training in number of areas vital for nuclear security and physical protection. This paper addresses the five phases approach adopted by Pakistan for human resource development to train the personnel involved in the nuclear security including the secure management of radioactive sources. The first phase is the Establishment of infrastructure including state-of-the art training center and associated laboratories required for the capacity building of staff. The second phase is Consolidation phase where focused was made on the capacity building of faculty/instructors to impart trainings. The third phase is the Delivery phase, where trainings were arranged for the staff of various stakeholders. Fourth phase is termed as Pursuit of Excellence. The hallmark of this phase was the establishment of Center of Excellence for nuclear security, which is a joint venture of three national institutes including Pakistan Institute of Engineering and Applied Sciences (PIEAS); National Institute of Safety and Security (NISAS); and Pakistan's Center of Excellence for Nuclear Security (PCENS). These three institutions are working together and providing education, trainings and technical support to all nuclear security stakeholders in Pakistan. PCENS organizes trainings in nuclear security from the operator's perspective, whereas, NISAS organize training courses for nuclear security in the regulatory perspective. The academic perspective is covered by PIEAS which conducts academic course at Master level in nuclear security. The fifth phase is Contribution, where Pakistan has offered its Center of

Excellence for the national, regional and international trainings under the umbrella of the IAEA. The paper will also address challenges faced by Pakistan during each phase and how these challenges were overcome.

Abstract ID: 53

Human Resource Development in Radiological Security for an International Audience: Lessons from the UK's Experience

Hobbs, C.[1]; Salisbury, D.[2]; Tzinieris, S.[1]; Homan, Z.[1]

[1] King's College London, United Kingdom; [2] Centre for Nonproliferation Studies, USA

Corresponding Speaker: C. Hobbs

This paper will outline the UK's experiences in developing and delivering a series of 'Fundamentals of Radiological Source Security' workshops since 2016. The objectives and structure of the workshop will be outlined, followed by a short history of its implementation, before detailing a series of lessons learned. This work forms part of the Global Threat Reduction Programme (GTRP), a cooperative initiative under which the UK has worked with key international stakeholders to address CBRN security issues broadly defined since the 1990s. A radiological source workshop for an international audience is a relatively recent addition to this initiative – reflecting a growing recognition of the need for effective security systems to protect radiological materials from potential adversaries throughout their lifecycle. The development of a workshop for an international audience of radiological source practitioners is not a simple endeavour given the diversity of operating environments within which radiological sources as used, the range of stakeholders and the different national contexts and regulatory systems. Consequently, a decision was made to provide a broad consideration of key aspects of radiological security. The workshop schedule covers topics beyond technical security measures and systems, including regulation and interface with the regulator, and the approaches that can be taken to develop a robust security culture. The importance of security culture in this context cannot be understated, given that radioactive sources are frequently used in environments which are either 'customer facing' (such as universities and hospitals), or in industries where sources are mobile, means that physical security is limited for operational or practical reasons. A strong security culture – whether through the development of human resources or through employees' actions – is essential in ensuring the security of radiological materials. Both a conceptual and practical examination of key radiological security issues are provided at the workshops, exploring their implementation in different operating environments, including radiological security in hospitals, universities and the transportation of radiological sources. In its delivery, the workshop draws on expert instructors from academia, industry,

the regulator and government. This includes those with recent experience from the UK's regulatory body, as well as from source-holding organizations including licensees from a university and a hospital. The IAEA Nuclear Security Series of guidance documents provides a solid foundation upon which to design training and educational activities. These are referred to throughout the workshop sessions with the content presented being consistent with IAEA technical terminology and nomenclature. However, careful consideration must still be given as how to best impart this knowledge, while also drawing out the considerable body of expertise held by the workshop participants. To achieve this, a range of learning-focused pedagogical tools for radiological security are utilized. This includes a detailed table top exercise, which runs throughout the workshop and integrates many key radiological security concepts: source categorization, vulnerability assessment, security cultural assessment and physical security upgrades. This paper will outline the UK's experiences in developing and delivering a series of 'Fundamentals of Radiological Source Security' workshops since 2016. The objectives and structure of the workshop will be outlined, followed by a short history of its implementation, before detailing a series of lessons learned.

Abstract ID : 93

Development of Physical Protection Measure Performance Data for Radioactive Material Facilities

Snell, M.[1]; Ek, D.[1]

[1] Sandia National Laboratories, USA

Corresponding Speaker: M. Snell

Even when radioactive material facilities have prescriptive physical protection requirements some of those requirements have quality requirements that require testing; for example, sensor performance and exercises performed with local responders. This paper will address methods for collecting this data that fit the staffing and resource limitations at radioactive material facilities. Further, some documents, such as the International Atomic Energy Agency Implementing Guide on Security of Radioactive Sources (NSS-11), suggest security objectives that might have a performance component (e.g., “provide delay after detection sufficient for response personnel to interrupt”); this paper will also address how to validate that such security objectives are met.

Abstract ID : 189

Tools for Promoting Sustainability: Tabletop Exercises, Site Security Plans, and Standard Operating Procedures

Roberts, C.[1]; Manion, J.[1]

[1] Pacific Northwest National Laboratory, USA

Corresponding Speaker: J. Manion

The U.S. Department of Energy/National Nuclear Security Administration's Office of Global Material Security programs cooperate with partner countries throughout the world to enhance the security of radioactive sources and detect the illicit trafficking of nuclear and radioactive material. To promote sustainable security and nuclear detection architectures, both the Office of Radiological Security (ORS) and the Office of Nuclear Smuggling Detection and Deterrence (NSDD) engage with partner countries to design, develop, and execute tabletop exercise (TTX) activities and draft and implement site security plans (SSPs) or standard operating procedures (SOPs) that promote effective physical protection, security management, and detection of radioactive and nuclear materials.

Tabletop exercise activities help test and strengthen interagency coordination, communication, and procedures in response to a nuclear or radiological threat. These TTXs emphasize the decision- making processes, communication and coordination of information, and deployment of resources involved in deterring, detecting, and investigating radiological material out of regulatory control (MORC). A discussion-based TTX provides participants the opportunity to assess and improve cur- rent operating procedures at a site, as well as discuss interagency coordination and communication in response to nuclear or radiological events. The TTX is one type of exercise that can facilitate an organization or organizations' evaluation of their procedures and performance in both radioactive material security and illicit trafficking detection activities.

The Office of Global Material Security programs' Site Security Plan / Standard Operating Procedure Workshop series brings together participants from a partner country's regulatory authority and facilities with nuclear and/or radioactive sources to prepare SSP/SOPs that meet regulatory requirements of the partner country consistent with international guidance. The development effort is a process that consists of multiple workshops, each followed by independent work by regulatory personnel/operators. The workshops foster the ongoing improvement of a strong national and site-level security culture/detection architecture and provide ongoing local training to facilities resulting in a stronger security/detection program. For NSDD, the process culminates in site-specific standard operating procedures and a mechanism for assessing if identified operational gaps have been addressed or if additional activities are warranted. For ORS, the process culminates in completion of security plans for sites in the country as well as transfer of the ability to facilitate development of SSPs to the regulator.

This paper will highlight exercises, specifically the TTX example and SSP/SOP activities, as tools for strengthening sustainability and the effectiveness of organizations' security of radioactive material and detection of illicit trafficking of nuclear and radioactive material. The discussion will focus on lessons learned and best practices in the implementation of TTXs and SSP/SOPs by both ORS and NSDD. A review of the planning for, implementation of, and outcomes experienced in ORS- and NSDD-conducted events will help to highlight best practices for future table top exercises and SSP/SOP workshops in continuing efforts to create strong and sustainable radioactive material security and nuclear detection architectures around the world.

Abstract ID : 186

The Value of Nuclear Security Simulation Exercises

Chatelus, R.[1]; McQuaid, A.[2]; Takoudis, G.[3]; Dallas, L.[1]

[1] Culmen International, USA; [2] International Atomic Energy Agency, [3]. European Commission Joint Research Centre

Corresponding Speaker: R. Chatelus

Participatory simulation exercises build on the foundation of advanced practitioners' nuclear detection knowledge and experience. They aim to promote the harmonization and exchange of good practices amongst experts. The exercises simulate work situations and environment at the table top level, and can be designed to focus on interaction between organizations with different but linked nuclear security functions within one state, or from different states. In this way, simulation exercises can be designed to focus on both internal (i.e., Front Line Officers and Technical Sup- port) and external (i.e., bilateral/regional/international) communications. This exercise methodology thus involves teaming individuals who in their day-to-day job responsibilities perform similar tasks and challenges them with realistic practical scenarios.

The success of the simulation exercise is grounded during the development cycle, where a master team including subject matter experts from the disciplines and countries participating in the exercise cooperatively develop scenario and inject elements. The resulting element of realism and regional appropriateness creates an environment conducive to engagement of the participants with the exercise, and, concomitantly, the exchange of ideas and established practices in different fields involved in the practice of nuclear security. Past iterations include SimEX (2015) and IASE (2016), which emphasized export control; COSINUS I (2016, Southeast Asia) and II (2018, Central Asia) which focused on nuclear security; and NUFORSE 2017 for nuclear forensics.

Simulation exercises are conducted in a no-fault learning environment, and are based on the premise that all participants will make a contribution through a decision-making process. This methodology provides an opportunity for all players to consider and discuss with their peers the potential courses of action before any decision is made. In this way practical problem solving skills are exercised against realistic scenarios that have precedent or are based on likely probabilities. In this way, the simulation exercise incorporates scenario analysis, an analytical method emphasizing examination of the consequences of an action under different circumstances. Participants use scenario analysis informally during scenario play, but more formally during the exercise debrief, where each team explains how and why it reached its decisions.

The simulation exercise is a methodologically sound training design through which regional practitioners can exchange good practices and network with their colleagues in an atmosphere that takes into account behavioural and cultural factors in nuclear security capacity building. The originality of the simulation exercise concept, and its specific added value, are explored in this paper. The paper will examine the conditions, pre-requisites and methodology which make a simulation exercise successful as an event, and relevant to overarching efforts to build nuclear security capacity and increase global interaction and awareness. Because exercise preparation and delivery is complex, a full description of the challenges of preparing and running the event, covering a range of disciplines and environments, is included, as well as the lesson learned for future exercises.

Abstract ID : 254

Scenario-based Learning to Manage Nuclear Threats in Virtual Electronic Environment

Toivonen, H.[1]; Ihantola, S.[2]

[1] HT Nuclear Ltd, Finland; [2] Radis Technologies Ltd, Finland

Corresponding Speaker: H. Toivonen

Training and exercises are crucial cross-cutting elements of a Nuclear Security Detection Architecture. The contents can be tailored for different target groups such as decision makers, incident commanders, nuclear experts or first responders. The focus of the training can range from general awareness raising to specific scientific or technical matters.

Training on realist nuclear security scenarios is difficult to arrange with real radioactive sources. For safety reasons, only small amounts of radioactivity (< 1 MBq) is typically available for training purposes. This is fine to learn to use the detection instruments. However, these small sources are unsuitable for teaching safe and efficient operation in scenarios where large sources (1 GBq – 1 PBq) are hidden and measurements must take place far a way from the sources. Another case difficult to train is a sudden release of radioactive material through explosion (RDD) or uncovering the shield of a large source (RED) which immediately lead to dangerous radiological situations.

A virtual electronic training environment overcomes the problems of safety. Any kind of radiological scenarios can be created, extending from illicit trafficking to nuclear fallout, without creating any safety hazard to the trainees. In the virtual world, measurement information can be handled in the same way as in reality, using electronic maps, spectral analysis and expert support for decision making. A new simulation tool, known as Thimulator, is introduced; it provides a platform for a table top exercise (TTX) but now the data are “real” in the same format as the instruments provide them. Thimulator can be used to track the movements of any field asset, such as bag pack or vehicle patrol or unmanned aerial vehicle (drone). The simulation software provides the spectral data to the reachback centre for further analysis in real time. The trainees will use this information to develop knowledge and wisdom which are useful for the decision maker to launch counter measures in balance relative to the threat.

Abstract ID : 217

Lessons Learned from Implementing an Exercise Program for Ukrainian Border Guards

Linville, D.[1]; Sklianchuk, Y.[2]

[1] Pacific Northwest National Laboratory, USA; [2] State Border Guard Service of Ukraine

Corresponding Speaker: D. Linville

IAEA Nuclear Security Series No. 21, Nuclear Security Systems and Measures for the Detection of Nuclear and Other Radioactive Materials out of Regulatory Control provides guidance on the development and improvement of nuclear security detection architecture (NSDA). As important as capable instruments, trained operators and good sustainability are to an effective NSDA, success also requires a systematic method of evaluating and improving the nuclear detection capabilities present within a state. A structured exercise and evaluation system is a proven method of identifying and correcting deficiencies within regulations, training, procedures or equipment.

The National Nuclear Security Administration's (NNSA) Nuclear Smuggling Detection and Deterrence program (NSDD) has created and conducted a series of Exercise Development Workshops with partner countries. The workshops are designed to provide the partners with a straightforward but comprehensive system for planning, conducting and evaluating radiation detection sys- tem (RDS) exercises. The NSDD exercise program is designed to increase the effectiveness of the partner's radiation detection program by providing a systematic approach which stresses the creation, execution and evaluation of operational and discussion-based exercises to support a process of continual improvement. These goals will help a partner achieve a more effective and sustain- able NSDA. In December 2016, the Ukrainian Border Guards (SBGS) participated in an Exercise Development Workshop. Following this event, the Border Guards used the NSDD materials as a starting point for the creation of their own exercise program.

The new Ukrainian SBGS exercise program used the framework presented by NSDD as a starting point, creating a system of exercises specifically designed to increase the effectiveness of their detection and border control operations. They developed an implementation strategy designed to both evaluate their ongoing operations and train field personnel in the new exercise system. The paper will highlight the lessons learned and best practices they developed through their experience with creating an exercise program tailored to the risks faced by Ukraine. It will discuss how the Border Guards tested and implemented the exercise program as well as how they developed the program's multi-level approach. Their experience is an excellent example of the benefits of partnerships; creating more effective detection architecture through the sharing of best practices and lessons learned.

Abstract ID: 8

Challenges of Maintaining the Security of Radioactive Sources of Categories 1, 2 and 3 in the Liberated Iraqi Provinces

Mizban, F.[1]

[1]Iraq

Corresponding Speaker: Mizban, F.

Many authorized radiation practices in Iraqi provinces, Al-Mosul and Saladin dealing with high activity radioactive sources (category 1, 2 and 3, Gamma Knife, Teletherapy cobalt unit, gauge level), subjected to periodic inspection and satisfy some extent of security requirement until Jun 2014 when these provinces were occupied by ISIS gangs, along three years we have no communication, no information about the security situation of these radioactive sources. Just these provinces were liberated during 2017 Iraqi Radioactive Sources Regulatory Authority (IRSRA) has formed technical teams accompanied by highly specialized equipment to survey the province of Mosul and focus on the west bank side of the Tigris river because it contains many medical and educational radiation practices dealing with high-activity sources, unfortunately the most intense battles were happened in the medical complex during the operation of liberation beside of direct sabotage for the medical facilities by ISIS gangs witch cause the wide destruction to the nuclear medicine hot lab (oncology and nuclear medicine hospital), hospitals buildings and broken of security measures of the theletherapitic unit (cobalt unit 11350 Ci@1980 in Al-jomhory hospital). Our activities distributed along period of time according of security permission from the military forces and federal police depending on efforts of removing of explosive material and war residuals from the roads of medical complex and internal hall of the hospitals.

The first mission was achieved at September 2017 to recover disused source, head of cobalt unit (Co-60, 6000 Ci@1970) which was stored in special grave in the backyard of the oncology and nuclear medicine hospital and transported to Baghdad (400 km) by airplane of Iraqi air force to stored securely in bunker B in Al-touatha site , the other RS of brachatherapy (Cs-137, total activity 350 mCi@1998, and St-90 , total activity 350 mCi@ 1997) and the other cobalt unit (Co-60, 11350 Ci@1980) in Al-Jumhory Hospital were couldn't access it to check the physical and security situation duo to presence of explosive materials were still un removed yet.

The Second mission was achieved after two months, IRSRA team was success to access to the hall of cobalt unit and assure the general situation, at the same time success in recovering of all barachatherpy (Cs-137, St-90) sources.

The third mission was achieved when the firing accident was happened on the MRI unit in the same hospital which contain the cobalt unit, the looters were burned the MRI and looting the electrical component and wires of the cobalt unit, fortunately the shield of the RS was still in good situation, our efforts focused on reinforce the security measure until preparing the requirement of dismantling and the transporting the unit to Baghdad.

By using mobile detection system our teams recover three lost Eu-152 sources (300 mCi for each) in small village outskirts of Mosul city and one Eu-152 source (about 300 mCi) in Saladin. The war operation caused damaging of the shield of Cs-137 RS (350 mCi @ 2009, was used as gauge level) on one reactor in factory for fertilizers production in Saladin, our team success in recovering that source.

Abstract ID: 40

The Revolution of Information Security in Sudan

Abdulrahman, M.[1]; Ayoub, K.[2]
[1] Sudan, [2] Sudan

Corresponding Speaker: M. Abdulrahman

The recent revolution of information security in Sudan attributed to adoption of effective measures and strategies that taken by relevant governmental institutions. These institutions handle the burden of information security in Sudan according to the concrete governmental strategy governed by the Ministry of telecommunications and information technology and derived by local bodies such as Sudan- CERT, National Information Center, and the Nile center for technology research. The Recent development in information security has impact on the status of cyber security and in turn yielded reliability and data integrity on governmental level and specifically the nuclear institutions. This paper illustrates the development of information security in Sudan and the efforts that have contributed to this progress.

Abstract ID: 64

Particle Resuspension and its Relation to Radiological Risk

Potter, C.[1]; Medich, D.[2]; Marshall, S.[2]
[1] Sandia National Laboratories, USA, [2] Worcester Polytechnic Institute, USA

Corresponding Speaker: C. Potter

The IAEA's Code of Conduct on the Safety and Security of Radioactive Sources has, as its basis, activity thresholds corresponding to source categories representing particular levels of risk. These are based both on internal and external exposure scenarios, the limiting values of which are designated as "dangerous" or D-values from which the category limits are obtained. Those categories 1-3 represent sources which, if not safely managed or securely protected, would or could cause permanent injury upon handling for a few minutes, minutes to hours, or some hours respectively. Scenarios are grouped by whether the material was dispersed or not. Four dispersed scenarios are considered: inhalation of airborne material, ingestion of contamination from handling a leaking source or of a poisoned water supply, contamination of the skin, and immersion in a cloud of noble gas. The first two of these represent internal exposure, the other two being external exposure. Of the 371 radionuclides listed in the Code, 84 of those are limited by external exposure, the other radionuclides being limited by external exposure or, in a few cases, having no limit.

In a dispersal event where a source has been purposely scattered over an extended area, the dose is received over four pathways, somewhat different than what was used in determination of the D values. If the material is dispersed energetically or in such a way that airborne radioactivity is generated, external exposure from "cloudshine" directly to the individual from radiation in the plume and internal exposure from the airborne radioactivity itself will provide the primary hazards. After the plume has passed or deposited, external exposure from "groundshine," radiation emitted from the deposited material, and internal exposure from "resuspension," airborne radioactivity from deposited material environmentally or electrostatically returned to the air, are the relevant exposure components. While only the plume exposure was considered in development of D-values, the groundshine and resuspension pathways remain important considerations in proactively estimating consequence from a dispersal, and, in some cases, actually represent source protection actions identified by some states.

For beta/gamma emitting radionuclides post plume passage, groundshine tends to be the limiting dose parameter, and in the case of such radionuclides of greatest concern – 60Co, 137Cs, and 192Ir – represents over 90% of a potential dose. This is not the case for alpha-particle-emitting radionuclides. Internal dose from 241Am represents over 90% of a potential dose from a distributed source. This is mostly due to a radiation weighting factor of 20 representing the additional hazard present by the alpha particle depositing all of its energy in a very small volume. In this case, it is of extreme importance that the understanding of the expected resuspension be as accurate as possible.

There have been several papers attempting to create an empirical model of resuspension using similar or identical data sets. These data are from nuclear weapons tests, some of which include a time-varying component, and some representing single measurements of serendipitously detected contamination. Additional research has been conducted to attempt to understand the mechanisms under which material resuspends and how representative current and previous models are of particular radionuclides and their associated chemical and physical properties.

Abstract ID: 90

Mixed Reality 3D Tabletop Tool with Radioactive Source Model Visualization

Le, T.[1]; Parks, J.[1]; Noel, T.[1]
[1] Sandia National Labs, USA

Corresponding Speaker: T. Le

Securing radioactive materials from across their life-cycle is a large collaborative effort that involves all levels of officials, policymakers, operational stakeholders, and local law enforcement. Both domestic and international cooperation is crucial to the prevention and detection of criminal/ unauthorized acts involving nuclear and other radioactive materials. Gathering all parties involved in the same room to evoke communication and collaborate presents both a logistical challenge and requires a great deal of time and resources. With new and emerging technologies in mixed reality, this communication, collaboration and visualization can be done remotely and can include tools to help enhance these types of collaborative tabletop exercises.

Our Scribe 3D Tabletop Tool is a visually rich software package that enhances tabletop exercises by providing a set of tools to visualize and record all events, actions, and discussions during a tabletop exercise. It provides an environment which organizes and evokes discussion allowing for a more comprehensive tabletop experience. As a tabletop exercise is conducted, a scenario is developed and recorded allowing users to visually play back the scenario and information all within a 3D environment. Because the scenario playback is within a 3D environment and not just a video, it allows users to take various view points and perspectives. All decision-making points are recorded for every event and engagement as well as the outcomes of those engagements. This enables the organization and review of decision making points to improve results and outcomes. Currently, Scribe 3D is being used by ORS to enhance tabletop exercises but does not include a radioactive source model visualization or a mixed reality experience for collaboration. This mixed reality experience includes:

- the ability for users to be immerse in the execution of a 3D table top scenario
- interact with the terrain and entities
- place themselves on the ground to watch a scenario unfold in first person

Enhancing the current Scribe 3D Tabletop tool with these features presents a significant improvement for use in the nuclear and other radioactive material security communities that conduct these exercises. At the 2018 IAEA International Conference, a talk on this concept will be presented, as well as an interactive demonstration of the mixed reality experience as explained above.

Abstract ID: 91

Randomized Operations–Board Exercise (ROBEx)

Cole, C.[1]; Thomas, B.[2]; Maddux, K.[1]; Barnes, S.[1]
[1] IB3 Global Solutions, USA, [2] Oak Ridge National Laboratory, USA

Corresponding Speaker: C. Cole

The Randomized Operations–Board Exercise (ROBEx) is an engaging interactive training technique used to assess the effectiveness of nuclear security measures and systems. ROBEx emphasizes informed decision-making, effective communications, coordination of information, and practical deployment of resources. Using a map and corresponding 3-D model scale pieces, ROBEx participants engage in discussion, decision-making, and manipulation of model pieces to reflect realistic operational activities at a site, border crossing, port of entry, checkpoint, or a combination of these locations.

Beginning with a defined scenario, participants place the 3-D pieces that replicate facilities, infrastructure, landscape, equipment, and people on a prepared map. A facilitator guides participants through the exercise. To generate unforeseen situations that could happen in actual operations, dice are used to randomly generate circumstances as the exercise progresses. Participants make decisions and take appropriate actions according to standard operating procedures and knowledge of operations. Participants move the pieces on the map to reflect the decisions made and the actions taken. Throughout the exercise, participants engage in stimulating discussions that reveal the strengths and areas of improvement of security personnel, processes, and equipment. The primary facilitator ensures the objectives of the ROBEx are met. A secondary facilitator serves as a scribe to document the decisions that participants make.

ROBEx creates a fun, compelling, no-fault training environment where participants use critical thinking skills to balance competing priorities just like they would in an operational environment. ROBEx is advantageous compared to a standard tabletop exercise because the random dice rolls create situations that might be unexpected, but are, inevitably, representative of the dynamics in operations. ROBEx is an effective technique that appeals to a broad spectrum of adult learning styles and successfully capitalizes on the principles of how adults learn. ROBEx is an affordable and practical training technique that requires minimal resources and uses equipment and accessories that are portable and easy to set up.

The United States Department of Energy/National Nuclear Security Administration Office of Nuclear Smuggling Detection and Deterrence conducted a ROBEx in early 2018 with a partner country. Participants evaluated the effectiveness of mobile detection system vans at a vehicle/pedestrian border crossing, an established law enforcement checkpoint, a construction zone, and an airport. The training objectives were met, and the partner country personnel have improved their security operations as a result of what they experienced and learned using ROBEx. The Nuclear Smuggling Detection and Deterrence Workshop and Exercises Team will continue using ROBEx to assist partner countries in the design, development, and execution of exercise activities that help test and strengthen interagency coordination, communication, and procedures in response to a nuclear or radiological threat.

Abstract ID: 144

Development of a National Train-the-Trainer Programme for Nuclear Security Detection in Malaysia via Collaboration between the International Nuclear Security Education Network (INSEN) and the Network of Nuclear Security Support Centres (NSSC)

Rahman, I.[1]; Peper, S.[2]
[1] National University of Malaysia, Malaysia, [2] Pacific Northwest National Laboratory, USA

Corresponding Speaker: I. Rahman

The International Nuclear Security Education Network (INSEN) is a partnership between the IAEA and educational and research institutions, and other stakeholders, committed to ensure the sustainable establishment of nuclear security education. The network's mission is to enhance global nuclear security by developing, sharing and promoting excellence in nuclear security education. In a parallel manner, the International Network for Nuclear Security Support Centres (NSSC), another partnership between the IAEA and Member States, contributes to the global efforts of enhancing nuclear security through developing an effective and collaborative network of nuclear security training and support centres. NSSCs support competent authorities, authorized persons, and other organizations with nuclear security responsibilities in sustaining the national nuclear security regime. The primary functions of an NSSC include human resource development, specifically through the provision of a national nuclear security training programme; technical support services for nuclear security equipment lifecycle management; and scientific support services for provision of expert advice, analysis, and research and development for nuclear security. As a corollary to these main functions, an NSSC also fosters nuclear security culture, and enhances national coordination and collaboration among the various organizations involved in nuclear security.

The INSEN and NSSC Network members often collaborate in human resource development (HRD) efforts and in the support of Coordinated Research Projects (CRP). The INSEN provides insight into the application of various teaching methodologies and provides evaluation services for nuclear security training programmes, while the NSSC Network typically contributes frontline officer (FLO) experience in operating radiation detection systems, and provides expertise in the application of a systematic approach to training (SAT). This paper will describe the successful HRD collaboration between INSEN and NSSC network members in Malaysia, specifically related to the development of a national train-the-trainer programme for Nuclear Security Detection, its pilot evaluation, and its national and regional implementation by the Malaysian NSSC. The Training Programme includes the following training courses: FLO Instructor Initial Training and FLO Training for Detection of Nuclear and Other Radioactive Material Out of Regulatory Control (MORC). The FLO Instructor Initial Training is an interactive course which addresses SAT, creating a conducive learning environment, evaluation, training preparation and delivery, hands-on demonstrations, scenario-based discussions, and practical exercises. In addition to highlighting this specific collaboration, additional areas of potential collaboration between INSEN and the NSSC Network will also be provided.

Abstract ID: 146

Assessment Framework for Legal and Regulatory Provisions for the Detection of Criminal or Intentional Unauthorized Acts Involving Nuclear or Other Radioactive Material out of Regulatory Control

Askin, A.[1]; Bray, K.[1]; Rose, Q.[2]
[1] U.S. DOE/NSDD, USA, [2] Culmen International USA

Corresponding Speaker: A. Askin

An effective and sustainable nuclear security detection architecture requires a comprehensive legislative and regulatory framework. Essential Element 1 in International Atomic Energy Agency (IAEA) Nuclear Security Fundamentals: Objective and Essential Elements of a State's Nuclear Security Regime describes the legislative and regulatory framework to govern the nuclear security regime. Additional guidance for States and their competent authorities on measures they should take to develop and maintain a legislative and regulatory framework, and put its provisions into effect, is described in NST002 Developing Regulations and Associated Administrative Measures for Nuclear Security.

Comprehensive legislation for the detection of material out of regulatory control criminalizes and establishes penalties for intentional and other unauthorized acts, defines roles and responsibilities for the diverse agencies which support detection, and specifies mechanisms of coordination among these agencies. These legislative provisions ensure the detection mission is supported by the relevant agencies and that detection events are appropriately investigated and prosecuted.

Regulations and associated administrative measures are generally developed by the relevant ministry or body to which a nuclear security role and responsibility is assigned via primary legislation. This is a relatively straightforward task in developing regulations and associated administrative measures for nuclear and other radioactive materials, facilities, and associated activities, as there is generally only one ministry or body assigned with this task—the nuclear regulatory authority. The existing regulatory guidance and experience for facilities is relatively mature. Additionally, these regulations are specifically supported by binding international conventions, such as the Convention on the Physical Protection of Nuclear Materials and its 2005 amendment. In contrast, developing a comprehensive set of regulations and associated administrative measures to govern the effective detection of criminal or intentional unauthorized acts involving nuclear and other radioactive materials out of regulatory control is complicated by the multitude of ministries and bodies with assigned nuclear security roles and responsibilities, such as Ministry of Interior, Ministry of Trade, Nuclear Regulator, Security Services, and Department of Defense. Given the number of competent authorities involved, there is the potential for gaps and unintended overlaps in these regulatory and administrative measures. Additionally, many of the regulations relevant to the effective detection of material out of regulatory control are not specific to nuclear and other radioactive materials, as some of these regulations are written for broader national security purposes and may encompass chemical and biological or other threats.

This paper will describe a holistic framework for identifying appropriate legal provisions, regulations,

agreements, and associated administrative measures for detection of criminal or intentional unauthorized acts involving nuclear and other radioactive material out of regulatory control. Applicable international conventions, consensus guidance, and good practices provide the basis for this framework. This paper will further present an assessment methodology which applies this framework to identify gaps and overlaps in regulations and associated administrative measures.

Abstract ID: 185

US NRC's Integrated Source Management Portfolio: Tools to Support Security and Licensing

Cervera, M.[1]; Randall, A.[1]
[1] United States Nuclear Regulatory Commission, USA

Corresponding Speaker: M. Cervera

The Integrated Source Management Portfolio (ISMP) is a set of information technology tools that supports the Radioactive Material Security Program and related radioactive materials licensing and tracking activities of the U.S. Nuclear Regulatory Commission (NRC). The key systems that comprise the ISMP are the National Source Tracking System (NSTS), the Web–Based Licensing (WBL) System and the License Verification System (LVS). The integration of these systems form a comprehensive program to ensure the security and control of radioactive material by tracking information on all NRC and Agreement State licensees and more than 80,000 risk significant radioactive sources possessed by approximately 1,300 licensees in the United States.

Briefly, the individual systems that compose the ISMP perform the following functions:

NSTS: This highly secure, accessible and easy-to-use IT system tracks high-risk radioactive sources from the time they are manufactured or imported through the time of their disposal or export, or until they decay enough to no longer be of concern.

WBL: Is an up-to-date electronic repository of all licenses nationwide, a web-based license system for NRC licenses, and an avenue for Agreement States to use the same licensing and information platform as the NRC. Designed to maintain information on materials licensees, WBL supports the entry of licensing information and license images that enables the NRC and Agreement States to manage the licensing life cycle from initial application through license issuance, amendment, reporting, and termination.

LVS: Helps ensure that only authorized licensees obtain radioactive materials in authorized amounts by brokering information stored in the WBL and NSTS. Therefore, LVS enables authorized licensees to confirm that (1) a license is valid and accurate and (2) a licensee is authorized to acquire the quantities and types of radioactive materials being requested.

Together, the ISMP provides the following benefits to support the Radioactive Material Security Program and related radioactive materials licensing and tracking activities of the NRC:

- Make national radioactive source authorization, possession, and transaction information available to other government agencies with a role in protecting the United States from nuclear and radiological threats.
- Provide licensees with a secure automated means to verify license information and possession authorization prior to initiating radioactive material transfers.
- Enable the NRC to monitor the location, possession, transfer and disposal of risk significant radioactive sources throughout the Nation.
- Improve source accountability, and alert regulators to tracking discrepancies.
- Modernize the NRC's licensing and inspection management systems.

This presentation will describe each system, how they work together, and how information they contain is used by the NRC, the Agreement States, and other Federal agencies of the United States.

Abstract ID: 201

Strengthening Radioactive Security in Mexico and Central America through Collaboration, Training and Certification

Delgado, R.[1]
[1] World Institute for Nuclear Security (WINS)

Corresponding Speaker: R. Delgado

The IAEA and many of its member States increasingly recognize the importance of developing, maintaining and sustaining the professional competence of individuals with responsibilities for nuclear and other radioactive materials. On 6 December 2016, the Permanent Mission of Canada presented to the IAEA a Joint Statement on Certified Training for Nuclear Security Management that was signed by 12 States, including Mexico. As of today, a total of 15 States have subscribed to this Joint Statement. Known as Information Circular 901 (INFCIRC/901), the Joint Statement emphasizes the importance of ensuring that "management and personnel with accountability for nuclear security are demonstrably competent". It also outlines two ways in which States can support the training of effective and competent managers of such materials and related facilities:

- Maintaining and continuously improving domestic or regional training through education, certification and/or qualification activities; and
- Supporting or participating in the development of World Institute for Nuclear Security (WINS) best practice guides and training activities.

In 2016, the Government of Canada signed an agreement with the Government of Mexico in which Canada agreed to contribute to the development of a sustainable and certified nuclear security training centre to support Mexico's commitment to INFCIRC/901. One of the results of the agreement is that it enabled WINS to contribute its technical expertise to the Mexican Secretariat of Energy (SENER) and its National Institute for Nuclear Research (ININ) by collaborating on a range of professional development services between September 2016 and March 2018.

Through the collaboration between WINS and Mexico the following major outcomes have been achieved:

- ININ underwent an ISO certification audit by an external certification body and achieved international certification of its learning services under ISO 29990:2010, becoming the first organization in Mexico to receive certification with this ISO standard.
- Blended learning was delivered to participants in Mexico and Central America based on material from the WINS Academy elective Module on Radioactive Source Security Management.
- Capacity development in the region by conducting a Train the Trainer programme for Mexican specialists, who in turn supported the delivery of the blended learning.
- Engagement with Mexican and regional stakeholders to endorse and promote ININ as a Nuclear Security Support Centre.

The cornerstone of this successful collaboration has been SENER’s and ININ’s commitment to the project. The continuous involvement and guidance from the National Commission for Nuclear Safety and Safeguards (CNSNS), the Mexican regulatory body, has also played a crucial role. Furthermore, WINS’ Mexican counterparts have continually demonstrated a high level of understanding and expertise in the core areas of the project.

Canada’s financial support and unwavering commitment to developing, maintaining and sustaining the competence of individuals with management responsibilities for nuclear security made the project possible.

This demonstrates the key role that States play in helping organizations and individuals achieve professional nuclear security competence and the importance of effective and ongoing communications among international partners.

Abstract ID: 232

Research on Computer-Based Analytical Tool for Evaluating Physical Protection System Effectiveness

Mardhi, A.[1]; Andiwijayakusuma, D.[1]; Khairul[1]
[1] BATAN- National Nuclear Energy Agency, Indonesia

Corresponding Speaker: A. Mardhi

Physical protection system (PPS) effectiveness of nuclear facility needs to be assessed regularly for providing adequate and optimum protection against sabotage or unlawful acts. The main challenge of this routine activity is to reduce the annual budget with still maintain the quality of assessment. The computer-based analytical tool offers alternative solutions by measure the likelihood adversary threat scenario against the essential parameter detect, delay and response to determine the most vulnerable path in the system. There are several available tools which has been developed such as EASI and SAPE, however for research purpose it is more suitable to have the tool that can be customized and enhanced further. The objective of this study is to demonstrate the research on computer-based analytical tool for assessing the PPS effectiveness as part of BATAN nuclear security program. This tool is use the combination of adversary path analysis method and the application of graph theory. The capabilities of this tool are able to model adversary line in multiple path for sabotage scenario, calculate the probability of interruption, and specify the critical detection point as PPS performance measurement and determine as well as rank the most vulnerable path in facility.

Abstract ID: 237

Radiological Threat Reduction through Collaboration and Capacity Building: Planning for the Future in Secure Disposal of Radioactive Material

Cole, J.[1]; Cocina, F.[1]; Dammann, M.[2]
[1] Los Alamos National Laboratory, USA, [2] Southwest Research Institute, USA

Corresponding Speaker: J. Cole

The Department of Energy's (DOE) National Nuclear Security Administration's (NNSA) Office of Radiological Security's (ORS) Off-Site Source Recovery Program (OSRP) has been tasked with the removal and disposition of radioactive sealed sources. It is the mission of the program to provide support, in the interest of national security and public health and safety, by preventing potentially harmful radioactive sealed sources from falling under the possession of individuals that would use this material for malicious intent. OSRP is a collaborative effort involving Los Alamos National Laboratory (LANL), Idaho National Laboratory (INL), and Lawrence Livermore National Laboratory (LLNL). Each lab has a unique and significant role and has contributed in securing end-of-life radioactive sealed source management for over 20 years. To date, OSRP has recovered over 41,000 disused sources totaling approximately 1.25 million Curies.

At the inception of the program Pu-239 was the only acceptable isotope to be recovered. As a wider security scope developed, OSRP expanded its mission to include the removal and disposal of other sources that posed a potential risk to national security, health, and safety. Starting in 2004 OSRP initiated its involvement in recovering high-activity cesium and cobalt devices, largely from medical, research, and industrial facilities. From early on, the demand for OSRP's services resulted in a backlog of device recoveries. Disused devices remaining in locations such as hospitals and universities presented a burden to licensees in terms of keeping the unwanted devices secure, and OSRP recognized the need for capacity building.

As demand increases for removal of high-activity devices, largely due to ORS's Cesium Irradiator Replacement Project (CIRP), it has become important for OSRP to build capacity in device disassembly and transportation. Additionally there is a limited number of U.S. Nuclear Regulatory Commission (NRC) or Agreement State-licensed personnel who are qualified and experienced in disassembling and preparing devices for shipment. In an effort to increase knowledge for interested parties, Southwest Research Institute (SwRI) offers an ORS-funded hands-on training course specializing in preparing devices for shipment. Currently this class focuses on the shipment preparation for some of the more common devices, specifically Gammacell 1000, Gammacell 3000, Gammacell 40, IBL 437C, and Mark 1 devices. Stringent security measures are taken to ensure that the sensitive information covered in this course is protected and does not compromise national security. This serves as a safe and effective way to build capacity in technical knowledge on a variety of devices currently being removed.

OSRP also utilizes a unique technical expertise from SwRI for the facility's ability to safely package sources for secure final disposition. It is one of the few facilities in the world specifically designed and capable of handling radiation levels that are associated with the sources housed in these devices. Additionally, the personnel working in this facility maintain expert knowledge of the devices and sources. As OSRP continues to support the CIRP initiative it is crucial to have the capabilities offered by SwRI to safely, securely, and effectively complete this work.

Another component to this effort is the use of the proper shipping container to transport the various devices. Due to the high activity of radioactive sealed sources these devices contain, U.S. regulations by the Nuclear Regulatory Commission (NRC) and the U.S. Department of Transportation (DOT) require certified Type B containers for safe and compliant transportation. As a way to increase transportation capabilities ORS has developed two new Type B containers. The most recently completed of these containers, the 435B, is currently certified to transport Gammacell 1000, Gammacell 3000, Gammacell 40, and Gammators in an overpack configuration. This provides a greater capacity and flexibility to safely and effectively remove these devices that had previously been limited in acceptable shipping configurations.

It is important to ensure that these devices are decommissioned with expertise and caution, and the radioactive sealed sources contained within are safely transported and properly disposed of. The execution of removing devices from the private sector is a complicated process but is vital to permanent threat reduction by emphasizing a cradle-to-grave policy on radioactive sealed sources.

This paper will discuss efforts in capacity building for secure source lifecycle management, supported by OSR, OSRP, and SwRI.

LANL internal reference number: ‘LA-UR-18-22972, Version 2’

Abstract ID: 239

Indonesia's Criminal Law Policy to Suppress Nuclear Crimes on Radioactive Material

Rushartono, D.[1]; Pramono, Y.[1]
[1] Nuclear Energy Regulatory Agency (BAPETEN), Indonesia

Corresponding Speaker: D. Rushartono

Act Number 10 Year 1997 on Nuclear Energy has regulated minor provision for the security regime. The Act has to be updated and harmonized with national legislations and regulations as well as international conventions. Therefore the criminal law policy has to be implemented into the Bill of Amendment of Act Number 10 Year 1997 on Nuclear Energy as integrated national law system.
The criminal law policy will or has been implemented nationally by the government also includes an understanding of how politics influences the law by looking at the configuration of the forces behind the making and enforcement of the law. The law can not only be regarded as articles that are imperative, but must be viewed as a subsystem that in fact is not impossible very determined by politics, both in the formulation of the material and the articles and in the implementation and enforcement. For example ratification of international conventions in the form of Act has to be joint consent between House of Representatives of Republic of Indonesia and the President of Republic of Indonesia.
As part of Member States of International Atomic Energy Agency (IAEA), Indonesia has ratified some international conventions and have obligation to reflect its commitments to harmonize with national legislations and regulations. In security regime, Indonesia has issued Presidential Decree Number 49 Year 1986 on Ratification the Convention of The Physical Protection of Nuclear Material, Presidential Regulation Number 46 Year 2009 on Ratification of Amendment to the Convention on the Physical Protection of Nuclear Material, as well as Act Number 10 Year 2014 on the Ratification of International Convention for the Suppression of Acts of Nuclear Terrorism. Indonesia also has taken into consideration in order to consistent with the IAEA Nuclear Security Series (NSS) publications Objective and Essential Elements of a State's Nuclear Security Regime (IAEA Nuclear Security Series No. 20), Nuclear Security Recommendations on Radioactive Material and Associated Facilities (IAEA Nuclear Security Series No. 14), and Nuclear Security Recommendations on Nuclear and Other Radioactive Material out of Regulatory Control (IAEA Nuclear Security Series No. 15), as well as with the Code of Conduct on the Safety and Security of Radioactive Sources. The International convention and IAEA Nuclear Security Series (NSS) also has regarded as the criminal law policy.
The Bill of Amendment of Act Number 10 Year 1997 on Nuclear Energy also appropriately dealing with other acts determined by Republic of Indonesia to have an adverse impact on nuclear security. In order to achieve the purpose of nuclear security, nuclear security measures is required, include protection, detection, and response. To implement the security measures, the Government of Republic of Indonesia develops Nuclear National Policies and Strategies. Nuclear National Policies and Strategies includes at least:

a. identification of the importance of nuclear security;
b. determination of threat level;
c. regularly setting performance standards and performance testing programs;

d. the determination of a safeguards system;

e. establishment of radioactive source security systems and physical protection;

f. the establishment of a supervisory coordination system;

g. stipulation of information security; and

h. establishment and development of detection and response measures; and

i. enhance expertise in nuclear security-related technologies.

The Development of Nuclear National Policies and Strategies has been coordinated by government agencies who held governmental affairs in the political, legal, and security. The Bill of Amendment of Act Number 10 Year 1997 on Nuclear Energy has define offences or violations under Indonesian Code of Penal those criminal or intentional unauthorized acts involving or directed at nuclear material, other radioactive material, associated facilities or associated activities. Those criminal or intentional unauthorized acts provisions also have been influenced by provisions of International Convention for the Suppression of Acts of Nuclear Terrorism.

The offences or violations define as follows: Any person is prohibited to abuse of nuclear material, other radioactive material, associated facilities or associated activities, includes:

a. create, test, or use radiological weapons

b. possess, master, transport, store, transfer, research, or develop radiological weapons;

c. producing, possessing, storing, using, transferring, transporting, exporting or importing, or conducting unlawful radioactive research and development and / or for the purpose of generating nuclear security crimes

d. participate in militant activities to use radiological weapons; or

e. participate in, assist and/or persuade others in the activities as stated in letter a and letter b.

The criminal law policy in the Bill of Amendment of Act Number 10 Year 1997 on Nuclear Energy has been harmonized with the International convention and IAEA Nuclear Security Series (NSS) to suppress nuclear crimes on radioactive material.

Abstract ID: 248

Radiological Security for Mass Events

Wooley, M.[1]; Davatz, G.[1]; Meshkian, M.[1]; Gendotti, U.[1]
[1] Arktis Radiation Detectors Ltd, Switzerland

Corresponding Speaker: M. Woolley

Increasingly, radiological security has become an integral aspect of mass event planning, especially of political summits attended by high-class dignitaries. This talk outlines a few best practices, typical equipment, and sensible interfaces between private security contractors and government authorities.

In a first step a perimeter must be defined. All points of entry through the perimeter that allow access to the venue should be monitored with suitable equipment: All pedestrians as well as vehicles entering the perimeter should be conducted to pass through a Radiation Portal Monitor (RPM). RPMs exist as relocatable, man-portable devices. They can be set up within hours to monitor passageways. RPMs are a means of primary screening. Vehicles or pedestrians triggering an alarm in an RPM need to be taken aside for secondary screening. Alarm resolution may be performed using a Radioisotope Identification Device (RIID). RIIDs are available in the form of handheld detectors. While RPMs can be operated by personnel having minimal specific training, personnel operating RIIDs need to be sufficiently knowledgeable in the field of radiation protection to have an overview of typical medical isotopes, naturally occurring radioactive materials (NORM), and actual threat sources. If an alarm cannot be resolved by means of a RIID, the case should be handed over to governmental authorities.

Once a perimeter has been established and access is controlled, the venue can be searched for radiological threats. This process is called profiling. Profiling can efficiently be conducted using one or several drone-borne gamma detectors running a systematic pattern covering the entire area. The goal is not just to discover concealed radiological threats, but also to understand the levels of background radiation for the entire venue. Visual inspection is equally necessary to discover shielded sources that could be hidden in places like trashcans. Inspection of such potential caches, as well as the resolution of any alarms arising in the profiling, can be performed using a RIID. Should no drones be available for profiling, a task can be performed in a more laborious manner by a team of security personnel each equipped with a Personal Radiation Detector (PRD), a device that does not necessitate excessive training in order to be effectively used. Networked PRDs are well suited for this purpose.

Drone-based profiling of a venue may be conducted using novel compact and modular plastic scintillation detectors coupled to the drones. Recently, there has been development towards these detectors for detection of illicit trafficking of radionuclides, resulting in rugged SiPM based gamma detection systems to efficiently detect gamma radiation in a wide range of energies. Due to their modularity and ease of scalability, these gamma detectors can also be used in a variety of radiation monitoring systems with different scales, ranging from hand-held contamination monitoring systems up to radiation portal monitors.

Once the venue has been profiled, guests can be permitted to enter the perimeter, always passing through RPMs. RPMs capable of isotope categorization serve to minimize the number of alarms and thus increase throughput. Note that besides being a tool for interdicting radiological threats, RPMs also have a deterrence value. During the event, a team of security personnel equipped with PRDs – ideally networked PRDs –may be introduced into the crowd to increase chances of detection.

Abstract ID: 277

Strengthening the Security of Radioactive Sources in Brazil: A Roadmap to Success

Tavares, R.[1]; Roza de Lima, A.[1]; Augusto da Silva, F.[2]; Monteiro Filho, J.[1]; Bloomfield Torres, L.[1]
[1] CNEN- Brazilian Nuclear Energy Commission, Brazil, [2] Institute of Radiation Protection and Dosimetry, Brazil

Corresponding Speaker: R. Tavares

This paper aims to outline past, present and future challenges and actions involved and their corresponding milestones in the effort of strengthening security of radioactive sources used for medicine and industry applications in Brazil. It starts with a brief historical description of security activities regarding higher-risk sources, the Goiânia radiological accident and its derived actions, changes in domestic threat environment, and the evolution of the nuclear security regulatory framework, followed by a roadmap based on four subjects: threat assessment, regulatory framework, physical protection measures, culture and awareness promotion, and integration with other government agencies and with private sector.

Regarding the threat assessment process, operators provide their assessments inside the Physical Protection Plans, and in accordance with regulation CNEN NE 2.01, it must pass through revision every two years and whenever it is necessary due to threat changes.

Regarding the regulatory framework, the current version of the nuclear security regulation, CNENNE-2.01 “Physical Protection of Operational Units of Nuclear Area”, approved by CNEN’s Board of Directors in August 1981, reviewed twice, in 1996 and 2011, is applicable to the operational units whose activities are related to production, use, processing, handling, transport or storage of nuclear materials. Recently, CNEN is through an updating process of its regulatory framework in nuclear security area, splitting CNEN-NE-2.01 in three other documents, more specific and better targeted: CNEN-NN-2.01 “Security of Nuclear Material and Nuclear Facilities”; CNEN-NN-2.05 “Security of Nuclear and Radioactive Material in Transport”; and CNEN-NN-2.06 “Security of Radioactive Sources and Associated Facilities”. The texts of the new documents are being developed and updated based mainly on national documents and laws, documents of IAEA Nuclear Security Series (in the case of radioactive sources and associated facilities, the main source is the Nuclear Security Series 14, Nuclear Security Recommendations on Radioactive Material and Associated Facilities, which is considered the “state of art” in the subject), and other related international instruments, such as the Code of Conduct on the Safety and Security of Radioactive Sources.

Regarding physical protection measures, the prescriptive measures in regulation CNEN NE 2.01 are intended to be replaced by graded-approach related physical protection measures based on the source categorization as recommended by IAEA, as well as the different source utilization on different types of practices. The measures will be set in three different levels: A, B and C, where level A is applicable to higher-risk sources.

Regarding culture and awareness promotion, CNEN, through its Nuclear Security Support Center (NSSC) has been organizing workshops and training events to different types of professionals in the industry.

Regarding integration with other government agencies and with private sector, this process has had great improvement after the Major Public Events held in Brazil in the last decade.

Abstract ID: 291

Optimization Planning Tool for Urban Search (OPTUS)

Edmunds, T.[1]; Wheeler, R.[1]
[1] Lawrence Livermore National Laboratory, USA

Corresponding Speaker: T. Edmunds

IAEA Nuclear Security Series No. 15 calls for competent authorities to develop appropriate instrument deployment plans to search for material out of regulatory control. The guidance states that these plans should attempt to maximize the likelihood of detection given available resources. In addition, IAEA TECDOC 804 provides high-level guidance on conducting searches. Researchers at Lawrence Livermore National Laboratory have developed a software tool to optimize performance of mobile detectors searching a given area that can support these IAEA missions. The tool computes an optimal route for search assets to follow that maximizes the probability of detecting a specified source in a given search time. The tool can be used to compare alternative search plans, equipment configurations, and detection algorithms.

The tool has been implemented on an open source geographic information system (GIS) platform that has a broad user base (QGIS). Road networks, constraints on traffic flow, building footprints, and other geographic information needed to structure the search problem are acquired from open source data resources such as OpenStreetMap. Traffic congestion factors have been measured for several U.S. cities are used by the software. Background radiation survey data are used, although it is our experience that the optimal route is not highly dependent upon background levels when detectors of sufficient resolution (e.g., NaI(Tl)) and spectroscopic detection and nuclide identification algorithms are employed.

The GIS-based interface allows the user to draw overall search perimeters, priority zones where search assets should be concentrated, and exclusion zones where mobile search assets should not be dispatched. The user also enters the search time, number of mobile detectors, source strength, and nuclide.

The code uses first-principles radiation transport calculations to compute signal-to-noise (SNR) ratios for all pairs of potential source and detector locations. SNR is updated when the detector makes multiple passes in the proximity of a possible source location. Given SNR contributions for each pass down each road segment, an optimization algorithm assembles a collection of road segments into a route that maximizes the probability of detecting the specified source within the allowed search time subject to traffic flow constraints. The code generally takes less than a minute to compute an optimized eight-hour search plan in an urban area.

The tool displays the optimal route on a map and statistics about the search. The tool also displays potential source locations that are color coded to reflect the probability of detecting the source at that location given the route driven. Finally, the tool generates a routing file with turn-by-turn directions in a standard format that can be read by navigation devices (.gpx file format).

Abstract ID: 334

Public Involvement in Radioactive Material Security

MacIntyre, D.[1]
[1] United States Nuclear Regulatory Commission, USA

Corresponding Speaker: MacIntyre, D.

An informed public is an important stakeholder in supporting efforts to ensure the safety and security of radioactive materials. The public can be enlisted to report suspicious incidents, and to recognize devices that have been lost, discarded, or are otherwise not where they are supposed to be – leading to safe recovery and return to regulatory control. As an independent regulatory agency that prides itself on openness, the U.S. Nuclear Regulatory Commission (NRC) focuses on open, accountable, and accessible government, as demonstrated by the NRC's long history of, and commitment to, transparency, participation, and collaboration in our regulatory activities. To continue this commitment the NRC invites members of the public to participate in numerous public meetings, the ability to request regulatory action, and actively solicits and responds to public comment on regulatory activities. The NRC also provides many opportunities for the public to learn about radiation science and related issues. This Interactive Content Presentation would demonstrate an NRC product that is aimed at informing a public audience about U.S. Government, specifically the NRC's, efforts to ensure the safety and security of radioactive materials. The presentation would briefly cover 1) the beneficial uses of radioactive materials in industry, medicine and research; 2) efforts to ensure their security through licensing, trustworthiness and reliability, access controls, physical controls, emergency planning, source registration, and secure transport; 3) international efforts, including IAEA's Code of Conduct on the Safety and Security of Radioactive Materials and various international transport conventions; and 4) cooperation in orphan source recovery efforts. The presentation will include an embedded video on radioactive source security. Ultimately, the presentation could be used at public meetings or on the NRC agency website and social media channels.

Abstract ID: 341

How Much Security is Enough?

White, D.[1]
[1]United States Nuclear Regulatory Commission, USA

Corresponding Speaker: D. White

When developing national (i.e., State) security requirements for the protection of risk significant radioactive materials, regulators need to determine how much security is necessary to provide adequate protection. There are several factors that go into the development of requirements (i.e., policies and regulations) for the protection of risk significant radioactive material (as defined by each state). Some of the factors that need to be determined when developing security requirements include: (1) what is the threat and/or consequence you are trying to protect against or prevent, (2) and based on threat and potential consequences, what is the appropriate level of physical security measures to ensure adequate protection, (3) what are some of the economic or political factors that need to be considered when implementing the security requirements, (4) and how do you ensure the security requirements are sustainable. When determining the answer to these factors it is important to balance the burden of implementing the new requirements with the benefits of using the radioactive material. The use of radioactive material benefits society in many ways such as in medicine, oil and gas exploration, industry, and research. However, there are both safety and security risks with the use of radioactive material. By following appropriate procedures, safety and security risks can be reduced. It is not possible to eliminate all the risk from the beneficial use of radioactive material and without a balanced approach to regulation, it is possible to over burden the regulated community which could result in the loss of the beneficial use of radioactive material.

This presentation will discuss some of the factors that United States Nuclear Regulatory Commission used to develop their national security requirements for the protection of risk significant radioactive material (i.e., Category 1 and Category 2 quantities of radioactive material). The presentation will also discuss some of the lessons learned during the implementation of the security requirements.

Abstract ID: 387

Implementation of a Concept of Operation on Detection of Illicit Trafficking of MORC

Bakri, N.[1]; Tahar, R.[1]; Alli, F.[1]
[1] Atomic Energy Licensing Board, Malaysia

Corresponding Speaker: N. Bakri

Nuclear security for material out of regulatory control (MORC) demands a comprehensive approach in addressing the threats and its challenges. MORC normally induces event that involve public and public domain where more than one particular national laws and authorities taking control on the scene. In Malaysia the approach in addressing nuclear security event involving MORC is conducted through a defined Concept of Operation (ConOps) in order to detect the illicit movement of MORC to and within Malaysia. Malaysia conducted exercise to evaluate the developed ConOps for detection of MORC at the maritime border with the involvement of criminals and terrorist group. Maritime space introduced a challenging scenario for it involved interior of the state that is in close proximity of open borders. Such exercise requires a massive effort and preparation involving all competent authorities that may have the role during nuclear security event involving MORC at the maritime area. Observations on measures that require enhancements and good practices were identified during the exercise. The Government of Malaysia also cooperate with the International Atomic Energy Agency (IAEA) to record the execution of ConOps for detection of MORC at maritime area for training purposes.

Abstract ID: 334

Public Involvement in Radioactive Material Security

MacIntyre, D.[1]

[1] United States Nuclear Regulatory Commission, USA

Corresponding Speaker: MacIntyre, D.

An informed public is an important stakeholder in supporting efforts to ensure the safety and security of radioactive materials. The public can be enlisted to report suspicious incidents, and to recognize devices that have been lost, discarded, or are otherwise not where they are supposed to be – leading to safe recovery and return to regulatory control. As an independent regulatory agency that prides itself on openness, the U.S. Nuclear Regulatory Commission (NRC) focuses on open, accountable, and accessible government, as demonstrated by the NRC's long history of, and commitment to, transparency, participation, and collaboration in our regulatory activities. To continue this commitment the NRC invites members of the public to participate in numerous public meetings, the ability to request regulatory action, and actively solicits and responds to public comment on regulatory activities. The NRC also provides many opportunities for the public to learn about radiation science and related issues. This Interactive Content Presentation would demonstrate an NRC product that is aimed at informing a public audience about U.S. Government, specifically the NRC's, efforts to ensure the safety and security of radioactive materials. The presentation would briefly cover 1) the beneficial uses of radioactive materials in industry, medicine and research; 2) efforts to ensure their security through licensing, trustworthiness and reliability, access controls, physical controls, emergency planning, source registration, and secure transport; 3) international efforts, including IAEA's Code of Conduct on the Safety and Security of Radioactive Materials and various international transport conventions; and 4) cooperation in orphan source recovery efforts. The presentation will include an embedded video on radioactive source security. Ultimately, the presentation could be used at public meetings or on the NRC agency website and social media channels.

Abstract ID: 2

A Model Transport Security Arrangement of Radioactive Material for Oil Exploration in Ghana

Kyei, Y.[1], Adu, S.[1]

[1] Nuclear Regulatory Authority, Ghana

Corresponding Speaker: Y. Kyei

The discovery of oil in Ghana has led to various oil exploration technology including the use of radioactive sources. Radioactive sources plays an important role in logging formation parameters, radioactive tracers, and other substances in hydraulic-fracturing fluid. Radioactive sources are sometimes used to determine the injection profile and location of fractures created by hydraulic fracturing. These sources arrive from overseas through the ports in Ghana and are transported to the oilfields by various means of transportation. There are various activities of this sources, there is the potential for an adversary to divert the use of the material for malicious purposes. There is the need to consider the security of the radioactive material during transport to the oilfield. Radioactive material used in the oilfields together with their documentations are received from the Ghana port and harbour authority by transport companies who are registered by the Nuclear Regulatory Authority, Ghana. The transportation of this radioactive material is considered as a dangerous good and therefore all the necessary security measures for its safe and secure transportation from one location to the other must be taken into consideration. Vulnerability analysis and risk assessment of the possible path to be used during the transport was carried out. This assessment comprises of assessing the roads and time of the day which may be suitable for the transport, the presence of police barriers along the route and possible secured rest stops along the route. The transport plan also involve an approved van equipped with communication device, secured from sabotage, and with the presence of a security personnel had been used to transport the radioactive source. This paper seek to present the procedures involved in transporting radioactive material from one destination to the other. The nuclear regulatory authority of Ghana is ensuring that the transport company comply with the transport regulation of radioactive material used in the country.

Abstract ID: 11

A real-time surveillance and management system for mobile radiation sources

Tran-Quang, V. Y[1], Vuong, H.[2]

[1] School of Electronics and Telecommunications, Hanoi University of Science and Technology,, Vietnam
[2] Vietnam Agency for Radiation and Nuclear Safety (VARANS)); Vietnam

Corresponding Speaker: V. Tran-Quang

This paper presents results of a real-time surveillance and management system for security of radioactive material (BKRAD). The BKRAD integrates various positioning and sensing techniques that allows us to continuously monitoring radiation source devices in a variety of challenging environmental conditions, such as indoor or underground areas. The unique aspect of the BKRAD is its ability to identify and recover radiation source projectors that were stolen or lost using specialized equipment that is secretly attached to each projector. In addition, this product is equipped with a high-tech sensor system to improve the safety and security of radiation sources against unauthorized access.

1 Introduction

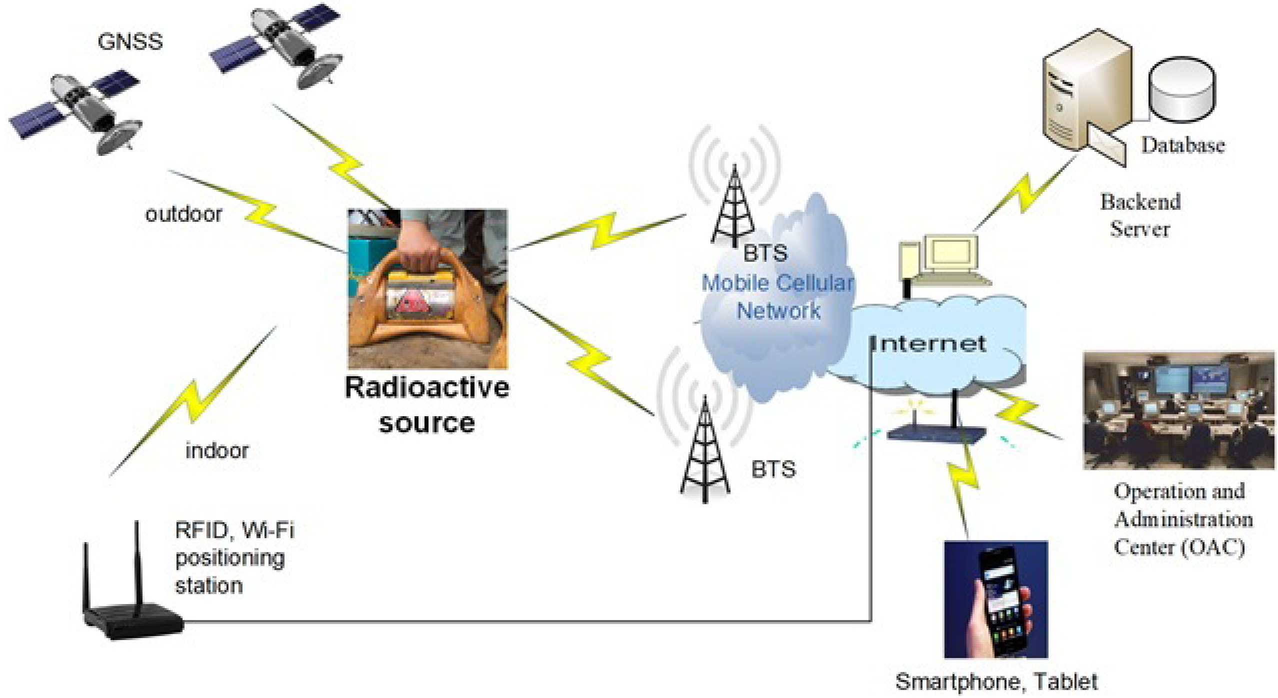
Radiation and nuclear technologies have been deployed rapidly and broadly in various industrial and economic sectors and society, which has brought various practical benefits. However, the management, transportation, storage and usage of radiation sources, such as nondestructive testing (NDT) devices, are complicated by many challenges. In fact, there have been many losses of radiation sources resulting in significant impacts on economic and social stability. Although these incidents did not cause serious radiological impacts on human and environment, but they have made a big public concern on physical protection of radioactive and nuclear materials. Therefore, a system for security of radioactive material in NDT devices is very necessary. In this project, we have successfully designed, manufactured and tested the BKRAD for security of radioactive source in Vietnam.

2 The BKRAD System

2.1 System Architecture

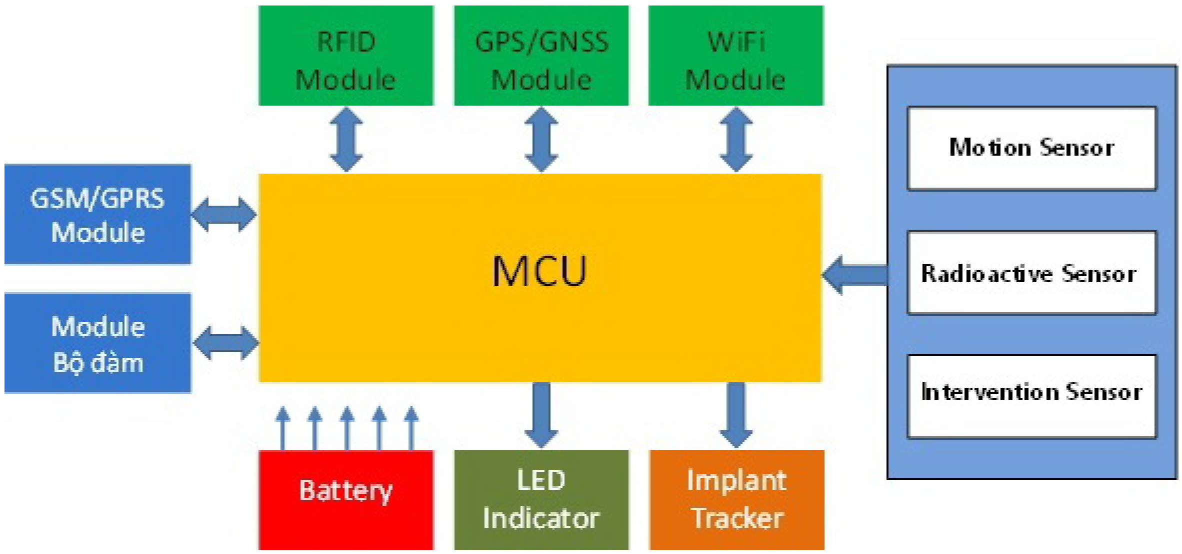
We proposed a general architecture for the BKRAD system as shown in Figure 1. The objects that need to be located and surveilled are the devices containing radiation sources, to which the BKRAD are attached to detect position, perform surveil, and communicate with central server. Mobile communication and the Internet are used as the main communication. In special situations, wireless communication (such as LORA) can be used. The central server collects and processes positioning–surveillance data. This module also provides management functions for supervisors and users through

Web interface or handheld devices.



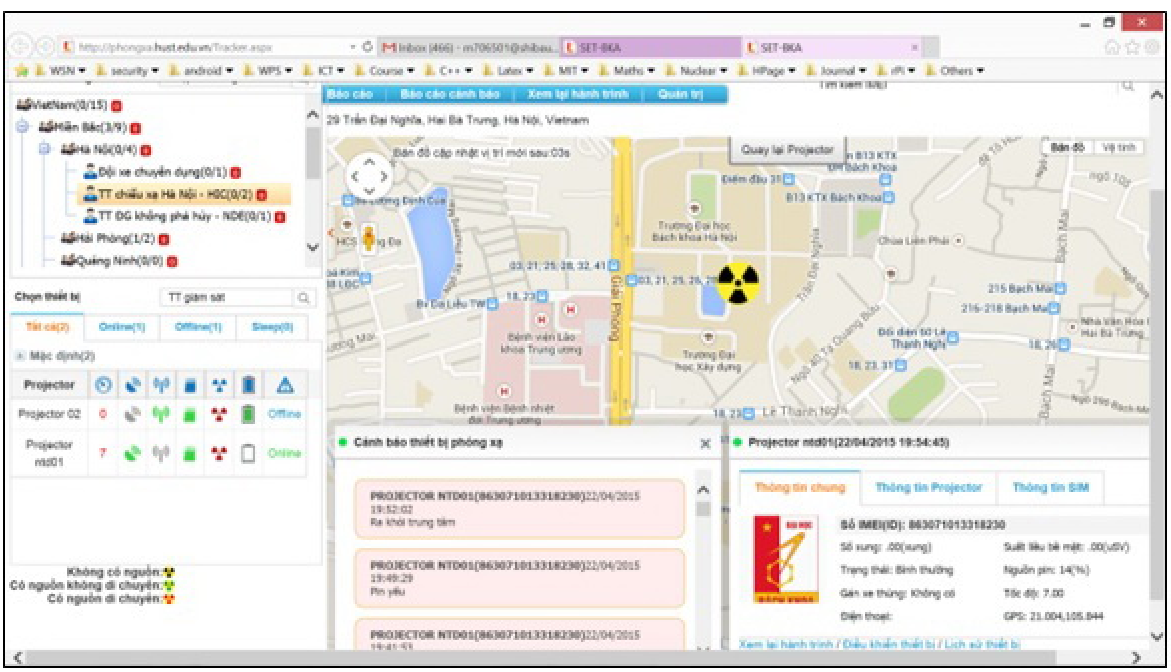
2.1 Hardware

The BKRAD structure physically fit SENTINEL 880 projector with alloy waterproof cover and shock resistance. The hardware device consist of three main modules: position-identifying, communication, and sensor–surveillance as shown in Figure 2. The position-identifying module is equipped with different positioning technologies (GPS, Cell-ID and WiFi) to ensure positioning required at any time and place, special when projector working in difficult environments (construction sites, factories, tunnels, etc.). Communication module equipped with GPRS/3G and LoRaWAN transceivers allows data to transmit to the central server in real-time. When a projector is in working or moving case, BKRAD sends data at a 30-second cycle. If the projector is not in use, it will automatically switch to energy saving mode and send data every 60 minutes. When the projector is archive in store, it will send data every 10 hours. One of the key features and characteristics that make the BKRAD system different from other position–surveillance systems is that it is equipped with a sensor–surveillance module, which help to collect data and events for remote surveillance. The sensor-surveillance consists of a radiation, motion, anti-access sensor, and implant tracker. By employing the implant tracker, we can detect the projector in the event of unauthorized access and dilapidation, which have practical significance for worst situation prevention and detection. The device is also designed to operate independently and stably powered by long-life rechargeable batteries to allow continuous operation for long periods (up to 10 days). Users need to do nothing but charge the device when the battery indicator is low or when receiving a warning from system). The device is embedded firmware update remotely.



2.3 Software

Software is designed on web interface and on smartphone to monitor and provide the location and status of projectors periodically, continuously, or as requested. Software also provides operational functions, system administration (code, renew, active, inactive, etc. a device if needed), statistics, reporting and warnings (SMS), such as radiation dose rate exceeding the prescribed limit or the transport of the devices containing radioactive material out of the safety corridor. Software is also designed with security functions, data encryption, device authentication, and multi-layer user authentication.



3 Conclusion

The BKRAD system has been passed many field tests with 5 projectors at 2 sites for 2 months. The field test results show that the all technical characteristics satisfied requirements for the security of mobile radioactive sources.

Abstract ID: 13

Self-Assessment of Nuclear Security Culture in Polish Medical Facility

Wiśniewska, M.[1]

[1] Poznan University of Technology; Poland

Corresponding Speaker: M. Wiśniewska

Self-assessment tool for promoting, enhancing and sustaining nuclear security culture in Polish hospital using radioactive sources.

The main goal of the poster is to present the results of the research in self-assessment of nuclear security culture conducted in Polish medical facility using radioactive sources. The research was processed in reference with the project supported by the IAEA under the Programme of Coordinated Research Activities under the name "Enhancement of Nuclear Security Culture in Medical Institutions Using Radioactive Sources and Materials". It has been planned for three years since 2015. The program ran at medical facility, second private radiotherapy center in Poland, specializes in nuclear medicine.

The main goal of the research was to promote, enhance and sustain nuclear security culture among all employees in the hospital and its subsidiary. The study paid special attention to the human factor in the security area and the importance of self-awareness and responsibility. The researchers' aim was to tailor the self-assessment questionnaire to the facilities' needs and wants.

The poster presents the research process. The first stage took place in the Radiotherapy Department, then in PET Department and finally in one of the subsidiaries.

The research process started with documents' analysis and group discussions, secondly came to survey followed by the interview in the focus group. When the first stage was completed and self-assessment tool accepted by the self-assessment team, a self-assessment was proceeded in the hospital. Analysis of self-assessment questionnaires was developed into the final report of nuclear security culture condition.

Closing, the goal of the research on Self-Assessment of Nuclear Security Culture in Polish Medical Facility, was to encourage personnel of the medical institutions, including non-medical personnel, to engage in promoting, enhancing and sustaining nuclear security culture approach. Employees are likely to be constantly attentive and focused on their responsibilities due to their work with radioactive sources. The primary purpose of self-assessment is to persuade personnel to realize what can be the consequences of their recklessness or ignorance to the public.

Abstract ID: 14

Regulatory Functions and Practices to Prevent and Detect Illicit Trafficking of Radioactive Materials in Ghana

Agbenorku, O.[1], Mensah, A.[1], Adu, S.[1]

[1] Nuclear Regulatory Authority; Ghana

Corresponding Speaker: O. Agbenorku

Illicit trafficking of radioactive materials is of serious concern in countries and across country's borders; this has become a problem from both nuclear proliferation and radiological hazard point of view. The regulations and procedures set to ensure the control of radioactive materials is to prevent and detect illicit trafficking of radioactive materials. In ensuring that radioactive materials do not become the subject of unauthorized use leading to illicit trafficking, preventive and detective measures should be taken into consideration. In achieving these, the following measures should be adopted to achieve the goals of prevention and detection of illicit trafficking of radioactive materials. The measures which are accounting for, control of radioactive materials and physical protection of such materials should be adopted. Act 895 of the Republic of Ghana which establishes the Nuclear Regulatory Authority (NRA) as an independent regulatory body has the duty to control all activities using radioactive materials. The NRA is mandated to provide regulations and guides to control activities and practices involving peaceful use of radioactive materials to ensure protection of persons and the environment against the harmful effects of radiation hazards. To achieve the goal of ensuring adequate protection of the public health and the environment in the peaceful uses of radioactive materials in Ghana, the following principal regulatory functions are considered, these are; establish regulations and guides, issuance of authorization, inspection of facilities, import and export control, maintaining effective inventory accounting and controls and training of frontline officers and other security agencies. Establishing regulations and guides defines the capabilities and activities that need to be satisfied by facility operators to protect against theft which could lead to illicit trafficking. An individual or organization intending to utilize radioactive materials shall obtain license from the nuclear regulatory authority. The applicant submits an application to the nuclear regulatory authority. The NRA staff reviews the submittals to ensure that the applicant's assumptions are technically correct and that the proposed activities will not adversely affect the environment. Any utilization of radioactive materials shall maintain physical protection program or security plans to prevent unauthorized access or illegal transfer. License is granted if all criteria for physical protection for radioactive materials and facilities are met. Another component of the regulatory function is inspection. To ensure that licensees comply with NRA's regulations and the conditions of their licenses, NRA periodically inspects licensed facilities. Inspections can be announced or unannounced, and varies in scope and frequency according to the authorized activities. Some illicit trafficking of radioactive materials can be detected during inspections. This detection leads to prompt information to NRA in order to reclaim lost material and to

inform the public of any potential dangers. Security in the import and export of radioactive materials is further guaranteed by a close working relationship between the NRA and Customs Division of Ghana to inspect the radioactive materials before it is exported or when it is imported. The NRA has also put in place a system of effective inventory, accounting and controls of radioactive materials called the Regulatory Authority Information System (RAIS) to improve the control of radioactive materials and to provide information concerning their actual location at any time. To ensure prevention and detection of illicit trafficking of radioactive materials across borders, NRA closely co-operate with Customs in detecting and solving the problem of illicit trafficking of radioactive materials. The NRA occasionally provides training for frontline officers and other security agencies on the use of detection instruments and how to communicate such incidents if a radioactive material is detected.

Abstract ID: 17

Physical Protection System for Gamma Chamber 5000 in Myanmar

Zaw, C.[1]

[1] Ministry of Education; Myanmar

Corresponding Speaker: C. Zaw

In Myanmar, Gamma chamber 5000 has been extensively used for the research works in the area of food preservation, sterilization of blood samples, modification of industrial materials, mutation breeding and waste water treatment. It is a self-shielded cobalt-60 gamma irradiator to limit the radiation field on the external surface of the unit, and self-contained dry source storage for safe design. It was firstly installed in Yangon city in 2000 and it is currently operating in Hmawbi township. Co-60 (444 TBq maximum capacity) in gamma chamber is a radioactive source (category 1) and the adversary can apply it for malicious acts. So, it is required to prevent and interrupt the adversary action before completing the task of theft or sabotage of Co-60 source for their intension. In our situation, the adversary may intend the Co-60 source for causing the exposure to radiation or release of radioactive substances. This action can affect to society, economic and environment of the country. Establishing an effective and sustainable nuclear security infrastructure is crucial for the protection of individual, people, society and the environment. Main method of preventing adversaries from successfully committing a malicious act is the physical protection system (PPS). The present work reviewed the status of current operation system for gamma chamber 5000 and then its physical protection system was proposed. The requirements of PPS design were discussed. The adversary task time of before and after implementing the PPS design in the facility was compared. This PPS was designed with the detection, delay and response process based on the scenarios. It can be applied as an effective way to prevent the adversary action for the intension of theft or sabotage of Co-60 gamma source and prevent the contamination of the environment. In reality implementing a PPS is costly but it can give the safety of the people. On the other hand, if the State does not recognize the threat of nuclear terrorism and does not take prevention action, the public will pose the risk. Therefore, the present work focused on the implementation of PPS in gamma chamber 5000 in Myanmar.

Abstract ID: 28

Enhancing Information Security in the Transport of Radioactive Materials in Ghana: Current Status

Agbemava, N.[1], Emi-Reynolds, G.[2], Gyekye, P.[1]

[1] Nuclear Regulatory Authority; Ghana
[2] Ghana Atomic Energy Commission; Ghana

Corresponding Speaker: N. Agbemava

The transport of radioactive material is an interim phase between production, use, storage and disposal of the material. During transport, access to sensitive information i.e. route, time of travel and level of security should be limited to approved individuals requiring such information to perform assigned duties. Application of key elements of information security such as identification of the information to be protected with authorised access by designated individuals and protecting the information from disclosure to or access by unauthorised individuals are required. The radioactive material transport security plan is subject to information security. In Ghana, the Nuclear Regulatory Authority (NRA) and the National Security Council (NSC) of Ghana are involved with the transport of radioactive materials i.e. especially with category 1 and 2 sources. Their involvement are consistent with the national requirements and procedures of ensuring appropriate protection of specific or detailed information relating to transport operations, security systems, and unauthorized disclosure.. The information security approach employed by NRA and NSC include identifying the information that requires protection and the classification of the information i.e. level of protection needed using graded approach. The NRA is recommended to ensure that consignor, transport companies and consignee apply information security during the movement of the radioactive material. The application of information security should be applied appropriately since certain information may need to be shared with other parties for operational purposes in order not to adversely affect transport operations. The NSC secretariat together with NRA is recommended to establish enforcement guidelines commensurate with the classification of information security. This will go a long way of enhancing information security during transport of radioactive materials in the country.

Abstract ID: 29

Security of radioactive sources on the Revision of Bapeten Chairman Regulation (BCR) Number 3 year 2013 about Radiotherapy in Indonesia

Sawiyah, S.[1], Rahadhy, S.[1]

[1] Nuclear Energy Regulatory Authority of Indonesia (BAPETEN); Indonesia

Corresponding Speaker: S. Sawiyah

Radiotherapy is widely known to be one of the safest areas of modern medicine, yet, for some, this essential treatment can bring harm, personal tragedy and even death, and has a security risk for Co-60 radiotherapy. Indonesia has about 18 radiotherapy facilities that use Co-60. The process of radiotherapy is complex and involves understanding of the principles of medical physics, radiobiology, radiation safety, dosimetry, radiotherapy planning, simulation and interaction of radiation therapy with other treatment modalities and also security of radioactive sources. Indonesia actually has regulation on security of radioactive sources that explain about security requirement for every facilities including radiotherapy but it seems like the security equipment and requirement in the radiotherapy is still very vulnerable and easy to break so we want to elaborate more detail of security requirement in the revision of the radiotheraphy regulation. The aim of this study is bringing the security of radioactive sources for radiotheraphy into the revision of radiotheraphy regulation and composing additional security requirement for radiotheraphy facility, the existing radiotherapy regulation talk about safety only, some consideration will be explained and described why we need to have security content in radiotherapy regulation so the name of the revised regulation will be radiation safety and security in radiotherapy. The analysis of this study is guided by theoretical review from few research result and references, by identifying and interpreting applicable rules. This study will examine the existing national legal frameworks of Indonesia in the context of security of radioactive sources in radiotherapy facilities, there is a case study done at 1 (one) radiotheraphy facility according to vulnerability assessment, and it explained method for vulnerability assessment of security in radiotheraphy facility. The result from the case study were the detection function will fail because of three causes, they are technical failure of component functions, the failure of component functions that occur deliberately (a threat), deliberately interrupting the power supply. All of that causes result into no signal from control panel and manual switch, fail to delay any malicious progress and fail to response any malicious progress; every cause is able to fail the detection function. The threat may affect power supplies and equipment failures. The malicious act may interrupt the power supply deliberately, as well as destruct the alarm equipment. If one of these threats occurs, the detection function fails directly. This means the facility is highly vulnerable. There are two possible results regarding security threats. The first is that the threat becomes a single cause, which is able to fail the system function. The second possibility is that the cause of the accident is a combination of threats and component failures. From this case study, regulatory body can consider more secure equipment for radiotherapy facility in the revision of radiotheraphy regulation. The security requirement in radiotherapy can be redesigned, for example all of the security equipment using back up power supply so the function of the security equipment didn't fail when the electricity blackout happen, any threat unable to damage the alarm, and a back up for technical failure of the component functions, so the failure probability of security system can be reduced. Hopefully all of this

study result were considered by BAPETEN to add security of radioactive sources for radiotheraphy in the revision of the radiotherapy regulation, BCR No. 3 year 2013.

The aim of this study is bringing the security of radioactive sources for radiotheraphy into the revision of radiotheraphy regulation and composing additional security requirement for radiotheraphy facility. This study examine the existing national legal frameworks of Indonesia in the context of security of radioactive sources in radiotherapy facilities by theoretical review from few research result and references, by identifying and interpreting applicable rules. The result from the case study were the detection function will fail because of three causes, they are technical failure of component functions, the failure of component functions that occur deliberately (a threat), and deliberately interrupting the power supply. All of that causes result into no signal from control panel and manual switch, fail to delay any malicious progress and fail to response any malicious progress; every cause is able to fail the detection function. Based on this case study result, the security requirement in radiotherapy can be redesigned, and to do that, first of all regulatory body need to revised regulation about radiotheraphy.

Abstract ID: 30

Implementation Security Plan as Requirement on Approval of Transport of Radioactive Sources from Regulatory Body Based on Indonesian Regulation

Hayani, A.[1], Noerwasana, A.[1]

[1] Nuclear Energy Regulatory Authority of Indonesia (BAPETEN); Indonesia

Corresponding Speaker: A. Hayani

Abstract

This paper is intended to describe implementation of security plan as requirement for issued transportation approval from regulatory body before radioactive sources transported, and it's should comply to an Indonesia regulation. Indonesian Nuclear Regulatory Agency (BAPETEN) as Competent Authority for Safety, Security and Safeguards of radioactive source has regulation dealing with radioactive source transportation. The regulation has developed based on IAEA requirement and guidance. This paper also analyze the compliance between implementation security plan on transportation of radioactive source in order to be in line with IAEA requirement and guidance (IAEA, NSS No.9) and to identify any improvement needed.

SYNOPSIS

Method

Method for this study is identify Indonesian regulation regarding implementation of security plan on transport of radioactive source including its existing implementation, gap analysis in order to get some recommendation for improvement.

Discussion

Indonesia has two regulation aimed at implementation of security on transport of radioactive sources. There are Government Regulation (GR) no. 58/2015 regarding Radiation Safety and Security on Transport of Radioactive Material and for detail requirement from Government Regulation (GR) no. 58/2015 is BAPETEN Chairman Regulation (BCR) no. 6/2015. Government Regulation (GR) no. 58/2015 describe about requirements for safety on transport of radioactive material, requirement for security for transport of radioactive material, safety management and procedure for transport of radioactive material including mechanism for transport radioactive source approval by competent authority. Chairman Regulation (BCR) no. 6/2015 describe detailed requirements for every security level and security measure (prevention, detection, delay and response) in import and export of radioactive sources category 1 and category 2 and also described detail security requirement in use, transport, and storage of radioactive sources.

Mandatory requirement on GR No. 58/2015 article 43 and article 44 describe that security plan should be developed by operator in the context of carrying out the transport of special form radioactive sources and low dispersible radioactive materials. The security plan listed on GR no. 58/2015 become one of requirement for apply radioactive source transport approval to regulatory body (BAPETEN) in accordance with the article 80. The security plan could be part of the document of security radioactive source program, in which those documents should be submitted to regulatory body as safety and security requirement for licensing of radioactive source uses. Security plan should be contain information about radioactive source, type of packages, transport mode, description of carrier personnel including any personnel responsibilities, security equipment, transit procedure, description of transport route, emergency procedure etc. Based on the explanation, it can be concluded that security plan is a dynamic document because the information on security plan depend on the situation of transport implementation.

Based on regulation in Indonesia GR No 58/2015 The security requirement for transporting the radioactive sources classified into 3 different level based on the categorization of radioactive sources: basic security level apply to radioactive source category 3, Enhanced Security level apply to radioactive sources category 2, and Enhanced security level with additional measures for radioactive sources category 1 and for radioactive sources category 4 and category 5 were excluded from security requirement.

Security requirements in Indonesian regulation based on a graded approach, taking into account the current evaluation of the threat, the relative attractiveness of a radioactive source, the nature of the source and potential consequences associated with its unauthorized removal or sabotage. This graded approach ensures that the highest consequence sources receive the greatest degree of security.

BAPETEN as competent authority as an obligation to oversee the implementation of regulations concerning the transport of radioactive sources. With application BALIS (Bapeten Licensing and Inspection system), all applications for approval of transport of radioactive sources from consignor, received by Bapeten. Almost 30 applications for approval of transport of radioactive sources received every day. This request application is transactional in which approval is filed for a single delivery prior to transport of radioactive sources with validity period is 3 months. The information that should be submitted for approval application is description of radioactive that will be delivered, type of packaging, the delivery destination address and personnel engaged in transport. It is not a complete data for security measure in the transport of radioactive source such as an security plan. Because the security plan is dynamic document, it should be attach on application for approval of transport of radioactive sources. Moreover, for supervision of the movement of radioactive sources in all territorial in Indonesia, Bapeten should increase the capabilities system or control mechanism of radioactive sources movement.

Based on IAEA Nuclear Security Series NSS No. 9, there are recommendation of security measure untuk for each security level for transport radioactive source which is it special form radioactive and other than LSA-I dan SCO-I, specially for security measure prevention, detection, delay and response on security plan. Gap analysis should be doing for assess any improvement from regulating point of view also implementation of security plan document and the security measure in Indonesia.

Key Words: radioactive sources, nuclear security, security plan

Abstract ID: 31

Strengthening Sustainability and Effectiveness for Security of Radioactive Material by Promoting International Cooperation and Domestic Interfaces in Myanmar

Tun, K.[1]

[1] Division of Atomic Energy; Myanmar

Corresponding Speaker: K. Tun

Development and sustainability of a Physical Protection Regime in Myanmar is presented. To promote the protection of radioactive material in use, transport and storage and to establish the security detection architecture for nuclear and other radioactive material out of regulatory control by international cooperation and domestic interfaces are further steps in the implementation of efficient national nuclear security regime.

In order to strengthen its national nuclear related legislation, the Division of Atomic Energy (DAE) has just recently completed the drafting of the Myanmar Nuclear Law that prohibits the use, production, storage, distribution and import/export of nuclear and other radioactive material without government license since it is designated to act as national competent authority for all nuclear related activities in Myanmar. Furthermore, Myanmar has expressed a political commitment with regards to the Code of Conduct on Safety and Security of Radioactive Sources. Then, Counter Terrorism Law Myanmar was promulgated on 4th June 2014, and it is based on UNSCR 1373 and UNSCR 1540 which is related to security issues.

For the international cooperation, the DAE is engaging the Global Threat Reduction Initiative (GTRI) Programme in collaboration with the International Atomic Energy Agency (IAEA) and the United States Department of Energy (USDOE), participating in the Integrated Nuclear Security Support Plan (INSSP) since 2013 and signing bilateral cooperation with Malaysia Ministry of Science, Technology and Innovation (MOSTI) in order to strengthen the state's nuclear security regime and to fulfill the international obligations.

Moreover, Myanmar cooperates with the Australian Border Force (ABF), the United Nations Interregional Crime and Justice Research Institute (UNICRI) and the European Union Chemical Biological Radiological and Nuclear Risk Mitigation Centers of Excellence Initiative (EU-CBRN COE) regarding with strategic trade control and container control. Myanmar, in cooperation with the IAEA and the USDOE, is now endeavoring to implement the physical protection systems at the Radiotherapy Departments in Government Hospitals and recently established the Central Monitoring Station in the DAE branch office in Yangon.

At the national level, the DAE is working together with the Ministry of Health and Sports (MOHS) for ensuring prospectively the medical sources sold by company also taking care by the company at the end of their useful half-life. Establishment of recording and reporting of incidents to regulatory authorities will come soon. Reporting systems for medical radiation incidents become Mandatory reporting as part of regulation and document procedure for investigation of medical radiation incidents including sharing information between the DAE and the MOHS will be established.

The DAE is using Regulatory Authority Information System (RAIS) and it is stand alone system. Its server computer is not physically connected with the internet or other local area networks for information security point of view. The Inspectors from DAE also disseminate security culture for radioactive sources to pave way for future use of Nuclear Security practices among private and government sectors. Radiation protection training for radiographers from Medical field is being conducted each year. Outreach disseminations of CBRN are conducting for Law Enforcement Departments, such as Criminal Investigation Department (CID) and Customs Department, each year and on demand.

Radiation Detection and Measurement Laboratory under the DAE is responsible to check and identify suspect metals. All detected event are notified initially to the IAEA Incident and Trafficking Database (ITDB). The DAE is endeavoring information release on Media for public awareness, engagement in national and international events, and translation of technical document into the national language and exchange of knowledge with relevant stakeholders.

Additionally, Myanmar is actively enhancing to create the intelligence systems to fight against the border illicit trafficking by means of a good coordination of the stakeholders as well as to integrate the knowledge and experience of all the organizations such as Myanmar Police Force and Container Control Teams which are related to the trafficking radioactive material.

To overcome challenges for establishment of effective nuclear security regime, we cooperate with the IAEA and other international supports for radioactive source security in local and border areas such as trying to get installation of radiation portal monitors and maintenance of them will be assisted by our nuclear instrumentation laboratory.

This paper will presents Myanmar's difficulties encountered and innovative approaches in the implementation of nuclear security regime and engagement with the international organizations and domestic interfaces.

Abstract ID: 36

Development of Course Module on Detection Systems for Radioactive Material for Graduate Program at Universitas Gadjah Mada

Sihana, S.[1], Putero, S.[1]

[1] Universitas Gadjah Mada; Indonesia

Corresponding Speaker: S. Sihana

Abstract

A new curriculum for master degree in nuclear security has been developed and implemented since August 2017. The structure of curriculum consist of 40-50 credits for two years program. The program provide one year with fundamental of engineering physics, one semester with specialization in nuclear security and one semester with thesis. It consist of four structured component, namely general education, mathematics and science, engineering fundamental, set of directive electives for nuclear security. One of the directive course is with the title "Detection System for Nuclear and Radioactive Material". It is a combination of some lectures and laboratory works. Module design as part of this course will be developed and presented in this paper. It provide e-learning resources, which can be used for classical class learning or distance learning for external users.

Introduction

In term of nuclear security, it has been differentiated between nuclear material and radioactive material. Nuclear material is any material containing fissionable material such as uranium U-235, uranium U-233 and plutonium Pu-239. Nuclear material are classified in three categories as listed in section 4 of IAEA NSS no 13 1. Radioactive material are material which contain unstable atoms. In term of NSS no 14, radioactive material is any material designated in national law, regulation, or by a regulatory body as being subject to regulatory control because of its radioactivity 2. Many applications of radioactive materials are used in sealed form and which called radioactive sources. In term of NSS no 14, a radioactive source is defined as radioactive material that permanently sealed in a capsule or closely bonded, in a solid form and which is not exempt from regulatory control.

Application of radioactive sources can be found in various industry, medicine, agriculture, research and education. Any misuse of radioactive material can cause risk to the public due to potential radiation exposure. Security radioactive material is important to prevent unauthorized acquisition and malicious use of high activity radioactive material. Security of radioactive sources is required during production, transport, used and waste disposal (see figure 1).

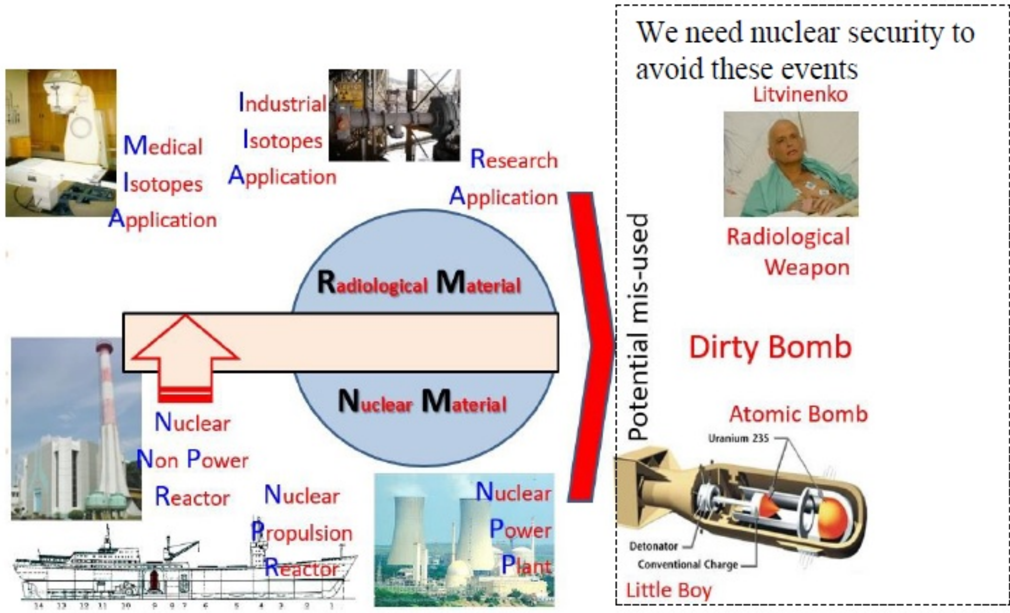


Figure 1. The use of nuclear and radioactive material and their potential misused

Detection system of radioactive material is an important measure to protect against sabotage, theft, diversion and other malicious acts. Some people who responsible for nuclear security in border security, custom, radioactive sources production, and transport should have capability to operate detection equipments. Nuclear Regulatory Body of Indonesia (BAPETEN) has already established the regulatory requirements for security of radioactive source as BAPETEN Chairman Regulation (BCR) [3]. It define requirements (a) for categorization of radioactive sources and assignment of security levels of radioactive sources, (b) license and approval requirements, (c) establishment of security for radioactive sources, and (d) recording and reporting. It seem that this document is a combination of IAEA NSS No 11 Security of radioactive Sources [4], and IAEA-TECDOC-1344 Categorization of Radioactive Sources [5]. This regulation require that license holder should provide adequate training for security personnel. The training should contain at least (a) introduction to security culture for radioactive sources, (b) job description for personnel in the security of radioactive sources, (c) function and operation of equipment for security of radioactive sources, and (d) emergency response to security of radioactive sources.

The course module for detection system for radioactive material provide comprehensive knowledge about basic principle of radiation detection as part of the requirement (c) in the BCR no 6 about “Security of Radioactive Sources”. The course module will be developed as e-learning resources. It allow students or other interested people with registered access to the course material for self learning activities.

The content of the course material are subjects that include radiation detection (alpha, gamma, beta and neutron), spectrometry (alpha and gamma), radioisotope identification device (RIID), personal radiation device (PRD), radiation portal monitor (RPM) and some practical exercises.

Curriculum Structure

Radiation may produce health hazards due to radiation interaction with body either by external radiation or through inhalation or ingestion of radioactive material. Nuclear or radioactive material can reach out the people due to accidents. To prevent of accident, nuclear safety is important to protect people against facilities malfunctions, system failures or human error. Other probability of nuclear or radioactive material can reach out the people due to unauthorized acquisition and malicious acts. We need measures against this event to protect the people, so nuclear security is required.

Base on the regulatory approach, we can categorized the nuclear and radioactive material as under regulatory and out of regulatory control. Protecting the material and facility, we need the four elements of nuclear security, such as preventive and deterrence, detection, delay and response. Based on the four elements of nuclear security, we can design four courses as core to provide the main subjects of nuclear security (see figure 2).

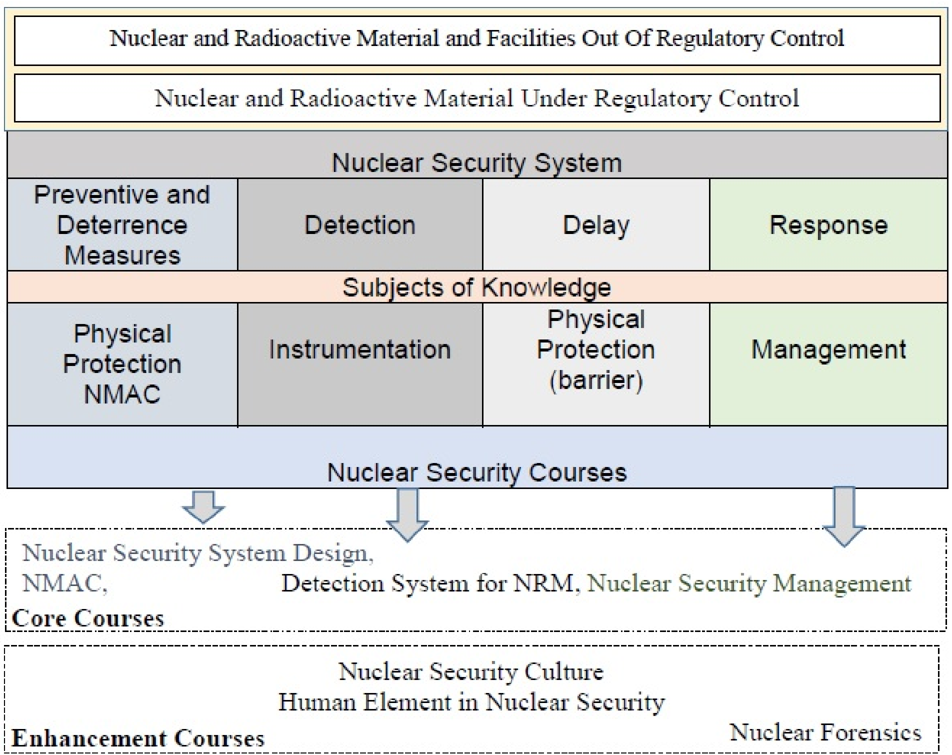


Figure 2. Concept model of course development for nuclear security education

Nuclear security courses consist of (1) Nuclear Security System Design, (2) Nuclear Material Accountancy and Control or NMAC, (3) Detection System for Nuclear and Radioactive Material, and (4) Nuclear Security Management. Free elective courses can be provide to strengthen the nuclear security competency. It consist of three courses (1) Nuclear Security Culture, (2) Human Element in Nuclear Security, and (3) Nuclear forensics.

Course Modules on Detection System for NRM

Several prerequisite will be applied to the student before joining in this course, such as completion of e-learning module on the IAEA OPEN-LMS: (1) Categorization of Radioactive Sources, and (2) Introduction to Radioactive Sources and Their Applications.

The course provide basic understanding on radiation detection systems and their practical application in nuclear security. Modules of this courses contain: (1) introduction to security of radioactive sources, (2) principles of radiation detection system (alpha, beta, gamma radiation and neutron), (3) principles of gamma spectroscopy, (4) principles of neutron spectroscopy, (5) application of personal radiation device (PRD), radioisotope identification device (RIID) and radiation portal monitor (RPM). Practical exercises will be conducted at the laboratory using PRD, RIID and TRPM. Part of the exam for this course, the student should complete the e-learning module "Use of Radiation Detection Instruments for Front Line Officers" on the IAEA OPEN-LMS.

Conclusion

A course on detection system for nuclear and radioactive material is very important for people who are specialized in nuclear security. The course should provide principles of detection system for alpha, beta, gamma radiation and neutron. Such module as part of this course will be developed as e-learning resources, which can be used for classical class learning or distance learning for external users. Continuous updating for the course structure and content should be regularly done to improve the quality and to modify based on feedback from users.

Reference

1 IAEA NSS No 13 Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/224/Revision 5), 2011.

2 IAEA NSS No 14 Nuclear Security Recommendations on Radioactive Material and Associated Facilities, 2011.

[3] Decree of Head of BAPETEN No 6 Year 2015 About Security of Radioactive Sources, 2015.

[4] IAEA NSS No 11 Security of Radioactive Sources, 2009.

[5] IAEA-TECDOC-1344 Categorization of Radioactive Sources, 2003.

Abstract ID: 37

Overview Implementation of radioactive source security regulation on Radioisotope Production Facilities in Indonesia

Yusuf, N.[1], Yuliati, E.[1]

[1] Nuclear Energy Regulatory Authority of Indonesia (BAPETEN); Indonesia

Corresponding Speaker: N. Yusuf

Production activities of radioisotopes and Radiopharmaceutical in Indonesia must follow the rules and regulations. The Nuclear Regulatory Agency shall ensure that the safety, security and safeguard aspects described in the application document for permits have been met. In accordance with the government regulation no. 29 concerning the permission of the use of ionizing radiation sources and nuclear material for the licensing of radioisotope production, the applicant must develop a radioactive source security program as one of the conditions for the issuance of the license. In more detail this radioactive source security program is regulated in a regulation, namely the regulation of the chairman of bapeten no. 6 years 2015 on the Security of radioactive sources. The program contains a description of Radioactive Sources, the design and layout of facilities, data equipment Radioactive Source Security, and the surrounding environment; Organization of Radioactive Sources Security; operational procedures of Radioactive Source Security; training; Inventory and recording of Inventory results; emergency response procedures for Radioactive Source Security; and reporting.

In accordance with Regulation No. 6 of 2015 bapeten chairman states that the production of radioisotopes in the category of radioactive sources category 1 and a security level A with the ratio of A / D ≥ 1000 radioactive sources, in the regulation of the chairman of bapetenradioactive source is mentioned as solid-shaped radioactive source encased in a capsule which is strongly bound.

Security level category calculations were assessed using radioactive safety references and several IAEA publications. IAEA RS-G-1.9 Categorization of Radioactive Sources and IAEA Nuclear Security Series No. 11 security of radioactive source in the form of A / D ratio (activity / D value). The result of this A / D ratio will determine the applicant to design the radioactive source security efforts, radioisotope production at the facility. Design of radioactive source security efforts that are reflected in radioactive source security programs, must fulfill prevention, detection, delay, and response functions.

Indonesia has two radioisotope and radiopharmaceutical production facilities namely IPRR-Pt.Inuki and PTRR-Batan that produce radioisotopes in the form of solid-state radioactive sources and radioactive sources of liquid states. Both of these facilities have obtained the license of radioisotope production in 2017 by fulfilling all the requirements of both the requirements of Government

Regulation no.29 concerning licensing of the use of ionizing radiation source and nuclear material and regulation of chairman of bapeten no. 6 years 2015 on the Security of radioactive sources. Regulation of chairman of bapeten no. 6 year 2015 on the security of radioactive sources does not clearly regulate the source of radioactive liquid state types so that in implementing both regulations bapeten using grading approach as the basis for decision-making at the time of granting permission. So the security level assessment of the radio isotope and radiopharmaceutical facilities in a category of security level b with an A / D ratio of 1000> A / D≥10.

In this paper, a review and assessment of the radioactive source security aspects of the licensing process for two radioisotope and radiopharmaceutical production facilities in Indonesia will be conducted. Design of facility security efforts with radioactive sources that meet prevention, detection, delay and response functions will also be discussed in great detail. From the review results obtained that the need for revisions of the regulations and the need for clearer implementation guidelines to facilitate the implementation of compliance.

Abstract ID: 39

Evaluation of Security Measures during Transportation of Radioisotope Material from Radioisotope Production Facility

Elkhatib, H.[1]

[1] Egyptian Atomic Energy Agency; Egypt

Corresponding Speaker: H. Elkhatib

Egyptian Radioisotope Production Facility (RPF) produces isotopes for medical and industrial purposes. The transport of radioactive material is interim phase from beginning till its destination. The specified procedures of an adequate transport security system incorporates the concept of defence in depth and uses a graded approach to achieve the objective of preventing the material from becoming susceptible to malicious acts. Pre-shipment check is crucial to ensure that all measure described in the security plan are in the place and functioning well and should be strictly followed.

Security measures during the transportation incorporate cooperation with ministry of interior (police) in addition to regulatory body. In addition, confidentiality and more than rout are also available as a way of trick to protect shipment against malicious threats. Monitoring& tracking shipments, command and control the operation are essentials to protect the shipment to establish good monitoring and communication during the transport operation. Consideration is given also to include medical support and escort guards are trained sometimes in paramedic skills. Although the potential consequences of an act of sabotage might differ very much depending on the location of the radioactive material, the transport security system is implemented to take into account:

• The quantity and the physical and chemical forms of the radioactive material;

• The mode(s) of transportation and its shielding;

• The package(s) being used;

• Measures that are required to deter, detect and identify the actual possible malicious acts involving any consignment while in transport to enable an appropriate response;

• Security culture of concerned personnel. So all personnel demonstrate full understanding of their roles and responsibilities before the transport, also, the achievement of effective security in transport is assisted by escorting qualifying team which is provided and supported by radiological officer (expert) according to our regulation taking account the unplanned stopover due to any reasons.

The competent authority is provided with sufficient authority, competence, financial and human resources to discharge its assigned responsibilities in relation to the security of radioactive material in transport and have the capability to enforce the applicable requirements and solves any issues or problems.

Abstract ID: 49

Enhancing of Nuclear and Radioactive Materials Security in Academic Institute

Pengvanich, P.[1], Yenjai, C.[1] Chanyotha, S.[1]

[1] Chulalongkorn University; Thailand

Corresponding Speaker: P. Pengvanich

Many academic institutes around the world today utilize and process nuclear and radioactive materials in one or more of their education and research programs. They have obligation under their national law to secure all materials as well as related facilities. Nevertheless, while there have already been many published good-practice guidelines for establishing a nuclear and radiation security system for a nuclear power plant, a gamma irradiation facility, a hospital, and a large research facility, similar guideline for an academic institute has not been much discussed.

As in many countries that utilize nuclear and radioactive materials, Thailand's security regulation is still in its development phase. While there have been considerable improvements in security of nuclear reactor facility and high-dose gamma facilities, there are still many small facilities including academic institutes that will need to review and enhance their security plan.

In order to design and implement effective security system for an academic institute, the specific characteristics, features, and constraints of the facility and its nuclear and radiation related activities must be taken into account. Some may present challenge when trying to employ defense-in-depth or graded approach in the plan. For instance, academic buildings are usually required to be freely accessible by students who may or may not need access to the nuclear and radioactive materials. A restricted area may only be one door away from a shared classroom which is used by many groups of people. While the inventory of nuclear and radioactive materials in an academic institute is not as large in term of quantity as in a nuclear power plant or other types of focus research facilities, it may have more variety that require different levels of protection.

In this paper, the specific characteristics, features, and constraints of academic institute have been explored. Comparison between academic institute and other types of facilities is made. Examples of systems and measures to enhance security, some of which have been implemented at the author's institute, are discussed based on the IAEA guidelines on establishing nuclear and radiation security.

As an academic institute, one important goal is to prepare its students for their future career. Hence, it should put emphases on providing both good academic and culture. Specifically, for students in nuclear and radiation related field, they should be introduced to the environment with good security

and safety culture. This paper also discusses several methods how academic program can be setup to make such introduction for students.

Abstract ID: 57

Detecting Criminal/Unauthorized Acts Involving Nuclear and Other Radioactive Material Out of Regulatory Control

Okoye, V.[1]

[1] Nigerian Nuclear Regulatory Authority; Nigeria

Corresponding Speaker: V. Okoye

Globally, from a nuclear security standpoint, the possibility of using nuclear or other radioactive materials for acts of terrorism (via insider threat, sabotage, theft) has long been established bearing in mind propensity to be used maliciously largely depends on motivation, perceived value, resources, specific knowledge & expertise, and material's specific properties. From a national perspective, illicit trafficking of nuclear and other radioactive materials is possible from domestically acquired radioactive substances or similar substances brought in through national borders. Coming closer home, Nigeria houses numerous radioactive sources some of which are not within regulatory control. Nuclear materials also exist in the only well controlled and accounted for highly enriched uranium (HEU) research reactor whose conversion to low enriched uranium (LEU) is in the offing. Priority is given and emphasis laid on sources with high enough radio-toxicity to cause serious radiological harm like cobalt-60, caesium-137, iridium-192 etc used in industrial and medical applications on the notion that nuclear materials are more tightly controlled. Given Nigeria's various security challenges, all of which take a toll on national security with potentially nuclear security dimensions, a well-defined and all-encompassing national nuclear security policy informed by proper threat/risk assessment which births coordinated nuclear security programmes at both national and facility level is surely the way to go. Detecting criminal/unauthorized acts involving radioactive materials transcends the use of physical detection equipment. The cyberspace may portend fertile ground for radicalization and gaining expertise in making devices capable of causing serious radiological harm, both of which are important precursors to such criminal acts. In addition to establishing a database (RAIS) for all nuclear and other radioactive materials under its control, the NNRA routinely embarks on orphan/legacy source search and secure exercises applying different physical technical detection technologies in the course including hand held gamma survey meters, radionuclide identifinders, backpacks etc and have recorded notable progress with each successive exercise. This strategy only provides for recovery of radioactive materials out of regulatory control intermittently against the backdrop that illicit movement and use of radioactive materials is highly unpredictable hence beckons for continuous monitoring and detection. The importance of fixed radiation portal monitors incorporating spectroscopic gamma and neutron detectors at strategic points like borders, ports, and checkpoints etc which can discriminate NORM and detect radioactive materials continuously cannot be overemphasized. These fixed radiation portal monitors equipped with supporting paraphernalia like CCTV, inbuilt algorithms with innovative software for remote and secure online data transmission, mobile systems with larger high sensitivity advanced detectors for localization and further assessment etc make for a robust system. On the flip

side, effective monitoring of cyberspace that may be potentially exploited by would-be criminals is another viable detection technique that should not be trivialized. Clandestine and nefarious activities involving illicit possession of nuclear and other radioactive materials can be detected early with effective and proactive information gathering and cyber footprint monitoring of identified persons of interest as determined by the state within the ambit of the law. This paper assumes the presence of non-nuclear radioactive materials out of regulatory control in Nigeria, hence focuses on the detection of such materials using a more conscious holistic approach involving development of a well defined and documented nuclear security policy which inadvertently translates into aforementioned improvements in physical detection and cyberspace monitoring strategies in line with Resolution GC (61)/RES/9 of the IAEA.

Abstract ID: 61

Physical Protection System of the Radioactive Waste Storage Facility at Institute of Applied Nuclear Physics in Albania.

Prifti, D.[1], Daci, B.[1], Byluku, E.[1]

[1] Institute of Applied Nuclear Physics; Albania

Corresponding Speaker: D. Prifti

Institute of Applied Nuclear Physics (IANP) is an institution of particular importance and therefore it is monitored 24 hours by state police. IANP is established in 1970, and is the main user of radioactive sources in the country. In Albania, the sources of ionizing radiation are used in various applications in medicine, industry, agriculture, research and teaching process. Radioactive waste storage facility (RWSF) is situated inside the territory of IANP.

The purpose of the physical security system of RWSF and other radioactive sources in use at IANP is to contribute to global efforts to achieve effective security of radioactive materials in use, storage and / or during transportation, and to fulfill the national responsibilities and international obligations, to reduce risks and respond appropriately to threats. The aim of the Physical protection system of the RWSF and other radioactive sources in use at IANP is to secure radioactive sources in use, radioactive waste and DSRS in an effort to prevent their use in a terrorist, criminal or destructive act to meet / demonstrate regulatory requirements / compatibility.

Institute of Applied Nuclear Physics is equipped with a system of entry and exit control, alarm system, fire protection system and surveillance camera system, who acts in cases that are violated the rules which are mandatory for all staff. Entrance and exit at the Institute is carried out by a certain procedure that aims to determine the steps to be followed by the staff of the IANP and by non-personnel people who seek to enter the Institution for work reasons or as visitors, mandatory for all. Entrance at IANP is controlled by two security levels; with biometric control (fingerprint) and proximity readers. For this purpose are installed at all entrances of the Institute premises electronic control systems, biometric and proximity readers. All employees and authorized persons are registered in the central system of biometric data and are equipped with a so-called "smart tag".

The physical security protection includes, radwaste and radioactive sources throughout the period of their use, processing and temporary storage. One of the main goals of security and alarm system is explicitly the demand for the implementation of very stringent rules for entry into areas where are stored the radioactive sources.

It has been recently integrated a third security system which is Lenel. The LENEL system of entrance and exit control, alarm management in case of unauthorized entry and CCTV system are integrated into a single platform which is OnGuard 2013. To control the entrance and exit to the premises where are stored the radioactive sources, are used access control terminals by some security factors (RFID access card, biometric sign - finger, Personal Code). For the alarm system of the sensitive premises are installed all the necessary components and their goal is to generate alarm in case of entry of unauthorized persons and in case of unauthorized movement of radioactive sources and radwaste.

The system of cameras surveillance includes cameras which are installed in all premises where radioactive sources are stored, manipulated and perimeter areas of these facilities are monitored 24/7. These cameras are integrated in the system which means that for certain alerts all the data are stored in database and can be accessed automatically. Also, IANP, in all its perimeter, is surrounded by a high barbed wall and is protected by the state police 24/7 who monitor also the camera system. This is done for two main reasons:

• First; to eliminate the risk of radioactive sources extraction from their storage site and therefore use for purposes outside their intended use, for terrorist purposes or others which pose a risk to the lives of citizens.

• Secondly; to protect employees charged for handling of radioactive sources from contamination. For these reasons, the entry into areas where radioactive sources are stored is required to be made under a rule that bans a single person. This is called "Entry Rule of Men in rooms where there are radioactive sources of Two Persons" or "Two Man Rule" IANP is responsible for the process of preparing and updating the physical security plan of radioactive materials at RWSF and in use at IANP, which is then approved by the Radiation Protection Commission.

Keywords: Radioactive Sources / Waste, Storage, DSRS, radioactive waste storage facility.

Abstract ID: 68

Thailand's Development of Regulatory Infrastructure for Transport Security

Tantideeravit, S.[1], Malain, D.[1], Kanchana, P.[1], Tedthong, S.[1], Pibanwong, W.[1]

[1] Office of Atoms for Peace; Thailand

Corresponding Speaker: S. Tantideeravit

This paper presents Thailand's approaches and progress in the development of instruments and technical competencies for transport security. The recently announced Nuclear Energy Act 2016 provides regulatory control of safety and security of transport of nuclear and radioactive materials, which was not covered under the previous Atomic Energy Act 1961. Key considerations are taken into account in the process of developing nuclear security regime for transport including, regulatory approach, licensee's capability on security, and responsibilities and technical competencies of relevant authorities. In line with IAEA security series NSS-9, the draft regulations and guidelines for transport security provide prescriptive approach for radioactive material requiring the basic and enhance security level, and performance-base approach for materials requiring additional security measure. Office of Atoms for Peace, OAP, as the national regulator responsible for both transport safety and security, has made the effort to assist licensee's preparation to comply with the security regime through conversation during regulatory inspections, public communication, and security training sessions for licensee by experts from national authorities and by the support from the U.S. Department of Energy. Real-time vehicle tracking system, as a technical competency building project, has been developed and used under the collaboration between the Department of Land Transport and OAP to facilitate close monitoring of shipments and improve the efficiency of detection and response. OAP also manages the national network of emergency preparedness and response, and is currently establishing a center for nuclear forensics in supporting the effectiveness of the country's nuclear security regime.

Abstract ID: 74

Sustainment of Security of SRS-PNRA Role for Technical Support

Ahmad, S.[1], Iftikhar, N.[1]

[1] Pakistan

Corresponding Speaker: S. Ahmed

Technical support for nuclear security matters is an important element for sustainability of nuclear security regime. An effective nuclear security system requires the availability of different types of sensor for intrusion detection and radiation detection equipment. Continued operation and sustainability of the security systems and radiation detection equipment is very essential for the prevention of the radioactive material from being stolen or unauthorized removal. Sustainability of such equipment and systems also requires timely technical support.

Realizing the importance; PNRA has established a Technical Support Unit (TSU) to provide assistance at national level to ensure equipment life cycle management, provide assistance during and after a nuclear security event, support in designing, commissioning and acceptance of physical protection gadgetry installation for facilities using high activity radioactive sources, and expert advice on nuclear security matters. The TSU is equipped with tools, equipment, and experienced manpower for technical support. PNRA also developed tool for assessment of security measures taken at high activity radioactive sources.

The TSU provides technical support to national organizations and licensees using radioactive sources in the areas of repair, maintenance and acceptance testing of radiation detection equipment (RDEs), provides expert advice's and support to Customs for combating illicit trafficking of nuclear/radioactive material. RDEs have been provided to Customs at selected entry/exit points at the boarders. The periodic testing of these RDEs is also carried out at TSU. TSU is further providing repair and maintenance to overcome the issues of high cost involvement in the R&M after warranty i.e shipment clearance and export control constraints; therefore PNRA provide technical support in repair & maintenance lab which has now limited capabilities of repair & maintenance. TSU also provides technical assistance to other national stakeholders in testing, calibration maintenance and troubleshooting of radiation detection equipment. The lab is equipped with oscilloscope, variable power supply, soldering station, mechanical & electrical tool kit, automated testing train etc. The lab has the capability to detect the fault and repair minor fault.

The paper will highlight PNRA efforts for establishing technical support unit and its contribution for supporting national efforts for nuclear security.

Abstract ID: 79

Handheld device for distinguishing spontaneous fission neutrons from others

Chuvaev, S.[1]

[1] SEC "YAFI"; Russian Federation

Corresponding Speaker: S. Chuvaev

This report is devoted to an analysis of the feasibility of manufacturing a neutron detector that could be used in the field to determine the type of neutron emitter. The main thing in this case is the answer to the question: "Is the neutron radiator an isotope source or a special nuclear material?". To distinguish the type of radiator, differences in the rigidity of the neutron's energy spectrum and / or in the presence of temporal correlations between emitted neutrons can be used. For more reliable and complete identification of the detected source, it is desirable to have the possibility of analyzing the concomitant gamma radiation.

In this paper, the results of model calculations (using the Monte Carlo method) of neutron sensitivity, temporal and energy distributions for various types of neutron sources are presented. Calculations have been made of the change in the neutron detection efficiency of various sources depending on the position of the 3He detector in the polyethylene moderator, as well as the influence of the source dimensions, its distance to the detector, and the presence of various scattering materials between the source and the detector. The response functions of the NaI (Tl) detector to the gamma radiation produced in steel and borated polyethylene converters under neutron irradiation of various sources are calculated.

A number of experiments were carried out at laboratory facilities, the results of which demonstrated the practical feasibility of a neutron detector with the coincidence attribute for the identification of neutron sources in the field.

Based on the analysis of experimental data, a prototype of a neutron detector was developed and fabricated. Laboratory and field tests of the prototype of the device were carried out and reported.

The technical characteristics of the device, the test results are given. The device is put into serial production.

Abstract ID: 81

Radiation Sources Licensing Information System Cybersecurity Measures

Sallam, H.[1]

[1]Computer Engineering; Egypt

Corresponding Speaker: H. Sallam

Radiation sources have a large range of applications in industry, research and medicine. The Code of Conduct on the Safety and Security of Radioactive Sources states that all states should establish a national register for radioactive sources. One of the main duties of regulatory body is licensing radiation sources. The number of radiation sources is more or less tens of thousands depending on their application in different areas in any country. Most of these sources represents significant risk and are placed in non-nuclear facilities such as hospitals and industrial plants. The regulatory body play an important role in improving security radiation sources through licensing and overview of sources in use in industrial and medical applications by an intensified inspection program.

Currently, radiation sources still licensed through paper forms submitted by end-users, some of this information was in turn transferred to internal database systems. This process, however, required much work and was error prone. As a consequence, many of regulatory bodies started developing and using a web-based source licensing application where, end-users are able to apply and submit the required information for licensing their sources. The web-based interface will enable the regulatory body as well as the end user to have access to the same information about their licensed sources, something which will hopefully improve the safety and security.

During the licensing information detailed information about the sources are submitted by the end-user to the regulatory body such as its origin, vendor, radioactivity level, transportation, and address where they are used. All these information are submitted through regulatory body website and kept in database on information system. Such information system is vulnerable to many possible threats from malevolent acts such as sabotage or other targeted attacks against these installations. cybercriminals are increasingly attempting to integrate multiple forms of attacks. Cyber security attacks on information systems may be used later in physical attacks on radioactive sources which lead to sabotage or theft of radioactive sources and using in dirty bomb by criminal organization.

The nature of threats to information security has changed due to the hackers and crackers sophistication. The main purpose of information security is to protect and safeguard the organizations' assets from threats. Mitigating such cybersecurity threats by deploying security measures to detect, response, and prevent security breaches is accomplished by monitoring new vulnerabilities, developing new risk assessment, deploying new technologies, and employee training can mitigate new threats and protect an organizational asset.

This paper discusses cybersecurity measures to regulatory body information system to reduce and prevent security threats based on best practices and experience feedback worldwide. These measures are not one-size-fit-all, they should selected, customized, and prioritized according to the information system configuration and the risks which are faced to reduce exploitable weaknesses and attacks. It should be implemented case-by-case to avoid useless complexity and high cost. Before selecting from the many available security measure, risk assessment should be done first. Risk assessment play a key role in implementing successful security measures. There many security measure introduced by specialized research centers, institutes and private companies. Most of these measure are common and agreed on by all stockholders. This paper propose three steps methodology for securing regulatory body information system, critical asset identification, risk assessment, selecting and prioritizing measures.

Abstract ID: 86

Pursuing Adaptable Partnerships: Expanded Government Engagements in the U.S. for Secure End-of-Life-Management of Radioactive Sealed Sources

Martin, D.[1], Zarling, J.[2], Taplin, T.[3]

[1] Energetics Incorporated; USA
[2] NNSA Office of Radiological Security/Idaho National Lab; USA
[3] NNSA Office of Radiological Security; USA

Corresponding Speaker: J. Zarling

The disposal of disused sources is the final step in insuring they are secure throughout their lifecycle. As result, for over a decade, the U.S. National Nuclear Security Administration (NNSA) has partnered with the largest State regulator association in the U.S., the Conference of Radiation Control Program Directors (CRCPD), to facilitate the collection and disposal of disused sources. Since 2007, the NNSA/CRCPD partnership has supported licensees in the disposal of thousands of sources that meet the waste acceptance criteria at the facilities available. Based on these initial efforts, NNSA and CRCPD have been able to adapt and expand this partnership to address new and more complex opportunities and challenges. This expanded cooperation began with a 2011-2012 project to dispose of Category 4 and 5 sources under a regulatory exception in Utah. More recently, the partnership has focused on the implementation of changes to Federal guidance that may enable the disposal of some Category 1 and 2 sources. These new and more complex projects include the pilot disposal of a Category 2 Cs-137 irradiator using the new guidance, and training to expand commercial service provider capabilities to support similar higher activity disposals.

The NNSA/CRCPD partnership on source disposal began in 2007 with development of the Source Collection and Threat Reduction (SCATR) program. For over 30 years, licensees in 39 U.S. states were able to dispose of sealed sources under 0.37Tbq at a radioactive waste facility near Barnwell, South Carolina. However, restricted access to the Barnwell facility was scheduled to begin on July 1, 2008. After that date, disused sources from licensees in 36 states would be relegated to indefinite storage. This looming lack of disposal access for most U.S. source licensees was widely recognized as a concern from the perspective of National security, public health, and safety. To help reduce the long-term risk, the NNSA and CRCPD under SCATR recovered 2,500 disused sources from licensees in Florida and disposed them at the Barnwell facility before the access restrictions took effect.

Based on this initial success, SCATR broadened its efforts to dispose of sealed sources, despite the ongoing facility access constraints. A disposal facility in Clive, Utah accepted certain types of radioactive waste from licensees all 50 States, but was not licensed to accept sealed source waste. In 2011-2012, to help reduce further the disused sources in long-term storage, the SCATR engaged both the facility operator and the its regulator to gain approval for a temporary license variance for disposal of Category 4 and 5 sealed sources This collaboration enabled the disposal of over 3,000 additional sealed sources, and the facility is currently pursuing a permanent license amendment to accept similar types of sealed source waste. The SCATR program continues to work with commercial brokers and generators to identify, collect, and dispose of disused sources that could potentially fall out of regulator control. Sources are recovered and disposed on a cost-share basis with participating licensees. The program has recovered and disposed of over 10,000 sources.

More recently, NNSA and CRCPD have collaborated on several projects to address the secure end-of-life-management of much higher activity sources. First, SCATR worked with a facility near Richland, WA and its regulator on the first ever use of the 2015 revised NRC Concentration Averaging Branch Technical Position (CA BTP) "Alternative Approach" provisions for sealed sources. Using the new guidance, the SCATR program recovered and disposed of a ~20.7TBq Cs-137 irradiator. These new disposal provisions were used to demonstrate the safe disposal of a device significantly exceeding the 'generic' regulatory limit of 4.81TBq. As result of this effort, NNSA has initiated conversations with the disposal facilities in Washington and the facility in Texas on ways to appropriately encourage and facilitate licensees in similar high activity source disposals in the future. Use of the revised guidance to address a broader range of high-activity Cs-137 and Co-60 sources has the potential to significantly reduce the risk posed by their indefinite long-term storage at the facilities where they were used.

Finally, NNSA has partnered with CRCPD to help address a potential further constraint on the disposal of high activity sources in storage. The limited number of qualified service providers capable of preparing devices containing Category 1 and 2 quantity materials for shipment was identified as a limiting factor in the numbers of disused and unwanted devices that can be recovered. In partnership, the two organizations developed a course to provide hands on training to help alleviate the backlog of self-shielded devices containing high activity sources awaiting recovery and disposal. This training course would aid in the issuance or amendment of radioactive material licenses to service providers that have completed the course successfully to prepare for shipment primarily in Type B shipping containers.

Abstract ID: 98

Nuclear Material Security Monitoring using Multisensor Integration

Nugroho, D.[1]

[1]Nuclear Energy Regulatory Agency of Indonesia; Indonesia

Corresponding Speaker: D. Nugroho

The security of nuclear material in a nuclear installation is determined by how far the installation can guarantee the fuel remains at a designated location. This paper developed a methodology of monitoring nuclear material in an installation by integrating multiple sensors in an integrated manner. By using several kinds of sensors, the certainty will remain monitored nuclear material movement for decision making will be more assured. Decision-making on information systems is obtained based on several levels of information. The first level is obtained based on the integration of the information of several CCD camera sensors and/or nuclear detector mounted distributed around the object. The second level is achieved based on image analysis and data operation. While the third level is obtained based on the understanding of perception at the third level of abstraction. The integration of some of these sensors can be represented using the Wavelett method. The integration of some information obtained from multiple sensors equally or differently sequentially will be able to reliably effect the movement of nuclear material movement in different spaces. Sequential information may be completed with a control area boundary, so that when the controlled area boundary is violated will provide flashing mode on the annunciator or alarm on the console. Thus the security of nuclear material will be monitored properly.

Abstract ID: 99

Stakeholder Coordination and Preparation for Hosting IPPAS Module 4 Mission

Srimok, B.[1], Watcharasuragul, V.[1], Pibanwong, W.[1]

[1] Office of Atoms for Peace; Thailand

Corresponding Speaker: B. Srimok

Thailand by Office of Atomic Energy for Peace (OAEP) has hosted IPPAS mission once in 2005. After the mission OAEP was divided into two organizations, Office of Atoms for Peace (OAP) and Thailand Institute of Nuclear Technology (TINT) which responsible for nuclear and radiation regulatory functions and nuclear and radiation research activities respectively. OAP and TINT have been performing their tasks and addressing 2005 IPPAS recommendations and suggestions. One of the tasks is issuing Nuclear Energy for Peace Act (NEPA), 2016 that addresses the legal recommendations and forms legal basis for nuclear regulations. If not hosting all IPPAS modules at the same time, the most logical practice is hosting module 1 IPPAS mission at first and later the rest of the modules. At the moment, all subsidiary regulations under NEPA are not completely published and enforced, the NEPA use some regulations and requirements that were effective under the previous Act by mutatis mutandis. Changes and improvements are certainly expected in the new set of regulations and requirements, hence hosting module 1 before completion of new set of regulations is not appropriate. Instead, competent authority staffs have been regulating radioactive materials under existing regulations for years. In theory, Thailand should be able to host module 4 IPPAS mission. Hence relevant data collections from stakeholders through various workshops and meetings have been conducted and used to evaluate whether the country is ready to host at least one module that is the most benefit, i.e. module 4 IPPAS mission. Input data in the analysis includes (a) existing relevant regulations; (b) stakeholders that are relevant to the contexts and their roles and responsibilities and; (c) how each ones currently interact and perform interconnected functions under existing legal framework. The results will address supporting factors and factors that are found to be challenging if Thailand hosts the mission. Timeline for hosting the mission will be based on the results of the evaluation. While timeline is expected to know, another crucial aspect is how OAP as a coordinating organization would share all the aspects of the results to all stakeholders. These are keys not only to just receive the mission but also strengthen and maintain effective national nuclear regime. At least, with stakeholders realizing and understanding the importance of their roles and responsibilities should encourage an involvement of all parties to perform interconnected functions in a better way.

Abstract ID: 101

Coordination Mechanisms for Inter-Agency Action in Detection of, and Response to Nuclear and Radioactive Material outside Regulatory Control in East African States

Sseggane, R.[1]

[1] Atomic Energy Council Uganda; Uganda

Corresponding Speaker: R. Sseggane

The IAEA published Nuclear Security Series (NSS) No. 20: Objective and Essential Elements of a State's Nuclear Security Regime published in 2013 provides guidance on the 12 essential elements of security that States need to apply as far as reasonable and practical. Since the 2005 Amendment to the Convention on the Physical Protection of Nuclear Material is in force, we consider these essential elements legally binding on states that have ratified it.

These elements can provide an understanding of the nuclear security accountabilities and responsibilities and can serve as the basis for establishing whether a State's nuclear security regime is comprehensive, effective and efficient. It is conceived that a sound nuclear security regime is one in which all relevant responsibilities and accountabilities are executed and implemented satisfactorily by the several stakeholders. The challenge then arises from the state being considered as a single stakeholder yet in the execution of duties operates through several institutions and organizations independent of each other in various ways.

The Essential Elements of a State's Nuclear Security Regime (IAEA NSS 20, 2013) seem to cover what one would easily conclude is all required for an effective and efficient nuclear security regime. It is evident however that without effective coordination and harmonization of the various responsibilities of the participating agencies, the objectives may not be achieved.

Let us consider an example of an intelligence report of illegal radioactive material being imported into the country by road for use in a planned radiological terrorist attack at a major public event in the city. Stakeholders that would have responsibilities in this case include the regulatory body, the police service, transportation authority, the police service, customs agency, intelligence services and so on. (IAEA, NSS 9, 2008)

There are several other cases in which stakeholders have to work together but there are no established mechanisms in the East African states to coordinate such inter-agency activities. The practice is to make temporary arrangements initiated by the most concerned agency at the time to organize collective nuclear security measures for the operation or the incident. Unless efforts have been made to establish a coordination framework for inter-agency action, it is very likely that the many national stakeholders will not know how to work together if an incident arises. The paper will further discuss risks and weaknesses to the nuclear security regime that arise from this situation with a look at a past experience and consequences of such a case.

The paper will propose a concept of coordination of national nuclear security stakeholders in the Detection of, and Response to Nuclear and Radioactive Material outside Regulatory Control in East African States. This will be achieved through:

- Identifying the national stakeholders and their respective roles;
- Reviewing the current situation as regards Cooperation and coordination of stakeholders at state level;
- Studying international best practice cases on such coordination of inter-agency action for applicable models; and
- Preparing a concept for coordination of national nuclear security stakeholders in the Detection of, and Response to Nuclear and Radioactive Material outside Regulatory Control.

The paper will give an analysis of the essence of coordination mechanisms for inter-agency action, the gaps in the interagency coordination mechanisms with their implications to East African states in relation to the benefits of sound coordination mechanisms where they are implemented and propose a concept for coordination of national nuclear security stakeholders. The establishment and implementation of sound permanent coordination mechanisms for inter-agency action in Detection of, and Response to Nuclear and Radioactive Material outside Regulatory Control will strengthen the nuclear security regimes in the East African states a great deal.

Abstract ID: 109

The Way Forward for Prevention and Detection

Pavlićević, D.[1]

[1] Montenegro

Corresponding Speaker: D. Pavlićević

The theme of the synopsis is the improvements of preventive measures in transport and preventive measures against drones that can be used as such in order to bypassing and endangering a nuclear security system. Also, the synopsis deals with the possibilities provided by wireless sending of data from remote sites, which improve detection measures for the purpose of tactical action against an illicit transit of nuclear material. All these measures aim to be the way forward for prevention and detection in the nuclear security system.

1. Enhancing Security in Transport of Nuclear material and other radioactive material

We are witnessing that terrorist acts are increasingly being carried out by vehicles. Potential risk may be the hijacking of the vehicle with nuclear and other radioactive material and with additional explosives, a terrorist act can be executed with enormous consequences. The aim this preventive measure is send alarm of a hijacking vehicle on time and vehicle can be stopped before the terrorists perform their task by remote control. Alarm send a warning such as opening a cargo area or taking control of the vehicle by unauthorized persons. Alarms may include: starting a vehicle, monitoring the driver's cab and cargo space. Vehicle stopping is done by command through the mobile telephone system. Signal is primarily designed to shut down the vehicle to disable its ignition and perform additional braking with an electric parking brake. The electric brakes have much less vehicle driftage than manual. Embedded, electronic circuits have the role of transferring the switching signals from the remote operator to the mechanics of the vehicle. An additional technical protection measure to be taken to prevent such a scenario is the GPS positioning. In order to apply this measure is necessary: electronics board, installations and batteries that allow work autonomy. This equipment must be hidden in the vehicle. Electronic components are: microcontroller board, a transmitter between microcontroller board and a gateway (mobile smart phone), sensors and relays. The control logic from the microcontroller board transmits to relays and logic circuits that switch off and include individual circuits in the vehicle.

2. DRONES as danger and possible way of obstruction them

Drones thanks to their technical capabilities in the hands of terrorists, create a danger of bypassing security measures for the purpose of illegal transit, theft of nuclear and radioactive materials and the sabotage of a nuclear facility. Technical limitation of drones are batteries. Theirs distance can be some kilometers. Time in air take maximum 30 minutes for commercial drones. If there is a load of either nuclear material or explosive, the time is shortened. Drones usually work at frequencies of 2.4GHz and 5.8GHz. RF jammers on the same frequencies disable remote controlling and Drones return to the starting position. Preventive measures against drones are the identification of risk areas of a nuclear facility and the protection of these areas by RF jammers.

3. Ability to transmit remote data from PRD devices such to a monitoring center or a mobile phone.

The transmission could be done via a GSM / GPRS network. This device has the option AUTO SEND to periodically send measured values to the IR port or Bluetooth for radio transmission. Together with an electronic circuit that receives data from the PRD and sends those via the GSM / GRPRS network in some monitoring center or a mobile phone. This device, together with the accompanying electronic circuit, must be protected against weather conditions with additional power supply. Camouflage in some external environment is that it can send data or alarm SMS/call to a monitoring center or a mobile phone. The system should be protected from low temperatures in the range of working temperature. The application of such a concept can be in the measurement (secret monitoring) of certain mountain roads that can be used for illegal border transportation. Mountains paths are narrow and prevent faster cargo passage such that PRD should that have precise measurement. Of course, this concept at one location should not have a high price, which allows covering a large number of potential illegal crossings. The autonomy of the work can be greatly increased in these conditions, since the external batteries can be hidden, buried, which allows for a great autonomy of operation. The same system can be added to devices such as motion detectors, outdoor cameras used hunters and border police. Although a border can be very long, monitoring can be carried out successively. Information about threats assessments, ITDB and other information on can be of use in preventive action against the illegal international transit of nuclear and other radioactive material. The solution can be implemented for different environments, such as for example in city and roads built-in a traffic lights where there is a significantly higher traffic flow and where the need for batteries and cameras can be avoided.

Abstract ID: 111

In a New York Minute: Economic Impacts of Radiological Dispersion Device

Trost, L[1], Vargas V.[1]

[1] Sandia National Laboratories; USA

Corresponding Speaker: L. Trost

In the Fall of 2015 the Office of Radiological Science (ORS) began working with Sandia National Laboratories (SNL) to use enhanced data, new models/methods, and informal expert elicitation to improve upon past studies and produce a better understanding of the full range of economic consequences of an RDD event. This analysis explores in detail the consequences and impacts associated with an RDD detonated in a major metropolitan area.

A representative (not worst case) scenario was developed to examine the effects of an RDD on populations, critical infrastructure, and buildings were examined in detail. Economic impacts were estimated at the local, regional, and national level based on physical effects, response, remediation, and event timeline. Findings suggest major impacts on society and the economy, however, prior resilience efforts and a prompt, coordinated response and recovery can reduce the effects to the population and the regional economy.

Informal expert elicitations, revealed that local response actions would primarily be focused on maintaining the health and safety of the local population. Actions include: demarcation of a protection zone, shelter-in-place areas, emergency transportation pathways, and identification of populations to be evacuated/relocated.

For this analysis, subway system contamination was much less than initially assumed. New models demonstrated that dispersal did not contaminate the entire system. It was limited to just a few stations with some disrupted because of their proximity to the protection zone. SNL indoor and surface infiltration models (PATH/AWARE) enabled a detailed analysis of infiltration into buildings and indoor surfaces. Results indicate low levels of indoor and surface contamination resulting in limited indoor remediation. The low levels are likely attributable to the built-in resilience of modern HVAC systems and increased performance in air filtering systems. Remediation costs were moderate due to limited replacement of indoor furnishings, fixtures, and equipment.

Modern building construction methods may limit the need for demolition. Many buildings in the event zone have facades, an outer layer, that could be removed and replaced with minimal disruption to indoor occupants. An additional feature of this remediation technique is likely low levels of re-suspension from the event compared to traditional demolition; further contributing to reduced costs when compared to past studies.

Business disruptions are characterized by the loss and the long-term relocation of businesses and residents are relocated within NYC MSA (9/11 findings). Perception effects manifest via worried well populations seeking unnecessary medical treatment and reduced tourism (similar to post-Fukushima). Regional impacts vary tremendously with some positive offsets. First year cost categories had significant down turn, but multi-year (10 years) analysis showed some recovery. With limited national effects found in the analysis. The response protocols, readiness, and action thresholds determine cost and human impact to a great extent resilience and preparedness will make a difference and either drive the economic costs higher/lower in a real event.

Abstract ID: 112

Importance of Security Culture with regards to Radioactive Sources

Hakam, O.[1]

[1] University of Ibn Tofail; Morocco

Corresponding Speaker: O. Hakam

Radioactive sources are being used in over 100 countries for a wide variety of peaceful and beneficial purposes, e.g. industry, oil well logging, medicine, agriculture, research and education. It is important to note that when radioactive sources are safely managed and security protected, the risks to both workers and the public are minimal. However, if a radioactive source becomes out of control and unshielded or its radioactive material is dispersed as the result of either an accident or a malicious act, the danger of radiation exposure becomes very real. In this respect, the International Atomic Energy Agency (IAEA) Incident and Trafficking Database (ITDB) has reported a total of over 3000 confirmed incidents (as of 31 December 2016) with less than 10% of them being related to trafficking/malicious use. Therefore, it is important to achieve an efficient security within national facilities and institutions using, storing and transporting radioactive sources and materials to prevent and detect such malicious acts before they occur.

Development of an effective security culture could start by building educational programmes on nuclear security at the universities and higher institutions for the young generation, to educate them and instil this culture at an early stage. The graduates, as future professionals, will implement what they have learned and ultimately contribute to the proper management of the radioactive material. This paper will talk about our experience at the University of Ibn Tofail in developing an educational programme on nuclear security that includes modules on the security of radioactive sources, security culture and security of radioactive sources during transport. The paper also will share our experience in organizing national, regional and international training workshops that promote security culture and help to share best practices among nuclear security stakeholders.

Abstract ID: 120

Strengthen Nuclear Security Regime Through Capacity Building Program (Activity Progress: Indonesia National Nuclear Energy Agency)

Indragini.[1]

[1] National Nuclear Energy Agency; Indonesia

Corresponding Speaker: Indragini

According to IAEA, capacity building for nuclear security is defines as a systemathic approach to education, training, exercises, enhancing awareness, workforce management, knowledge management and use of knowledge network to develop and continuously improve the governmental, organizational and individual competences and capabilities necessary for establishing and sustaining an effective nuclear security regime. As an operator, Indonesia National Nuclear Energy Agency (BATAN) develops and implements nuclear security capacity building program to ensure the competence of its workforces. For that, centers in BATAN collaborate and support each other. BATAN also gets great support from other states, agency and organization at national, regional and international level.

The development and implementation of capacity building elements in BATAN include cooperation with University Gadjah Mada (UGM) by accepting students for doing research and development nuclear security culture at Center for Security Culture Assessment (CSCA). For workforce management, BATAN provide regulations related to nuclear security implementation responsibility for each centers and Nuclear Areas, under coordination of assigned center, Berau of Law, Pubic Relation and Cooperation (BHHK). The regulations include tasks and training scheme for nuclear security personnel at each level of position. Based on the regulations and training proposal from BHHK, Pusdiklat conducts nuclear security training to fulfill any identified gap competence for nuclear security personnel and other workforces in each nuclear area. In conducting training activities, Center for Education and Training (Pusdiklat) develop a concept, which call Learning, Inovation on Nuclear Science and Technology (LIoN). The concept covers active learning, smart learning space, on-line learning, on-line library and learner community. Every personnel who attended training/workshop/other activities, such as research program, held either in domestic or overseas must implement and share their knowledge and experiences gained from program through sharing knowledge activities and preserve training material in server. By creating learning and sharing culture in organization, it will promote capacity building in individual level and encourage knowledge management. As result, in the last 5 years, there have been significant improvement in implementation of nuclear security regime in BATAN, especially in nuclear security culture, human reliability (trustworthiness), physical protection system evaluation and performance test, nuclear security plan, develop threat assessment and risk analysis document and information security. Although, in process, BATAN faces challenges such as development of sufficient automatic data base for workforce training

history and competency, personnel aging and development of training facility, either classroom modification and physical protection system laboratory.

Capacity building is an endless process. BATAN commits to strengthen and sustain nuclear security regime through massive cooperation among centers in organization and stakeholders at national level. Support from and collaboration with other states and organization at regional and international level are valuable opportunity and very important factor in conducting the program. BATAN commits to contribute to the program through knowledge network globally as well.

Abstract ID: 123

Securing the decommissioning of radioactive waste hangars within Public Company Nuclear Facilities of Serbia

Žarković, D.[1], Arbutina, D.[1], Mladenovic, M.[1]

[1] Public Company Nuclear Facilities of Serbia; Serbia

Corresponding Speaker: D. Žarković

This paper will present preparatory activities for securing the decommissioning of radioactive waste hangars within Public Company Nuclear Facilities of Serbia (PC NFS). It will present all of activities that are done and will address some of activities that need to be done to make decommissioning process of old hangars H1 and H2 more secure.

Public Company Nuclear Facilities of Serbia (hereinafter PC NFS) is the only nuclear operator in Serbia. It was founded in 2009 under the Law on Ionizing Radiation together with the Serbian Regulatory Body. Since its establishment, PC NFS has continued all nuclear activities previously managed by Vinca Institute of Nuclear Sciences; Two research reactors (RA-final shut down and RB-zero-power critical assembly, operational but currently not-licensed), RWM facilities- old Hangars H1 and H2 with legacy waste, new hangar H3 (for the storage of intermediate and low level radioactive waste) together with the secure storage for the high activity sealed radioactive sources, and closed uranium mine Kalna are the part of the Company. Waste processing facility is under licensing and it is also part of the Company.

Institute of Nuclear Sciences served for many years as the main radioactive waste management facility in former Yugoslavia, being a national storage facility for the radioactive waste from different institutional activities (medical, military, etc.) as well as the center for research and waste solidification technology development. The main fraction of the low and intermediate level waste (LILW) is stored in two metallic hangars (H1 and H2). They held more than 4,000 sealed and unsealed radioactive sources along with transuranic wastes and depleted uranium.

Since 2003, The United States Department of Energy's (DOE) has endeavoured to provide technical and financial assistance to Vinca Institute of Nuclear Sciences to improve protection of nuclear and radiological material. After the PC NFS was founded, all the cooperation in the field of nuclear security was continued through PC NFS. The last building, upgrade and maintenance of PPS at the Vinca site (site which uses PC NFS and INS Vinca) together which has covered facilities of interest both in PC NFS and INS Vinca was successfully finished at the beginning of 2016. This upgrade didn't include facility for radioactive waste treatment and this facility should be incorporated in PPS of PC NFS. Also, some problems and weaknesses were found and will be presented in this paper.

Decommission of old hangars H1 and H2 with legacy waste is expected in the near future and this will be totally new process in Serbia. Preparedness for this activity must be patient and comprehensive. In the manner of security, it is very important that it needs to be incorporated from the beginning of process and that is from the preparation for decommissioning. Also, security must be integrated in a way that it will not interrupt safety and it will not complicate whole process. People are more familiar with safety than with security and if some action will complicate their activity they will mitigate it. Because of that, it is very important to have strong security culture. In autumn 2015, PC NFS has signed research agreement with IAEA under CRP on Development of Nuclear Security Culture Enhancement Solutions(NSCES) and this cooperation is also very important for this process. Raising the awareness of security treats changes the way of thinking and the way of acting in the different situations. Employees in PC NFS showed awareness of security treats and understanding of security measures that are put in place. They also showed adherence to security procedures. All of mentioned creates good base for securing decommissioning of hangars H1 and H2.

One of expected activity is transport of radioactive sources from the hangars H1 and H2 to the hot cells that are located in the reactor RA building. Legislation and procedures that are connected with that process was revised. Team of 3 employees was formed and their activity and findings will also be presented in this paper.

Abstract ID: 126

International Cooperation in Strengthening Nuclear Security- Public Company "Nuclear Facilities of Serbia

Arbutina, D.[1], Žarković, D.[1], Mladenovic, M.[1]

[1] Public Company Nuclear Facilities of Serbia; Serbia

Corresponding Speaker: D. Arbutina

Public Company Nuclear Facilities of Serbia (hereinafter PC NFS) is the only nuclear operator in Serbia. It was founded in 2009 under the Law on Ionizing Radiation together with the Serbian Regulatory Body. Since its establishment, PC NFS has continued all nuclear activities previously managed by Vinca Institute of Nuclear Sciences; Two research reactors (RA-final shut down and RB-zero-power critical assembly, operational but currently not-licensed), RWM facilities- old Hangars H1 and H2 with legacy waste, new hangar H3 (for the storage of intermediate and low level radioactive waste) together with the secure storage for the high activity sealed radioactive sources, and closed uranium mine Kalna are the part of the Company. Strengthening nuclear security is the vital part of the development strategy of PC NFS. Department for nuclear security was founded in the 2016, first time after repatriation of spent nuclear fuel to the country of origin (Russian Federation) in 2010 which has shown the willingness of PC NFS management to make nuclear security equal to the radiation and nuclear safety, emergency response and preparedness and radioactive waste management. Since 2003, The United States Department of Energy's (DOE) has endeavored to provide technical and financial assistance to Vinca Institute of Nuclear Sciences to improve protection of nuclear and radiological material. After the PC NFS was founded, all the cooperation in the field of nuclear security was continued through PC NFS. The last building, upgrade and maintenance of PPS at the Vinca site (site which uses PC NFS and INS Vinca) together which has covered facilities of interest both in PC NFS and INS Vinca was successfully finished at the beginning of 2016. Scope of this paper is to provide the results of the project, issues that we were facing during the building and upgrade of the system which, at the and, made PPS at both PC NFS and INS Vinca significantly upgraded (without going into the sensitive information)together with the proposals for the future upgrades that were prepared within PC NFS in 2017 and 2018. Paper will also show our efforts in establishing international cooperation in the field of advanced security technologies We will also provide the results of cooperation with US DoE in strengthening complete nuclear security regime within PC NFS through training and workshops that were provided by the experts from the various US DoE national laboratories and organizations (up to date we have finished four workshops: Workshop on Mitigating the Insider Treat Using Behavioral Science, Insider Treat Identification and Mitigation, Site Security Plan and International Response Training Course) which helped us in strengthening our nuclear security capacities as well as enhanced our cooperation with the Serbian Regulatory Body. Those workshops and training has involved not only the PC NFS staff but also the representatives from all the other relevant institutions. Paper will cover the efforts in strengthening the nuclear security culture as the foundation of every nuclear security regime and continuous education of our staff through cooperation with IAEA and WINS.

Abstract ID: 127

Infrastructure for detection of orphan sources in Lithuania

Kievinas, R.[1], Ladygiene, R.[1]

[1] Radiation Protection Center; Lithuania

Corresponding Speaker: R. Kievinas

Radiation Protection Centre (RPC) is leading institution in the area of state management of radiation protection and security of sources of ionizing radiation. During the years RPC created and developed an effective national legislative and regulatory system of control of radioactive sources within Lithuania. In order to prevent a loss of control of any radioactive source license or and temporary permits for activities with the radioactive source is required. All information about radioactive sources must be provided to the State Register of the Sources of Ionizing Radiation and Occupational Exposure and routine reporting from license holders is mandatory on the inventory results of radioactive sources. However, there is a certain probability that orphan radiation source can be discovered. For that reason the system on detection of orphan sources on the EU border crossing points, custom posts, metal scrap yards and garbage disposals was created. Additionally, for preventive measure to detect orphan source RPC have lunched various campaigns for search and recover orphan sources left behind from past activities.

Despite all the preventive measures applied, orphan sources are being found approximately 3-4 times per year. Over the past five years 22 times orphan sources were detected, mostly it is smoke detectors, old and obsolete devices with radioactive sources. Scrap metal contaminated with radioactive material is detected annually as well.

The best method to recover orphan sources is organization of the campaigns and using or installing radiation detection equipment in strategic locations. Lithuania with international partners support instigated radiation monitoring measures at all external EU border crossing points, airports and maritime ports of entry. Both portable equipment (PRD) and the fixed radiation portal monitors (RPMs) are used to screen all pedestrians and vehicles for radiation when passing through a monitoring point.

Another strategic location to detect orphan source is the scrap metal yards. To increase probability to recover orphan source in the scrap metal yards RPC have placed requirements. The requirements cover mandatory radiation protection training for scrap metal workers. Additionally, scrap metal yards must be equipped with hand held dosimeters and each batch of metal must be measured. The costs of management of all orphan sources or contaminated objects found in the scrap metal yards are covered from state budged. In such cases disposition of the orphan source belongs to radioactive waste manager.

Following the requirements of IAEA and European Commission, for recovery of orphan sources RPC have organized campaigns to detect and recover orphan sources left behind from past practices. Firstly, it was performed administrative search on historical records of authorities (research institutes, medical facilities etc.) and reports of the USSR military sites closure. Later, practical search companies were performed in the sites selected from the administrative search. In response to request of eight municipalities the search of orphan sources and radioactively contaminated materials at sites were carried out in 2014-2016. One legacy site contaminated by 226Ra has been found during the searching campaign.

Recent year RPC have launched Program on Searching of Orphan Source in Living Environment (2017-2023). Some State Municipalities informed that they have past soviet military sites with unknown activities in the past. The Municipalities intend to perform searching for orphan source and radioactive materials in those territories. Furthermore, search of orphan sources during mass public events using mobile ionizing radiation detection system MDS is also foreseen.

In the case if orphan source was found, recovery activities must be followed according the rules placed on the Government Resolution of the Republic of Lithuania of 16 March 2005 No 280 “Rules on the handling of orphan ionizing radiation sources, substances of orphan nuclear fuel cycle, orphan nuclear and fissile substances and objects contaminated with radionuclides”. The rules on the handling of orphan sources determine the actions of the state and local authorities after the discovery, identification and suspension of ionizing radiation sources.

The proper implementation of preventive measures increases protection of Lithuanian population, workers and environment from the harmful effects of orphan sources.

Abstract ID: 130

Strengthen of Physical Protection Regimes for Radiological Facility

Adail, A.[1], Tawfik, Y.[1]

[1] Atomic Energy Authority; Egypt

Corresponding Speaker: A. Adail

The function of Physical Protection Regimes (PPR) should meet three basic elements (detection, delay, and response) and it is required to protect the facility against; possibility bombing, sabotage, and theft. The system must be fast in performance to achieve sufficient time for the arrival of response forces and complete the defense about the property in a timely, thwart the adversary and neutralize on the implementation of its mission. The performance of the physical protection system should be designed to oppose and limit the capabilities and tactics of the attacker (force, deceit and stealth) toward the entity that contains modern tactics and different concept, and in the way to work is a barrier against the attacker is difficult to penetrate and overcome it. In this paper an improving of the physical protection system effectiveness for a radioactive sealed sources facility is presented. The hardest scenarios will be used as a tested for the performance of this system based on the principles of physical protection. If the evaluation reveals any weakness, the initial system design must be redesigned to correct the vulnerabilities and another analysis of the redesigned system is performed.

Abstract ID: 132

The Maintenance Management Plan: A Road Map to Sustainable Systems

Stinson, C.[1]

[1] ORNL/NSDD/USDOE; USA

Corresponding Speaker: C. Stinson

A robust and disciplined approach to maintenance is crucial to the lasting success of equipment, facilities, nuclear security measures, and systems related to nuclear security detection architecture. Properly designed and implemented, a comprehensive maintenance management plan will reduce long-term maintenance costs, improve system availability, and extend the service life of the equipment, instrumentation, and systems. The United States Department of Energy/National Nuclear Security Administration Office of Nuclear Smuggling Detection and Deterrence defines maintenance as "actions taken to preserve, restore, verify, and improve an asset's functional capability." A maintenance management plan describes the tasks and the good practices required to effectively maintain the systems.

The following seven core capabilities comprise an effective maintenance management program:

- Maintenance Scope and Task Selection: Defining the scope and selecting tasks can be achieved by determining which pieces of equipment should be actively maintained, developing a list of corresponding maintenance tasks, and determining the level of effort to perform those tasks. A proper balance of preventive maintenance and corrective maintenance should be used to provide a high degree of confidence that degradation of facility equipment is identified and corrected, that life of the equipment is optimized, and that the maintenance program is cost-effective.
- Maintenance Provider Management: A maintenance provider is any group, organization, or company responsible for executing routine and corrective maintenance tasks to ensure proper functionality of the installed instrumentation. Selecting and managing a maintenance provider is a multifaceted endeavor. Important aspects of managing any maintenance provider include clearly communicated expectations, regular working communications, and a comprehensive system of documentation and review tracking the provider's progress and performance.
- Spare Parts Management: The objective of a spare parts management process is to have the correct spare parts available at the correct time in the correct quantity. The availability of necessary spare parts enables maintenance providers to perform corrective maintenance tasks in a timely fashion. The ability to perform corrective maintenance tasks in a timely fashion

reduces the effect on system availability, thereby reducing the success of the mission and efficient site operation.

- Radioactive Check Source Management: Many installation, training, operations, and maintenance activities associated with the radiation detection instrumentation require the use of radiation sources with specific isotopes and activities. The storage, handling, transport, and disposal of these sources are subject to national and international rules and regulations, which can vary greatly by country.
- Configuration Management: 'Configuration' refers to the functional and physical characteristics of a hardware and software product or system, such as the Radiation Detection System (RDS). Configuration management is the process of directing and controlling the functional and physical characteristics of the RDS's hardware and software. A robust, and flexible configuration management approach is needed to ensure all deployed RDS perform as intended, and the physical/functional configuration of systems are adequately identified, documented, and controlled. The benefits of a strong configuration management program include identifying and maintaining integrity of configuration items, proactively managing proposed changes to configuration items, minimizing unauthorized system changes, and enabling the development of a complete and accurate set of documentation.
- Maintenance Budget: The objective of a maintenance budgeting process is to obtain sufficient funding to execute the maintenance management plan. This requires a deep understanding of all aspects of the maintenance management plan as well as the organization's budget cycle and budget submittal process. The maintenance manager or their delegate is responsible for preparing and submitting a maintenance budget.
- Continuous improvement: Continuous improvement is the series of actions taken to measure the performance of an action or series of actions and bring them closer to the ideal. In the context of RDS maintenance, this means measuring how well the RDS is being maintained year-to-year and using this information to improve maintenance or reduce costs.

The maintenance management plan describes the elements that are important to a sustainable maintenance program. The plan should be specifically tailored to establish the maintenance priorities of each facility based on its mission, needs, and installed equipment. Effective implementation and management of the maintenance activities are achieved primarily through establishing and enforcing written policies, procedures, and standards for maintenance. Tracking metrics and continuous improvement should be a fundamental part of any maintenance management program because what is not measured cannot be changed.

Abstract ID: 133

Organizational Culture Change: The Key to Sustaining Nuclear Security Measures and Systems

Stinson, C.[1]

[1] ORNL/NSDD/USDOE; USA

Corresponding Speaker: C. Stinson

The most recent International Atomic Energy Agency General Conference resolution on nuclear security, GC(61)/RES/9, calls upon States to enhance international partnerships and capacity building to improve and sustain Member States' national capabilities to prevent, detect, deter, and respond to illicit trafficking and other unauthorized activities and events involving nuclear and other radioactive material. Many Member States meet this obligation by donating equipment, training, and associated resources to other Member States.

Regardless of whether equipment, training, or other resources are donated, one of the most challenging issues facing both organizations is the need to bring about a change in culture to ensure a successful integration of the donated item into the accepting organization's operations. The accepting organization will have additional roles and responsibilities associated with the new item. Leaders at all levels in the accepting organization must be willing to make course corrections. Strategic leaders in both organizations must reconceptualize the goals and values of their organizations and inspire people in their organization to work together to achieve these goals.
The term 'organizational culture' can be defined or applied in many ways. The following definition particularly suits this discussion: "The deeper level of basic assumptions and beliefs that are learned responses to the group's problems of survival in its external environment" and "shared by members of an organization; that operate unconsciously; and that define in a basic 'taken-for-granted' fashion an organization's view of itself and its environment" [1].

Schein also characterizes culture as having three levels: behavior, values, and beliefs.

- Behavior and artefacts: The most observable level of culture is behavior, which consists of day-to-day performance of duties, adherence to procedures, dress codes, and even the level of technologies employed.
- Values: Values are believed to determine behavior to a large extent but are not directly observable. There may be differences between stated and operating values.
- Assumptions and beliefs: Once a set of values becomes so deeply embedded in the organization to the point of being 'taken for granted,' they drop out of external consciousness and become beliefs. Assumptions and beliefs are the deepest level of an organizational culture and are the target of our efforts to successfully implement change.

Without guidance or support, an organizational culture evolves aimlessly in response to the workplace environment. But an organizational culture can and should be purposely created and maintained by leadership. Strategic leaders should be the principal source for the generation of an organization's ideology, specification of norms, and communication of core values.

- Organizational values express preferences for certain behaviors, outcomes, or both.
- Organizational norms express behaviors accepted by others.

To successfully implement major changes in an organization, new approaches, ideologies, and values must be effectively communicated by leadership, internalized by employees, and then translated into productive actions and behavior in the workplace.

Organizational values and norms establish the foundation of organizational culture and must be consistent. History has repeatedly shown that efforts to implement new strategies will likely fail if those strategies are inconsistent with the underlying organizational culture. Great care must be taken when planning for and implementing major changes because, as sociologists Fine and Kleinman describe, "distinct societies are composites of smaller subcultures rather than a single homogeneous culture" [2]. Subgroups within organizations create subcultures that have very specific characteristics and a sense of identity. Subcultures in an organization tend to form along functional lines because of their biased knowledge of events and explanations of cause and effect relationships in their microcosm of the larger environment.

Management must be highly visible and clear in its communications to establish and reinforce the organization's ideologies, values, and norms. Leaders have a better chance of success in transforming the organizational culture if they accept and support productive organizational subcultures and effectively communicate how employees must perform for the organization to achieve its new objectives.

References

[1] SCHEIN, E. H. Organizational Psychology, 3rd ed, Prentice-Hall (1988).

[2] FINE, G. A., KLEINMAN, S. Rethinking subculture: An interactionist analysis. American Journal of Sociology. 85 1 (1979) 1–20.

Abstract ID: 135

Testing and performances of radiation detection instruments for nuclear security

Deyglun, C.[1], Weber, A.[1],Pepin, N.[1], Funk, P[1], Lambert, T.[1]

[1] IRSN; France

Corresponding Speaker: C. Deyglun

Each year, radioactive materials are lost, stolen or otherwise out of regulatory control. Most incidents are minor, but material is potentially available for criminal acts. The ability to detect illicit transport of radiological or nuclear material is an important component to reduce the threat.

Hence, in the framework of the Illicit Trafficking Radiation Assessment Program phase II Round Robin Test (ITRAP+10 phase II RRT), the IRSN developed platforms for testing nuclear security equipments. In the continuity of ITRAP+10, this project allowed checking the radiological performance of security equipments and their compliance with different standards (ANSI/IEEE and IEC). In addition, it supports national testing laboratories to build up facilities for performing tests and to get hands-on feedback to improve efficiency of testing procedures.

Three radiation detection instruments have been tested: a Personal Radiation Detector (PRD), a Spectroscopic Radiation Portal Monitor (SRPM), and a Radiation Isotope Identification Device (RIID).

The paper describes first the two platforms that IRSN designed and developed during this project: the first one is dedicated to static tests, the second one to dynamic tests. The static test platform has a pop-up design. It is machinery that exposes a radioactive source for a defined time. The platform is coupled with different acquisition devices such as temperature, atmospheric pressure and humidity sensor, webcams, alarm sensor and ionization chamber. Motor and sensors are controlled by a Raspberry Pi and home-made software developed in Python. The dynamic test platform has a conveyer-rail design. It is machinery which transports one or more radioactive sources through the spectrometric radiation portal back and forth. The platform is a small motorized carriage with guidance along a rail. Speed, timing, number of crossings are parametrized according to the tested scenario.

The measurements and tests performed at IRSN are then presented. Sensitivity to gamma radiation or neutrons has been tested. Detection efficiency, time to alarm and false alarm rate have been evaluated. In addition, several scenarios to lure or disturb the instruments have been tested, for example over-range response, detection of gradually increasing radiation levels.

To complete the study, modellings of the spectroscopic radiation portal monitor are performed with MCNP. It aims to develop a procedure in order to evaluate the performances of radiation portal monitors without heavy tests and take into account the environment (walls, pillars, other portals, etc.).

In a first step, models of different portal monitors installed in the laboratory are tested in order to obtain the best agreement with experimental data. New scenarios will be tested in the future.

Abstract ID: 136

A Case Study on the Effectiveness of Mechanical Attack Testing to Help Determine Vulnerabilities of a Device that contains Radiological Material and Proven Methods of Addressing such Vulnerabilities

Kurnot, J.[1], Kuca, M.[2], Neidigk, S.[3]

[1] Gamma-Service MedicalGmBbH
[2] United States Department of Energy Office of Radiological Security; USA
[3] Sandia National Laboratories; USA

Corresponding Speaker: M. Kuca

Radioisotopes such as Cs-137 and Co-60 are utilized in various medical, industrial, and research applications. This radiological material can be a theft or sabotage target which necessitates a certain level of security to adequately protect it. The presented work will show the value of careful planning and coordination between private and public entities to assess and identify the vulnerabilities of devices that contain high-activity radiological materials that are commonly thought to be either self-protecting due to the large amount of radiological material or very difficult and time-consuming to breach. This work will show that combining engineers from various disciplines and other subject matter experts in areas such as law enforcement, mechanical breaching, and master safe technicians can result in thorough vulnerability analysis that not only identifies attack pathways but various characteristics along those pathways such as baseline delay times and probable points of detection. Once such analysis is completed, engineering teams can focus on developing conceptual physical protection solutions that can be integrated into the device while meeting technical, operational, and financial requirements and constraints. An on-ongoing partnership between the U.S. Department of Energy's Office of Radiological Security, Sandia National Laboratories (US), and Gamma-Service Medical GmbH (Germany) will be used to illustrate these points and how they may be applicable to other manufacturers.

Abstract ID: 147

Front Line Officer Standard Operating Procedure Development for MORC Detection Operations

Wright, T.[1], Askin, A.[1]

[1] Lawrence Livermore National Laboratory; USA

Corresponding Speaker: T. Wright

The United States (U.S.) Department of Energy's (DOE) Office of Nuclear Smuggling Detection and Deterrence (NSDD) supports the security of nuclear and other radioactive material by working with partner States to implement systems to detect nuclear and other radioactive material out of regulatory control (MORC). Supporting sustainability of these systems is essential to ensuring the long-term impact of the NSDD program. One core component of sustainable radiation detection system (RDS) operations is developing and improving the partner country's site-level standard-operating procedures (SOPs).

SOPs are a set of written instructions that describe the tactical, step-by-step details of how a regularly conducted operation should be performed. SOPs provide operators with instructions on how to perform a job properly and consistently and establish a basis for developing operation evaluation criteria and assessing performance during drills, tabletop, and field training exercises. Developing and enhancing SOPs required to prevent, detect, and respond to nuclear smuggling involves engaging with multiple organizations to discuss organizational responsibilities, operational coordination, and communication protocols. In support of partners interested in developing or enhancing SOPs, NSDD typically engages with detection organizations such as border police, customs, and law enforcement, as well as response organizations such as regulatory authorities and nuclear forensic agencies.

NSDD has worked with several partners on SOP development, including Cambodia, Croatia, Jordan, Kenya, Kyrgyzstan, Sri Lanka, and Tajikistan. This experience has enabled NSDD to learn and observe many important lessons and practices regarding effective SOP development, such as the following.

1. A comprehensive regulatory framework, including national-level policies and procedures, provides a solid foundation for site-level SOP development. Elements of this framework related to MORC that support SOPs include:
2. Clearly defined nuclear security roles and responsibilities of competent authorities
3. A coordinating body or mechanism
4. A national response plan for MORC

5. Criminal offenses and penalties for unauthorized access, acquisition, use, illicit trafficking, hoaxes, and scams involving MORC
6. Requirements for implementation and maintenance of nuclear security measures for the detection of MORC
7. A national threat and risk assessment that addresses MORC
8. Procedures for managing radiological/nuclear crime scenes and handling evidence
9. The process of developing SOPs contributes to effective and sustainable nuclear security. A comprehensive SOP requires that the roles of all stakeholders are appropriately documented. An effective way to elicit stakeholder roles and process is to hold a workshop that brings the stakeholders together and utilizes scenario-based discussions to provide context for stakeholders to describe their operations. Once the operations are initially documented, additional scenarios can be used to create, assess, and improve the resulting SOPs and to discuss interagency coordination, information sharing, and communication protocols in response to nuclear security events.
10. Procedures are only effective if they can be implemented in the actual facility. To verify that the SOP accurately captures facility operations and reflects the realities of the operational facility, agencies can benefit from a walk-through of their SOP at their facility.
11. An effective SOP covers site activities end-to-end, including primary inspection (detection by instrument), alarm assessment, secondary inspection (identification), and response to MORC.

Abstract ID: 148

Incorporating Security into the Design and Transportation of Type B Packaging: Lessons Learned and Best Practices

Coel-Roback, R.[1], Zarling, J.[2], Wald-Hopkins, M.[1], Schultze, M.[3], Noss, P.[4], Taplin, T.[5]

[1] Los Alamos National Laboratory; USA
[2] NNSA Office of Radiological Security/Idaho National Lab; USA
[3] Oak Ridge National Laboratory; USA
[4] Orano Federal Services
[5] Department of Energy NNSA; USA

Corresponding Speaker: J. Zarling

The National Nuclear Security Administration (NNSA) and the Off-Site Source Recovery Program (OSRP), along with our commercial partners, have developed two different Type B containers to address the need for transport of disused radioactive sources recovered in the interest of national security. The first container developed, the 435-B, is an unshielded leak-tight container with a total maximum weight of 4,581 kg (10,100 lbs). The 435-B relies on the shielding of the radiological devices or the long-term storage shield (LTSS) that are currently authorized content for the container. To date, two production units have been fabricated and licensed, and a third is under construction. The first two units are being used to transport disused radiological sources and devices, primarily from medical and research applications, in the continental US.

The relatively light weight and small size of the 435-B make it easier to recover sources in congested areas, provide flexibility in the types of vehicles that can be used to transport it, and allow it to be transported in an intermodal container. The 435-B is designed to be transported by ground, air, or water. The features that contribute to the versatility of the 435-B may also make it more vulnerable to theft and present unique security challenges. During the design effort for the 435-B, the potential for security issues were taken into consideration. During fabrication, additional security features were identified, which in some cases resulted in the need for a revision to the Safety Analysis Report and a modified Certificate of Compliance. These revisions required additional time and money for what is inherently an expensive and time-consuming effort.

For a container of this size and ease of transport, tracking, detection, and delay measures are a necessity. A tracking and detection system was developed and installed on the container pallet and conveyance. This system was designed to avoid impact to the performance and operation of the container, and be used interchangeably with other containers. Simple delay measures have also been incorporated into the container to allow additional time for response.

The second Type B container developed by the NNSA, the 380-B, is a shielded container with a maximum total weight of 30,390 kg (67,000 lbs) and requires a dedicated trailer for transport. Although the size and weight of this container make it a less likely target for theft, security features have been built into the design as well. The first production unit of the 380-B is currently in fabrication and scheduled to be completed in spring 2019.

Incorporating security features into the initial design and testing/analysis of a new container will obviously save time and money. However, new technologies that can be used to enhance the security of packaging used for transportation of radiological materials are continually being developed. Using less specificity in describing or depicting non-safety significant features, and putting in language regarding optional delay or detect features, may allow for future security upgrades without necessitating revisions to certification documents. Avoiding specificity where not needed for the safety analysis of a container may in itself contribute to increased security, given that related documents are sometimes publicly available.

In addition to packaging design considerations, the NNSA's Office of Radiological Security has undertaken an evaluation of transportation security in the United States in cooperation with transportation security experts. The results of this assessment will be more concrete guidance for complying with US laws and regulations, and recommended best practices that can enhance the security of radiological shipments both in the US and internationally.

Abstract ID: 149

Strengthening of Integrated Operational Procedures for the Detection of Radioactive Material at Border from the Binational Perspective

Pazmiño, X.[1]

[1] Ecuador

Corresponding Speaker: X. Pazmiño

In conjunction with globalization and the development of international trade to generate wealth worldwide, new forms of crime that have diversified and increased in the area of crime have increased. However, to this end, a series of treaties and agreements have been created that oblige States and their governmental bodies to regulate and apply cross-border control measures under a binational cooperation framework.

Ecuador has experienced a transition in the inter-institutional coordination with the governmental entities, strengthening the actions of the National Police of Ecuador in several aspects such as the nuclear safety under the development of the established procedures for which through the Interinstitutional Agreement and under the precepts established legal, the creation of the Coordination Unit for the Control of Contingency in Border Zones was proposed, whose nature is the operative institutional coordination with all the police services at national and inter-institutional level, as well as the control in border areas; Its fundamental mission is to coordinate, coordinate and execute police operations in border areas for the control of illicit activities, so it is proposed to include specific procedures for the detection of radioactive materials, as a component of a global strategy that ensures that these materials do not they are subject to involuntary displacement or fall into criminal organizations. These procedures have a very broad connotation that the radiological detection with intelligence functions, risk assessment, and also the risk detection tool, with the use of the generated capacities for traffic control, aimed at strengthening the integrated operations and the exchange of information between the respective competent authorities in the matter of radioactive material, customs, security and intelligence control.

Parallel to the installation of gantries or commercial equipment to detect illicit traffic or the involuntary displacement of radioactive material, manual operational procedures with the use of portable means for detection to be very important and strengthen control operations, taking into account the type of instrument to be used, categorization of equipment, response levels, location, evaluation and response to radiological events at the border.

Control and surveillance are merged as a very important element of activities to prevent events related to the use of radioactive material as an object of illicit trafficking or as involuntary displacement, in one way or another the application of prevention mechanisms in Border crossings relate to the application of early warning systems to the Ecuadorian State and bordering countries, better counter the criminal action and the loss of control of vulnerable or orphan sources.

The world experience has indicated that one of the fundamental bases of any operation is the interinstitutional coordination of the governmental entities of a State, strengthening the responsibility of adding other institutions in the areas of criminal activity and radioactive control by formulating criteria of action and operational tactics of border control and unauthorized steps, programs that are applied in everyday life by law enforcement.

The following is a summary of the general phases that must be developed within the detection procedures with radioactive material at the border:

DIRECTORATE GENERAL OF OPERATIONS OF THE NATIONAL POLICE OF ECUADOR - COORDINATION FOR CONTINGENCY CONTROL IN BORDER ZONES GENERAL - PHASES OF THE DETECTION PROCEDURES WITH RADIOACTIVE MATERIAL IN BORDER**

PHASE 1 a. Strategic evaluation of the need for surveillance of radioactive materials at the border.

b. Selection of portable detection instruments suitable for monitoring.

PHASE 2 a. Determine levels of investigation and action according to the alarms received.

PHASE 3 a. Evaluation of the alarms obtained.

b. Response to alarms that have detected the presence of radioactive material.

c. Verification and location.

PHASE 4 a. Nature of the radioactive materials found.

b. Notification and integrated inter-institutional procedure.

c. Chain of custody for collection of radioactive material found.

d. Application of nuclear forensic investigation procedures.

e. Determination of illicit trafficking of radioactive material.

In conclusion, establishing integrated coordination mechanisms is an essential part of the response systems of binational institutions and government entities for the control of radioactive material or contaminated goods detected in border areas, adopting preventive actions associated with a bad practice or operation. undue The strengthening of response capacities should also be based on new creative approaches to this problem with an interdisciplinary vision, interrelating curricula and training programs in the prevention of transnational organized crime.

Engineer Ximena Bastidas Pazmiño

SECOND POLICE SERGEANT

TECHNICAL DEPARTMENT OF SECURITY AND RISK MANAGEMENT OF THE DIRECTORATE GENERAL OF OPERATIONS

NATIONAL POLICE OF ECUADOR

xbastidas18@hotmail.es

ximena.bastidas@policiaecuador.gob.ec

Abstract ID: 150

National Detection Strategy for Nuclear Security Detection Architecture – Case Study Indonesia

Yuwana, H.[1], Annisa, I.[1]

[1] Nuclear Energy Regulatory Agency of Indonesia (BAPETEN))

Corresponding Speaker: I. Annisa

National Detection Strategy for Nuclear Security Detection Architecture - Case Study Indonesia. The wide area of Indonesia's geographical condition is made up of islands and water (archipelagic country) becomes a challenge in conducting supervision, particularly from the aspect of nuclear security. The challenges on the oversight of nuclear security aspect is become a concern both in the national and international levels if linked to potential acts of terrorism. The nuclear security begin to draw particular attention after an increasing number of terrorism threats in which possible to occur anywhere and with unpredictable time and method. Potential theft of nuclear materials to create IND (Improvised Nuclear Device), theft of radioactive materials to make RDD (Radiological Dispersal Devices) and RED (Radiological Exposure Devices), or potential act of sabotage for nuclear facility/ installation, as well as when transporting radioactive material or nuclear material. Indonesia has enacted regulations related to national defense, security, intelligence, and nuclear energy. Indonesia has established RPMs in several main seaports used for the screening of individuals, vehicles, cargo or other entities for detection of illicit sources from or heading to the port. This requires the integration of a nuclear security system and an appropriate nuclear security measures in which could be described in the nuclear security detection architecture. Nuclear security detection architecture should be developed based on National Detection Strategy. Referring to the existing regulations in Indonesia may not describe prescriptively the concept of national detection strategy. The concept for the development of national detection strategy as a basis for establishing nuclear security detection architecture could consider the scope and national priorities, roles and responsibilities of each competent authorities, commitments and coordination mechanisms among competent authorities, threats assessment, assessment of the selection of nuclear security detection architecture and provisions of international cooperation arrangements.

Keywords: nuclear security, national, detection, architecture, development

Abstract ID: 154

International cooperation in HRD (Master programme in Nuclear Security)

Dimitar, D.[1]

[1] UNWE – Sofia; Bulgaria

Corresponding Speaker: D. Dimitar

Even a small nuclear explosion in a major city would immediately kill tens of thousands of people and cause even more deaths subsequently. A radiological dispersal device or "dirty bomb" would also have significant consequences for human health, property, and the environment. Radiological substances are used broadly in different sectors of industry, medicine and research. In the hands of terrorists, radioactive sources have considerable potential for malicious use to cause destruction, disruption, and fear. Radioactive substances are used in medical and industrial applications. This civil sector use of nuclear energy and radioactive isotopes is likely to grow, with increasing quantities of materials in use, storage, and transport. Strong, reliable, and effective governance is required to reach high standards in nuclear safety and security, and to ensure the use of nuclear technology for peaceful purposes.

Many initiatives tried to address the threat of nuclear terrorism. The scope of the current regime includes international agreements, UN Security Council resolutions, IAEA recommendations, and national actions. In addition, groups of like-minded states also have been assembled, such as the G-8 and the Global Initiative to Combat Nuclear Terrorism, which have taken useful steps toward strengthening nuclear security. In 2010 U.S. President Barack Obama has taken the nuclear security issue to the highest political level and it was followed by several Nuclear Security Summits.

One of the most important elements of this process is education. We need investment in personnel education and training in order to build cadres for regulatory bodies and nuclear medicine operators, as well as other radioactive sources applications.

Nuclear security is a multidisciplinary challenge. It requires cooperation between many stakeholders at world, regional and national level, and cooperation between educational organizations, governmental and non-governmental bodies. It requires a strategy to strengthen nuclear security in developing countries with a multifaceted approach and the concerted efforts of multiple stakeholders to ensure positive results. It could serve to reduce the threats of nuclear and radiological terrorism, protect collective health and the environment from accidental dispersion and contamination, and reduce and eliminate other security vulnerabilities. In the academic community there is evidence that a shift has occurred in the field of education and training and attention should be given to how best to sustain new educational initiatives launched recently.

One of these initiatives in the launch of International Master Programme in Nuclear Security according to the requirements of IAEA NSS 12 and efforts of IAEA staff and International Nuclear Security Educational Network (INSEN). Several university consortia in the world, among them University of National and World Economy in Bulgaria, has taken steps in providing this Master programme. The already accumulated 3 years' experience in Bulgaria gives the opportunity to draw conclusions and to show the challenges facing the programme. The programme is a successful example of cooperation between international organization (IAEA), National governments, Universities from all over the world and business organisations.

Currently, this is the only Programme in the world. We already had one group of 11 foreign students from developing countries, who successfully graduated, and currently we have the second and the third group of 11 and 10 students, already studying in Bulgaria. The programme has a big potential for development and improvements, which includes and requires cooperation between different stakeholders, among them IAEA, EU, UN organizations, national governments and business. This cooperation could include lecturers, fellowships, visits, educational material with continuous support and cooperation with IAEA.

The target audience of the Master programme are nuclear regulators, nuclear operators, transport and transport companies, MoI, Ministry of Defense, Energy, Interior Ministry, intelligence services, disaster response services, border services, equipment manufacturers, policy students- all of them at national and international level, in fact very broad community. These people are interested in this topic and the curriculum is oriented towards them in accordance with IAEA NSS 12. The IAEA is providing fellowships for 6-8 students per year from developing countries and their study in Bulgaria.

Currently we are trying to receive additional support from relevant European structures, again jointly with the IAEA. This is not a University or even Bulgarian project. It should be concerted effort of interested stakeholders and the hope is that it will make the program sustainable. Main challenges in the future of the programme are related with the selection of candidates, need of project management and funding, teaching methods, as well as development of new relevant disciplines, where we have fast technological advances, for example in the field of cyber security.

Abstract ID: 155

The Use of Innovative Approaches in the Search for and Regaining Control Over Orphan Radioactive Sources in the Republic of Moldova

Balan, I.[1], Lee, B.[2], Kalinina-Pohl, M.[2], Potter, W.[2]

[1] Regulatory Body NARNRA; Republic of Moldova
[2] Middlebury Institute of International Studies at Monterey, James Martin Center for Nonproliferation Studies; USA

Corresponding Speaker: I. Balan

Content

The problem of finding and establishing control over orphan radioactive sources (materials) is very important, as it is one of the most effective measures to reduce the threat of obtaining such materials by criminal groups.

At the same time, in the process of performing regulatory functions, the problems associated with radiation safety involving more common household products have been identified. These problems are manifested in the uncontrolled spread of various radioactive items or small-sized radioactive sources, for example, parts of special instruments such as smoke detectors, ice thickness sensors, detectors from measuring equipment, etc.

Due to their specific properties, these devices can be detected and identified by analyzing open source information on the Internet, using primary data about the type of activity of an enterprise or an economic agent, identifying and conducting an online survey of employees who worked at these enterprises, or using keyword searches related to equipment containing radioactive sources and also the field of application of this equipment. As a part of a cooperation agreement between the National Agency for Regulation of Nuclear and Radiation Activity (NARNRA) of the Republic of Moldova and the James Martin Center for Nonproliferation Studies (CNS), NARNRA provided CNS with a list of 101 enterprises for such open source analysis.

Based on these preliminary data, CNS collected background information on each enterprise and mapped their locations. CNS also used this list to identify former or current employees of these enterprises through publicly available social media. It then conducted a network analysis establishing a link between workers and employers to identify individuals who would have more connections to other employees.

In parallel with these actions, CNS and NARNRA developed a questionnaire to be used directly during personal interviews with former or current employees of enterprises that used or stored radioactive sources, or through Internet surveys. As of the end of March 2018, 41 individuals participated in personal interviews or online surveys and about 400 orphan sources (category IV and V) were discovered as a result of these efforts.

Such collaboration has led NARNRA to explore other approaches to the open source analysis. One of them targeted devices in transport vehicles (aircraft, railway transport or water transport) containing radioactive sources or substances, or special equipment with radioactive sources. It was established that most frequently encountered radioactive sources from aircraft are sources based on Strontium/Yttrium-90 "BIS-1" or "BIS-3" as part of "RIO-1" or "RIO-3"-type icing sensors installed on old Soviet-era helicopters Mi-2, Mi-8, Mi-17, An-24, An-26 and on some models of Yak-40 aircraft.

It was also recognized that radioactive sources based on Nickel-63, Plutonium-238 and 239, Thorium-232, and other radioactive sources, are present in the measuring instruments (gas-liquid chromatographs (“Tsvet-500”, “Tsvet-550”, etc.) and infrared spectrometers and other measuring equipment - Strontium/Yttrium-90 and Cesium-137. Virtually all sources belong to IV or V categories.

The obtained results confirm that these innovative methods of searching for and establishing control over orphan radioactive sources are time- and cost-effective. They can be successfully applied by different countries to ensure radiation safety and security, thus reducing the threat of radiological terrorism.

Abstract ID: 156

Reviewing the Prescriptive-based Regulation of the Continental Shelf Territory of Indonesia for Regulating Security of Radioactive Sources

Nirwono, M.[1], Lee, S.[1], Syuryavin, A.[2]

[1] Kyungpook National University; Indonesia
[2] BAPETEN; Indonesia

Corresponding Speaker: A. Syuryavin

Indonesia is the largest archipelagic state and internationally recognized. However, the development of national law must also be in line with changes in international relations in international forums. This study is a review research regarding the prescriptive type of radioactive sources security regulation that is adopted by the Indonesian government to regulate the implementation of nuclear security regime throughout Indonesia. In this study, it will be analyzed the specific characteristics of Indonesian regulation. The approaches concept used, and how the prescriptive regulation is implemented in the Indonesian archipelago. Valid and reliable data from related ministries and institutions are extracted to analyze and reveal the specific behavior of the regulations. The position of the regulation among international law also discussed. The results show that radioactive source security regulation developed by Indonesia tends to a prescriptive regulation than performance one. The advantages of this type of regulation is the simplicity in controlling and supervising the application of nuclear and radiation facilities and a good understanding of licensees in conforming the nuclear security requirements asked by the regulations. However, some disadvantages also are revealed. Some limitations due to financial constraint and a huge variation in radioisotopes activity used have triggered some problems and complain.

Abstract ID: 157

Enhancing Security System of Irradiation Facility in Vinca Institute, Belgrade – Serbia

Vujcic, I.[1], Masic, S.[1],

[1] Vinca Institute for Nuclear Sciences; Serbia

Corresponding Speaker: I. Vujcic

Irradiation facility for industrial sterilization of medical equipment and food conservation that is part of the Vinca Institute for Nuclear Sciences is the only plant of this type in Serbia. Irradiation facility provides commercial services to industry mainly in the fields of sterilization of medical devices, food irradiation and modification of polymer insulators. It has the maximum capacity of 25.000 m3 irradiated products per year and it has operated since 1978. The facility core is cobalt–60 gamma irradiator with wet storage working in batch mode. The current activity of source is around 100 kCi. The facility is designed for the maximum value of 1 MCi.

Risks associated with the use of radioactive materials are numerous. Legislation in Serbia strictly prescribes the conditions of use of radioactive material in order to protect the exposed personnel, the population, and the environment. There is also a threat of nuclear terrorism in all plants with radioactive sources. Therefore, in 2016, in the Radiation Unit of the Vinca Institute, a new security system was established. This innovative security system was created in cooperation with International Atomic Energy Agency (IAEA), Department of Energy USA, (DOE) and Vinca Institute.

Access to the control room and the source is enabled only for employees whose biometric data is inserted into the database. This is enabled by setting up the palm vein scanner at the entrance to the control room. This system is very reliable and practically impossible to forge because vein patterns exist inside of the body, it is practically impossible to recreate someone's biometric template. The sensor of the palm vein scanner needs the hand and blood flow to register an image. The palm vein reader has a high tolerance for skin surface problems. The new security system provides video surveillance of the entire plant. Also, a new alarm station was created. Armored security doors were placed in the warehouse and the control room. As a part of the improvement of the security system, the new radiation detector at the entrance to the labyrinth is added. A new fire department was also installed. All of these systems are connected and monitored 24 hours a day at the central alarm station located in a separate location within the Institute.

In this paper, a detailed overview of the new innovative security system installed on the Radiation Unit of the Vinca Institute is presented. All listed parts of the system are presented. A detailed description of the functioning of each individual component of the system is given. Also, some future possibilities for improving the system are presented.

Abstract ID: 160

Robust and Flexible Design of Neutron Scintillation Detector Based on Wavelength Shifter and Silicon Photomultiplier

Osovizky, A.[1], Ginzburg, D.[1]

[1] Radiation Detection Department, Rotem Industries Ltd; Israel

Corresponding Speaker: A. Osovizky

The design of portable neutron detectors for the use in the radiation security applications is prescribed mainly by the dedicated standards [1, 2]. Neutron detection for this purpose is mainly based either on gas filled tubes or based on scintillation detectors. While the gas filled tubes are limited in their flexibility in dimension and shape, scintillation detectors are being more flexible and compatible to portable instrumentation. Moreover, in recent years, the neutron detection has been thwarted by the He3 worldwide shortage [3]. The uniqueness of the He3 counters is both, in its efficiency and gamma-ray rejection. The gamma-ray rejection is of special concern in security and border control applications. These considerations make the scintillation detectors solution preferable and more accessible. Scintillators can be divided into hygroscopic crystals, such as the LiI(Eu), and non-hygroscopic solutions such as the 6LiF:ZnS(Ag) screens.

The 6Li(n,α) reaction is one of the three well established methods to detect thermal neutrons (the other two are 10B(n,α) and 3He(n,p)) [4]:

6Li + n --> 3H1 + 4He2 + 4.78 MeV

The use of silver-activated zinc sulfide ZnS(Ag) thin screens is widely known for its scintillation properties and are used primarily for alpha particle or other heavy ion detection.

In this work we propose a solution that is based on the SiPM coupled to a 6LiF:ZnS(Ag) scintillator [5]. The neutron interaction with 6Li enriched atoms in the LiF is converted into light signal by scintillating mechanism of the ZnS(Ag), that is further detected by the Silicon photomultiplier.

The neutron capture probability is defined by the cross section and the number of atoms per unit volume. The thermal neutron absorption cross section of Li is 941 barns and is lower than the cross section of 3He (5330 barns); however, due to the very high 6Li atom density (~1022 atoms/cm3) the LiF scintillator provides a high neutron capture probability of about 75% for 0.025eV for thickness of 1 mm.

When the neutron is absorbed, a 2.06 MeV alpha particle and a 2.74 MeV triton are ejected in opposite directions. These alpha particles and tritons travel for a few microns in the scintillation compound (α ~0.007 mm, T ~0.04 mm) losing energy and exciting the ZnS(Ag) phosphor. This yield up to 170,000 blue light photons per neutron with peak luminescence wavelength of 450 nm.

Since the ZnS(Ag) scintillator is opaque, only a thin layer (about 0.5mm) can be used effectively. This limits the detection efficiency. In order to compensate this limitation, a larger scintillator surface is needed; however, this leads to a challenge in light collection. In order to maintain the size advantage of the SiPM the light can be gathered by a light guide that increases dramatically the detector volume. Another option is to use a wavelength shifter (WLS).

The WLS absorbs the emitted light photons and re-emits light photons with longer wavelength, which are then conducted to the SiPM. The WLS dye concentration determines the light absorbance sensitivity and also the transparency to the re-emitted light. For thinner WLS configurations a higher dye concentrations should be used. In this study a new WLS produced by the Institute of Scintillation Materials, Kharkov, was tested. The WLS has a very high efficiency for absorbing the ZnS(Ag) blue light photons and re-emitting at wavelength with low probability to be re-absorbed by the WLS. The neutron detection performance of two WLS configurations see Figure 1, with different dye concentration and thickness will be presented in this work.

Figure 1. Absorbance and transmittance of 3 mm and 10 mm WLS with dye concentration of 600ppm and 200ppm, accordingly.

References:

[1] American National Standards for Homeland Security, ANSI N42.32/33

[2] IAEA nuclear security series No. 1, Technical and Functional Specifications for Border Monitoring Equipment

[3] Kouzes RT. 2009. “The 3He Supply Problem.” Pacific Northwest National Laboratory White Paper PNNL-18388.

[4] G.F. Knoll, Radiation Detection and Measurement - 3rd edition (Chapters 14 and 15), John Wiley & Sons, 1999.

[5] Eljen EJ-426 datasheet.

Abstract ID: 161

Lessons Learned from adversaries 'perfected' activities in Kenya

Kaboro, B.[1], Gatebe, E.[1]

[1] Radiation Protection Board; Kenya

Corresponding Speaker: B. Kaboro

Kenya, through the regulatory authority, has been active in ensuring security of radiological sources from falling into wrong hands. In line with this, installation of physical security upgrades of facilities with radioactive sources falling under IAEA category I and II has been completed. These is not only from the results of strong emphasis from the IAEA [1], but also due to vulnerability of radioactive sources in the country, where terrorism has been real. However, studying from recent criminal 'perfected' activities in the country, there is need not to be complacent, but seek to learn lessons from how they are being planned and executed. This paper highlights recent adversaries 'perfected' tactics in Kenya in accomplishing their malevolent acts. It also seeks to sensitize the Government to review existing threat assessments and find ways to implement them, in an effort to ensure that the responsible actors are always ahead of such adversaries.

Insecurity has been one of the major concerns in the country. Kenya has been a victim of terrorism before, following numerous attacks in the recent past, most of which have been fatal. Some of these attacks include: bombing of US Embassy in 1998, where 290 people died; Westgate Mall attack in Nairobi city in 2013, where 67 people lost their lives; Garissa bus attack in 2014 where a dozen people were killed; and the horrible attack on a public university in Garissa in 2015, that killed 148 people. In these attacks, terrorists have used conventional devices such as explosives, riffles, guns and pistols. However, becoming aware that terrorists are now becoming more organized in networking, skills and using advanced technology; the use of sophisticated materials such as nuclear and other radioactive materials might be one of the considerable options. With this in mind, there is a dire need for the country to study adversaries' behavioral changes, technology used, employed tactics, among others, and find counter measures, to ensure that they are way ahead of them. Studying from such 'clever' behaviors in robbery, thefts and other criminal activities in Kenya would be the best way to start with, which may provide good data for evaluation.

One of the examples of these ‘perfected’ robberies in Kenya was the theft of currencies worth about 5 million dollars at a well-guarded KCB bank in Thika town, which is about 50 km from Nairobi city in November 2017 [2]. Three young men who were fresh graduates from a local university rented a stall in a building close to the bank and pretended to sell stationery [3]. For the next 6 months, the culprits dug a 30-meter tunnel, reinforcing it with steels, to the bank strong-room in what was seen as a well-planned action. They managed to get to the bunker and opened the safe undetected, and went with the loot! Another example to learn from is the robbery of criminals who drilled through a walls of Equity bank in Kayole Nairobi in November 2016 [4]. An unknown number of people drilled through the rear walls of the bank premises and made away with currencies worth of several million dollars. They also welded through cash deposit units of ATM machines attached to it and cleaned them out. These criminals were able to disable CCTV surveillance and alarm systems during the break in. These two examples are just a few of the reported well planned and executed robberies in Kenya.

These cases provide examples of existing threats for radioactive material, noting that banks are more secured than even facilities housing category I radiological sources. Adversaries could still use the same well calculated planned or even more advanced strategies to access radiological sources, which could be both harmful and dangerous if used maliciously. This paper will study adversaries employed tactics and change in their behaviors. It will also critically evaluate associated threats to radiological sources, and suggest possible countermeasures to ensure more enhanced national security.

References

[1] IAEA/NSS No. 11 (2009); Security of Radioactive Sources; Implementing Guide; International Atomic Energy Agency, Vienna.

[2] Kenya News | 2017-12-25; by Jacob Onyango, Crime Category. Retrieved from https://kenyannews.co.ke/tuko-news/armed-robbers-busted-while-trying-to-break-into-another-kcb-branch/

[3] The Daily Updates | 2017-12-25; Retrieved from http://thedailyupdates.co.ke/ 2017/12/25/thika-kcb-bank-theft-planned-executed/

[4] The-Star Kenya News | 2016-11-07; Retrieved from https://www.the-star.co.ke/ news/2016/11/07/robbers-break-into-kayole-equity-bank-steal-atm-machine-with-cash_ c1451095

Abstract ID: 167

Aspects of Nuclear Security during the Re-Export of Unused Sources of Co-60 in Paraguay

Invernizzi, F.[1], Florentin, R.[1]

[1] Autoridad Reguladora y Nuclear (ARRN); Paraguay

Corresponding Speaker: F. Invernizzi

This paper its presents the related aspects of Nuclear Security that were taken into account and carried forward from the beginning of the procedures for the re-export process of 5 (five) unused sources of Co60 from Paraguay until its re-export in March 18 of 2018. The Radiological and Nuclear Regulatory Authority (ARRN by Spanish name) of Paraguay was the institution in the country that carried out the Coordination of work whose planning lasted for more than a year. A Nuclear Security Committee has been created and a Nuclear Security Rules of radioactive sources has been approved in Paraguay. All relevant aspects related to the physical security during transport as well as the physical security of the sources during the storage conditioned in the containers in 3 different sites where they were located were documented. For the country it has represented an experience of great importance considering that these sources were the most relevant from the point of view of associated risk.

Abstract ID: 182

Cooperation on Radioactive Materials Transportation Security: Beyond the signed agreement

Cervera, M.[1], Tardiff, A.[1], Sapountzis, A.[1], Jackson, G.[1]

[1] United States Nuclear Regulatory Commission; USA

Corresponding Speaker: M. Cervera.

The physical protection of radioactive materials in the U.S. has expanded due to the potential for malevolent use, and thus more focused attention on security and control of these materials following the events of September 11, 2001 and continuing threats of malicious use. The Category 1 and 2 quantities of radioactive sources listed in the International Atomic Energy Agency (IAEA) Code of Conduct on the Safety and Security of Radioactive Sources are considered the most risk significant for the Unit-ed States and have been the focus of Federal and State efforts to place tighter controls for security - especially during times of elevated risk of loss, theft, and diversion, such as during transport. Transportation security of these risk-significant materials is especially complex due to the number of U.S. Government agencies that have various roles and authority for implementation and enforcement of applicable regulations. This paper will focus on two major topics: 1) the significant progress that has been made with regard to interagency coordination and communication on the secure transportation of radioactive materials within the U.S. or across U.S. borders with the promulgation of 10 CFR Part 37 in 2013; and, 2) the ongoing activities to improve and streamline cooperation with the implementation of the commitments made in the Memorandum of Understanding (MOU) titled,"Memorandum of Understanding Among the Department of Homeland Security, the Department of Transportation, and the U.S. Nuclear Regulatory Commission Concerning Cooperation on Radioactive Materials Transportation Security."

The regulations that NRC established modified security requirements for the use and transport of risk significant radioactive materials, as well as for shipments of small amounts of irradiated reactor fuel. Elements of these regulations address areas such as preplanning and coordinating shipments, advance notification of shipment details to the NRC and U.S. States through which the shipment will pass, and control and monitoring of shipments that are underway. Cooperation between various agencies of the United States and the individual states is conducted via formal agreements. This paper will present the

MOU process, the goals of the MOU, the scope and composition of the working groups, and finally the challenges encountered in implementation of the signed agreement.

Abstract ID: 183

US NRC's Evaluation for Category 3 Sources: Is increased protection and accountability necessary?

Cervera, M.[1], White, D.[1], Wu, I.[1]

[1] United States Nuclear Regulatory Commission; USA

Corresponding Speaker: M. Cervera

Given the Nuclear Regulatory Commission's (NRC) experience with the regulation of higher activity sources and in response to audit findings by the United States Government Accountability Office (GAO), the NRC took specific actions to evaluate whether it is necessary to revise NRC regulations or processes governing source protection and accountability for Category 3 sources.

Specifically, the NRC conducted the following tasks:

1. An evaluation of the pros and cons of different methods of requiring transferors of Category 3 sources to verify the validity of a transferee's license prior to transfer;

2. An evaluation of the pros and cons of including Category 3 sources in the national registry for Category 1 and 2 sources: the National Source Tracking System (NSTS);

3. An assessment, based on these evaluations, of these and any additional options for addressing the source accountability recommendations made by the GAO;

4. A vulnerability assessment which identifies changes in the threat environment between 2009 and today that argue in favor of or against expansion of the NSTS to include Category 3 sources;

5. A regulatory impact analysis of the accrued benefit and costs of the change, to include impacts to the NRC, Agreement States, non-Agreement States, and regulated entities;

6. A discussion of potential regulatory actions that would not require changes to regulations to include changes to guidance, training, and other program improvements; and

7. Any other factors arising from assessments that would bear on the NRC's deliberation on a proposed change.

The NRC also assessed the risks posed by the aggregation of Category 3 sources into Category 2 quantities and to collaborated with its Agreement State partners, non-Agreement States, regulated entities, public interest groups, industry groups, and the reactor community. Additionally, the NRC considered the results of the assessment of the security requirements in 10 CFR Part 37, ‘‘Physical Protection of Category 1 and 2 Quantities of Radioactive Material,’’ that was published in December 2016 as part of this review.

In the interest of fully informing the public of the NRC's evaluation of Category 3 source security and accountability, the NRC requested specific feedback from stakeholders and held extensive public meetings. The information received from this stakeholder outreach helped the NRC to fully assess the regulatory impact for any recommendations related to Category 3 source security and accountability.

The results of the evaluation were documented and submitted in August of 2017. This presentation will describe the process the NRC used to conduct the evaluation and develop the options under consideration, and summarize the stakeholder feedback to the issues.

Abstract ID: 194

Experiences of Security During Transportation of Radioactive Material in Malawi

Manda, C.[1], Mandoloma, L.[2]

[1] Environmental Affairs Department, Ministry of Natural Resources, Energy and Mining; Malawi

[2] Lessah Mandoloma; Malawi

Corresponding Speaker: C. Manda

Malawi is a land locked country located in Sub Saharan Africa. The country boarders with Tanzania to the north, Zambia to the west and Mozambique to the south. A good road infrastructure connecting the boarders has been developed to facilitate import and export of goods and services. Uranium mined at Kayerekera Mine in the northern part of Malawi has been the major source of radiation triggering radioactive material security in the country. Production at the mine began in 2009 and halted in 2014. Over the production years, uranium has been transported by road from Karonga to Mchinji boarder through a distance of approximately 650 KM then through Zambia to Namibia. This study sort to showcase the experiences of security during transportation of uranium concentrates in Malawi. Specifically the study targets the regulatory environment and coordination among the stakeholders during transport of radioactive material.

The paper employed a secondary review of the literature on the statutes, regulations and guidelines prevailing of security during transportation of radioactive material in Malawi. Key informant interviews were conducted to document the experiences in the coordination and transportation of uranium concentrates in Malawi. In particular, the study reviewed Paladin transport plan and guidelines for Safe Transport and Security in Transportation of Radioactive Material in Malawi.

The study observed that the Atomic Energy Act (2011) makes provision for safe and secure transportation of radioactive material. The law through Section 58, places a requirement for a license to transport radioactive material. Furthermore, the Act calls for development of radioactive material transport regulations. The transport regulations were developed in 2016 and are awaiting enactment. Subsidiary atomic energy regulations of 2011 compliments the Act through providing security

requirements for importation and export of different categories of radioactive materials and radioactive waste. The regulations also defines a fee structure for a transportation license.

Recognizing the inadequacy of national regulatory infrastructure on security of radioactive materials during transportation, Malawi in retrospect developed the guidelines on safe transport and security in transportation of radioactive materials and Intergraded Nuclear Security Support Plan (INSSP). The INSSP and guidelines were developed in 2014 and 2015 respectively. These guidelines provide security levels for the safety of radioactive materials during transport, basic security principles, responsibilities for various parties (MDA, operator, consignor, carrier, and consignee) and packaging requirements. Despite of the guidelines being developed after halting of uranium production, Paladin has been operating using a transport plan which outlines the transport plan and emergency response procedure for uranium oxide concentrate (UOC) during transportation. The plan adheres to the IAEA security requirements and transport guidelines and national regulatory infrastructure. The plan provides for appropriate packaging of UOC, labelling, placarding, inspections, response procedures and consignor responsibilities.

Despite of the country's challenges of lack of an operational competent and independent authority; and lack of resources both financial and technical; the national regulatory framework with complimentary international laws, regulations and facility transport plan provides an opportunity for an effective security regime during transport of radioactive material.

Abstract ID: 196

Cradle to Grave Control of Sealed Radioactive Sources in Uganda

Menya, R.[1]

[1] Staff of Atomic Energy Council; Uganda

Corresponding Speaker: R. Menya

Radioactive Sources have been extensively used in Uganda for decades in various fields such as; Nuclear medicine, well logging, industrial radiography and radiotherapy among others.

There are radioactive sources out of regulatory control that already exist or orphan sources entering illegally in Uganda which pose risk to members of the public or contaminate the environment if safety measures are not put in place. Moreover, they might be acquired by unauthorized persons and used for malicious purposes that can cause radiation exposure to the members of the public and the environment.

During inspections, it has been noted that facilities have inadequate security measures and security culture for radiation sources in use, storage and transportation. The Atomic Energy Regulations, 2012 do not have detailed requirements pertaining to security of sources. The country currently has no centralized storage facility for recovered orphan sources. When found, they are stored temporarily at facilities with storage bunkers. As the control of such temporary storages is very challenging, the construction of a Centralized Temporary Storage Facility is underway. In addition, the inter-Agency collaboration in the field of security is inadequate. If sources are not properly secured, they can easily be accessed by adversaries for harmful purposes.

To-date Uganda faces a number of challenges in management and control of orphan sources. Shielding materials for radiation sources are often used as raw materials in recycling companies and if the source is not removed from the shield may be melted. In addition, orphan sources can be a result of illicit trafficking or inadequate security and storage measures at the facilities.

In order to combat such a situation, a systematic strategy for regaining control over orphan sources has been developed to reduce undue radiation risks associated with unregulated sources. This is the first strategy tackling orphan sources in Uganda.

The author highlights some of the measures such as operationalise the centralized temporary storage facility immediately, carry out administrative search as well as physical search during inspections in all facilities to find unknown disused sources among others taken towards control of the radioactive sources and future priorities for implementing the strategy to ensure control is regained in the country over the radioactive sources.

Keywords: Radioactive sources, Orphan sources, Temporary storage facility

Abstract ID: 200

Strengthening Information Exchange and Experiences Between Competent Authorities including Neighboring Countries for Lost, Stolen or Illicit Trafficked Radioactive Material in Uganda

Sekyanzi, D.[1]

[1] Atomic Energy Council; Uganda

Corresponding Speaker: D. Sekyanzi

In Uganda, radioactive sources is widely used for peaceful purposes in the medical, industrial, education and research. Such practices range from radiotherapy and nuclear medicine in the medical field to nuclear gauging, industrial radiography and well-logging in the industrial field, among others.

Radioactive sources in the past have either got lost, stolen or illicitically trafficked by adversaries both knowingly and unknowingly with a few reported cases from competent authorities for example in 2002 the Criminal Investigation and Intelligence Department (CIID) of the Uganda Police Force (UPF) impounded an old rusted Canister containing a Cobalt 60 source which was transferred to a bunker in a Referral Hospital for safe custody but later went missing in July 2007 and to date it has never been found. Similar cases were reported in 2003, 2008 and recently in 2015 when Uganda Revenue Authority (URA)-customs impounded a suspicious package containing rock samples of Uranium ore (as later identified by Atomic Energy Council) which was being trafficking to an unknown destination through the western Mpondwe border with the Democratic Republic of Congo. No arrests were made.

Additionally, in 2015, during routine inspections by Atomic Energy Council (AEC) at an old abandoned Cobalt plant in western Uganda, 2 Cs-137 Nuclear gauges were found missing. The operator was in final stages of winding up business and the old mine appeared to be partially abandoned with a few security officers on site. A visual and physical search was conducted a week later by the AEC team but no sources were recovered. The case was reported by AEC to UPF-Counterterrorism department, and investigations are still on-going till today.

Atomic Energy Council through its Memorandum of Understanding (MOU) with URA-customs signed in 2015, identified the need to exchange information and experiences with competent authorities regarding lost, stolen, abandoned and trafficked sources within the country and across its neighbors. The competent authorities include: AEC, URA-Customs, Security agencies, the Uganda Police Force, Border Control personnel, Civil Aviation Authority, Ministry of Foreign Affairs, Ministry of Internal Affairs, Ministry of Health, Office of the Prime Minister among others. AEC through its bid to strengthen information on the International scale within the region signed MOUs with Tanzania Atomic Energy Commission (2015) and "Comité National de Protection contre les Rayonnements Ionisants" of the Democratic Republic of the Congo (2016). A draft MOU with the Kenya Radiation Protection Board is under discussion.

A number of competent authorities maintain information in their databases that need to be shared for purposes of securing radioactive sources within the region. Such information include among others: authorized users, sellers and practices involving ionising radiation (AEC); location and number of radioactive sources (AEC); importers, transporters and exporters of radiation sources (URA); reported cases of lost sources (AEC and UPF); criminal investigations regarding illicit trafficking of sources (UPF, URA-Customs and Security Agencies). These databases are hardly shared due to poor coordination between the competent authorities.

This paper discusses the mechanisms that AEC is to go through to strengthen the interface between competent authorities and also the regulatory bodies in the neighboring countries to ensure that vital information and experience is shared for purposes of securing the storage, transport and use of radioactive sources in the region.

Keywords: Lost, stolen or illicit trafficked Radioactive sources, Information Exchange and Sharing Experiences.

Abstract ID: 208

The Status and Progress of Securing Radioactive Materials in Malawi

Gamulani, C.[1]

[1] Atomic Energy Regulatory Authority; Malawi

Corresponding Speaker: C. Gamulani

This paper aims at exploring the efforts, challenges, opportunities and progress in securing radioactive materials in Malawi. Malawi became a Member State of the International Atomic Energy Agency (IAEA) in 2006. In that case Malawi is relatively a new Member State of IAEA. Upon becoming a Member State of IAEA, Malawi started seriously implementing programmes to establish its regulatory infrastructure for radiation safety and protection, and for the security of radioactive sources. Through the IAEA Technical Cooperation programme Malawi initiated the establishment of its regulatory infrastructure for radiation safety and protection, and for the security of radioactive sources.

With the global interest in ensuring security of nuclear and radioactive sources, Malawi initiated the implementation of programmes with the aim of ensuring security of nuclear and radioactive sources. Despite having few years in implementation of regulatory infrastructure for radiation safety and protection, and for the security of radioactive sources, Malawi is challenged to improve its nuclear security regime to match with the global standards so that security of nuclear and radioactive sources is achieved. This paper takes you through the journey Malawi has been taking and the progress in securing radioactive materials in Malawi.

Abstract ID: 212

Formulation of a Regulatory Plan for the Control of Security

Ramos, I.[1]

[1] Autoridad Reguladora; Ecuador

Corresponding Speaker: I. Ramos

Considering that facilities where radioactive sources of categories 1, 2 and 3 are handled, used or stored should security, in accordance with the evaluation of the threats, the nature of these and the consequences derived from the unauthorized withdrawal.

In Ecuador with the purpose of knowing what is the real situation in relation to security in the different facilities that own and use radioactive sources and taking advantage of the visit of experts from the IPPAS mission, as well as experts from the IAEA whose objective was to train to the inspectors of the Regulatory Authority on how to perform security inspections in radioactive facilities, for which 5 facilities using radioactive sources were selected in both medicine and industry, in order to assess factors such as access control, reliability of people, protection of information, preparation of a physical security plan, training and qualification of personnel, accounting, inventory and notification of events.

As a result of these evaluations, the following was found:

1. There are no legal requirements for the operator to report nuclear security events to the Regulatory Body or another Competent Authority.
2. The security plan should consist of more than just procedures. It should encompass all information concerning how the operator meets the regulatory requirements. As there are as yet no requirements, there is no formal security plan
3. During the visits to five facilities using and/or storing radioactive sources, we observed that some safety measures could be used to fulfill security functions. For example, during the visits to the hospitals, we observed that CCTV cameras for control of the patient conditions in hospitals also could be used as a security measure for detection. Doors, walls and other special elements for safe use and storage of radioactive sources are considered as physical barriers preventing access of adversaries to radioactive sources.
4. Some installation implements the defense in depth through the application of sequential and diverse barriers (e.g. steel cage surrounding a concrete floor vault) both of which must be defeated to gain access to the radioactive source when in storage.

5. Defense in depth requires that redundant and diverse means of achieving detection be implemented. A security plan should consist of more than just procedures.
6. The security plan should describe the overall security system in place to protect the radioactive material and should include measures to address an increased threat level, response to nuclear security events and the protection of sensitive information.
7. The installations must develop a contingency plan, identify foreseeable nuclear security events, provide initial planned response actions, and assign responsibilities to appropriate operator personnel and response personnel.
8. Implement detection and assessment measures for any attempted or actual intrusion which could have the objective of unauthorized removal or sabotage of radioactive material. Detection may be achieved by such means as visual observation, video surveillance, electronic sensors, accountancy records, seals and other tamper indicating devices, and process monitoring systems.

The Regulatory Authority of Ecuador through the Directorate of Licensing and Radiological Protection is working on the regulations for nuclear security of nuclear and other radioactive materials, in order to establish the principles and minimum security requirements for nuclear and other radioactive materials, including security levels, categorization, and the prevention of unauthorized access, unauthorized removal, or sabotage thereof, to protect persons, property, society, and the environment from unacceptable radiological consequence that could result from inappropriate or malicious actions with radioactive material and associated facilities.

Considering the established in the Code of Conduct in relation to each State must establish or define the internal threats and assess the vulnerability in relation to said threats, based on a potential loss of control and malicious acts involving one or more sources radioactive, We are working in the analysis of threats jointly with other involved institutions such as the Secretary of Intelligence, Ministry of Defense, Armed Forces, National Police. We have held working meetings in order to identify threats in which radioactive material may be involved within the country's threats.

Knowing the type of threat, whether internal or external, the degree of risk for each installation can be determined and therefore the level of protection required for each installation will be commensurate with the potential danger that it poses.

Abstract ID: 219

Regulatory Management to Ensure the Security of Radioactive Sources in Viet Nam

Nguyen, T.[1]

[1] Vietnam Agency for Radiation and Nuclear Safety; Viet Nam

Corresponding Speaker: T. Nguyen

Currently, Viet Nam has approximately 600 facilities that use and temporary storage of total more than 5000 sealed sources. Of which more than 2000 sources are in use and nearly 3000 sources are in temporary storage. Most of these sources are being applied in industry, medical, research, education and other fields.

From 2014 up to now, in Vietnam, it has also existed some cases of insecurity and illegal transfer of radioactive sources, mainly in industrial application, which are disused source, therefore it is not strictly managed.

Measures to strengthen management to prevent and detect for insecurity of radioactive sources of Vietnam's Regulatory Body

To enhance the ensuring for security of radioactive sources, effectiveness of the implementation of policies and laws in the atomic energy field, the Regulatory Agency on radiation safety in Vietnam has focused on the following issues:

- Reviewing the shortage of relevant legal provisions and developing related legal documents to enhance on supporting for detection, prevention and response to acts of appropriating, sabotaging, transferring or illegally using radioactive sources, the risk of loss of security of radioactive source.
- To strengthen the training and equipment for security forces at all levels from the government to local, to strengthen the State management of security of radiation sources, especially mobile radioactive sources.
- Maintaining the transmission system of the Integrated Nuclear Security Network between the General Department of Customs, the Customs Sub-Department of Noi Bai International Airport and the VARANS; A collecting radioactive warning situations and remotely assisting and counseling for customs forces; Coordinating with the Customs

Organization to organize training courses on detection, prevention and treatment for radioactive sources for their officers.

- Establishing the supervision system to ensure security of mobile radioactive sources, Metal and Steel Collection and Recycling Facilities in Vietnam; Participating in the development of the GPS system for tracking of radioactive source under the Project “GPS system for tracking of mobile radioactive source in industrial radiography – RSLTS” in the Tripartite Cooperation Project with the International Atomic Energy Agency and Korea.

- Enhancing inspection, verification to ensure the security of radioactive in Viet Nam.

In parallel with implementation the measurement to strengthen ensuring the security sources mentioned above, Vietnam still faces to certain challenges due to the current tendency of, illegal import radioactive substances into Vietnam increases rapidly. This potential risks raised from unsafe operation at facilities, indirect hazards associated with radioactive sources such as appearing the radioactive sources out of regulatory control, accident during transportation process, nuclear power plant incident, satellites using radioactive waste batteries, etc.

Abstract ID: 224

Atomexpert Practicies in Training Activities on Security of Radioactive Material

Golovchenko, S.[1], Goltsov, V.[1]

[1] Atomexpert; Russian Federation

Corresponding Speaker: V. Goltsov

1. Atomexpert Profile Activities on Security

Formed in April 2008, "Atomexpert" Ltd. provides services related to the NS (PP) of Radioactive Material and facilities, Physical Protection of the critical sites and facilities, counteracting terrorist acts at these sites and facilities.

The organization has highly skilled professional members with specialized knowledge and experience in each of the Profile Activities bringing together the NS, the Nuclear Industry and Academia experts.

Profile Activities:

- International Activities in accordance with INFCIRC/225/Rev.5
- Facility Operator's NSS (PPS) Requirements Development
- NSS (PPS) Design Expertise
- Design and Evaluation of NSS (PPS)
- Compliance Assessment
- Training

2. Atomexpert Practicies in Training Activities

2.1 Background and Goal

Atomexpert attributes great attention to Training Activities on Security of radioactive materials at specific capacity building across the board i.e. among all relevant categories of professionals/specialists dealing with security matters. Training is an effective method to upgrade the level of knowledge and practical skills, disseminate new information, increase awareness and improve the systems of antiterrorist and physical protection. By providing practical training to all relevant categories of professionals based on innovative and tested methodologies, the quality of their performance can be greatly improved.

2.2 Training Methodology

Development of training manuals, training of the trainers (ToT), making use of the latest training methods and tools available. Possibly, developing e-learning modules in order to disseminate updated information and best practices to the targeted audiences.

2.3 Targeted Audiences

Specialists in the area of security of RM, antiterrorist and physical protection of critical sites and critical infrastructure at various levels – from ordinary security managers of the sites to higher specialization professionals.

2.4 Types of Training Activities

- Seminars, workshops and courses on various aspects of security
- Lectures and presentations
- Interactive training (e-training)
- Development of training materials and handbooks
- Training of Trainers (TOT)

3. Atomexpert Most Popular Courses

3.1 Course on Forms and Methods of State Management in Counteracting Nuclear and Radiological terrorism

3.2 Course on Security of Radioactive Material at Nuclear and other Critical Sites

3.3 Course on NSS (PPS) equipment compliance assessment to certification requirements

4. Course effectiveness analyses

The results illustrating the effectiveness of the above mentioned courses will be presented respectively

5. Conclusions and Acknowledgements

"Atomexpert" Ltd. provides services related to the NS (PP) of radioactive material and facilities, physical protection of the critical sites and facilities, counteracting terrorist acts at these sites and facilities.

Atomexpert attributes great attention to Training Activities on Security of radioactive materials at specific capacity building across the board i.e. among all relevant categories of professionals/specialists dealing with security matters.

It is crucial to provide practical training to all relevant categories of professionals based on innovative and tested methodologies, hence the quality of their performance can be greatly improved.

The results of Atomexpert Practices in Training Activities on Security of RM confirm this statement.

Abstract ID: 228

Strengthening Nuclear Security Infrastructure for Radioactive Material Detection and Prevention of Misuse in Ghana

Addo, M.[1], Davor, P.[1]

[1] Ghana Atomic Energy Commission; Ghana

Corresponding Speaker: M. Addo

The use of radioactive material in Ghana dates back to 1952 when radioisotopes were employed in various fields especially in medicine. In 1963, the Ghana Government realizing that the application of radioisotopes and radioactive sources were gaining grounds, took steps to put in place nuclear security framework in order to prevent, detect and respond to theft, sabotage, unauthorized access, illegal transfer of nuclear and radioactive materials in Ghana. The initial step was the establishment of the Ghana Atomic Energy Commission (GAEC) by an Act of Parliament (Act 204). GAEC's mandate was to be the sole authority in Ghana responsible for matters relating to peaceful uses of atomic energy and fulfilling the state's obligation on nuclear safety, security and environmental care. For the Commission to strengthen its capabilities, it established the Radiation Protection Board (RPB) by Atomic Energy Amendment Law (PNDCL 303) in 1993 as a national nuclear regulatory authority. The PNDCL 303 Law prescribe powers and functions of the RPB in terms of licensing, inspection, supervising, monitoring operations of irradiation devises, radioactive materials and ensure their safety and security. To broaden the safety and security of radioactive materials in Ghana, in 2015 the RPB was modified into an independent Nuclear Regulatory Authority (NRA) by Act 895 of Parliament. This has provided effectiveness in the nuclear security regulatory regimes in Ghana, where the NRA is currently drafting national legislations for terrorism prevention and nuclear security. The nuclear regulatory system has signed a memorandum of understanding with some state agencies like the police, armed forces, customs, nuclear facility operators, Bureau of National Investigation (BNI), National Fire Service (NFS) and immigration service under a National Nuclear Security Committee (NNSC). The NNSC is essentially a nuclear security coordinating body which functions directly under the highest security body, National Security Council (NSC). The NSC is responsible for providing support from the seat of government during nuclear emergency events. The aim of these well-structured security bodies was to enhance the effectiveness of nuclear security infrastructure in Ghana to prevent, detect and respond to criminal and unauthorized acts involving use of nuclear or radioactive materials. The regulatory system

with assistance from the International Atomic Energy Agency (IAEA) in recent times has worked hard in offering comprehensive interactive and participatory training programmes to those agencies in order to sustain human resource development in nuclear security. Generally, these programmes feature demonstrations involving the use of radioactive sources and detection equipment. Thus, government over these periods with the support of international technical support organizations had acquired more detection equipment for frontline officers in an effort prevent illicit trafficking of radioactive materials and in combating crimes in Ghana. Also, the state as part of enhancing the nuclear security infrastructure, by way of human resource development, is in advance stage of implementing Nuclear Safety and Security programme at the Graduate School of Nuclear and Allied Sciences (SNAS) with the support of the IAEA. Thus, Ghana's commitment in ensuring security of radioactive materials can be further attested as it has signed numerous international binding legal instruments on nuclear security including the CCPNM, Safeguards and Nuclear Terrorism Conversion. All these efforts have enhanced the purpose of the nuclear security framework in Ghana, in that no unauthorized use of radioactive materials and terrorism threat in recent years have been experienced though its neighbours, Côte d'Ivoire, Burkina Faso and Mali suffered attacks from terrorist groups.

Abstract ID: 240

Security of Radioactive Sources in Switzerland

Flury, T.[1]

[1] The Federal Department of Home Affairs; Switzerland

Corresponding Speaker: T. Flury

Swiss legislation on radiological protection fixes a procedure of licenses and inspection for the use of radioactive sources and radiological installations. The licensing authority is the Federal Office of Public Health (FOPH). According to the Code of conduct on the safety and security of radioactive sources published by the International Atomic Energy Agency (IAEA), the FOPH manages an inventory of high activity sealed sources (HASS), which lists the most dangerous sources present in various Swiss companies. The FOPH regularly collects information on their state and location and reinforces the control system with local inspections in order to improve compliance with the above mentioned code of conduct. The transport, import and export of these sources is carried out according to international legislation and specific guidance of the Code of conduct. The revised Swiss legislation which came into force in 2018 now requires licensees of high activity sealed sources (Cat 1-3) to provide a security plan in order to guarantee a minimal security according to the goals set by the IAEA (Document NSS 11). In order to harmonize and facilitate the implementation of these additional security measures the FOPH in collaboration with other offices (Swiss Army, Swiss Federal Nuclear Safety Inspectorate, SUVA) defined standards for the source security (physical protection, technical protection, organizational). These rules are currently being implemented. In this presentation we give an overview of the past, the present and the future steps of the project to secure HASS in Switzerland.

Abstract ID: 246

Enhancing Security during Transport of Radioactive Material

Eisawy, E.[1]

[1] Head of Operation Safety Department; Egypt

Corresponding Speaker: E. Eisawy

The main concern in the past was theft and diversion of radioactive material but the recent incidents, have heightened sensitivities to security in face of terrorist action. Security is mainly the responsibility of the State, which has to set up the necessary regulatory framework.

This paper aims to describe the regulatory implementation of security issues in the transport of radioactive material by the Nuclear Regulatory Authority of Egypt (Competent Authority for regulating transport of radioactive material in Egypt). It provides requirements in implementing and enhancing a nuclear security regime to protect radioactive material while in transport against theft, sabotage or other malicious acts that could, if successful, have unacceptable radiological consequences. An effective legal framework is essential to ensure and facilitate secure transport of Radioactive Material. Domestic legislation and international recommendations have an active role strengthening long-term control over the transport of Radioactive Material, and are periodically reviewed to ensure they remain effective. As Emerging technologies have a clear and significant role in enhancing the current security approaches during transport of radioactive material, the paper is aimed to identify and apply modern technologies in promoting the security in transport of radioactive material.

Physical protection measures have become a matter of international interest and cooperation as well as a security plan during transport of radioactive material. Regulatory body of Egypt has the responsibility of requiring the Operator a complete Physical Protection system for radioactive facilities in accordance with the regulatory requirements set forth by it, as well as a Security Plan during transport of radioactive material. Regulatory Body carries out various activities related to the evaluation, monitoring and control of the design of the Physical Protection Systems and the Security Plans. The objectives of the requirements of physical protection of such materials during transport is assisted by minimizing both the total time the material remains in transport and the number and duration of transfers of the material, avoiding the use of regular movement schedules and limiting the advance knowledge of transport information including date of departure, route and destination to designated officials having a need to know that information.

Security Plans are required for carriers, consignors and other participants engaged in the carriage of high consequence radioactive material. Some of the elements included in the security plan are:

- specific allocation of responsibilities for security to competent and qualified persons with appropriate authority to carry out their responsibilities;

- records of radioactive material transported. These Records should be kept for a specific time from the date of carriage;

- review of current operations and assessment of security risks, including any stops necessary to the transport operation and the intermediate temporary storage of radioactive material;

- effective and up to date procedures for reporting and dealing with security threats, breaches of security or security incidents: detail the system or procedures in place for reporting a security incident or a security concern;

- procedures for the evaluation and testing of security plans and procedures for periodic review and update of the plans: detail the requirement for testing of security plans and the frequency for periodic review and update of the plans;

- measures to ensure the physical security of transport information contained in the security plan: state how the information in the plan is protected from unauthorized access e.g. held electronically on a password-protected computer in a location with restricted access. If printed, the plan should be kept secure and treated as a sensitive document, only to be shared with emergency services or the competent authority on request. Everyone with access should be aware that this information should only be made available on a need to know basis;

- measures to ensure that the distribution of information relating to the transport operation contained in the security plan is limited to those who need to have it: detail the measures in place to restrict the distribution of information about the high consequence radioactive material transport operations to those who need to have it;

- clear statement of measures that are to be taken to reduce security risks, commensurate with the responsibilities and duties of the participant, including:

training;

security policies (e.g. response to higher threat conditions, new employee/employment verification, etc.): consideration should be given to changes to threat levels;

operating practices: document how high consequence radioactive material is accepted and the process for determining specific security requirements necessary for a particular movement such as how movements are controlled and monitored to ensure security. Additionally, the plan should detail how any problems with the movement are dealt with, for example during unplanned stoppages;

- equipment and resources that are to be used to reduce security risks: identify and record the equipment and resources deployed in the security arrangements for high consequence radioactive material movements;

As security procedures, consignors must submit to Regulator body the Security Plan for transport including satellite tracking systems real time notification of departure and arrival, custody escort in their own vehicles and any news that may occur during the journey, one responsible for the security designated by the consignor and a contact phone number. The consignors may contact the Regulator security section in order to consult and agree the details of the requirements. In the procedure previous to the transport of radioactive material, the company must submit to Regulatory Body a written security plan containing the details above mentioned with due anticipation and must also send the Notice of Regulatory Body Transport form, adding the corresponding security information. Radioactive material security must be compatible with the security approaches of the consignor, carrier, consignee, etc. With the objective of controlling and monitoring the compliance with the applicable requirements of security Standards, Regulatory Body performs inspections and regulatory audits to consignors, carriers, and other related users. Some of the measures to be taken for protected radioactive material are: Minimize the total time of the transport of transport material; Protect the material according to the category; Avoid regular routes; Confidentiality of information; Cross checks about "personnel reliability"; Custody vehicles; Permanent communication; Satellite tracking.

The regulatory body in Egypt is in process of implementing a Data Base to store all information relevant to transport of radioactive material and the corresponding security measures: consignor, consignee, security, responsible, origin and destination of shipments, carrier, routes, type and amount of radionuclides (physical form, activity, etc.), models and approval certificates of packages, transport index, starting and ending date and time, quantity of vehicles and satellite tracking. The Data Base is used for recording the data related to Notice of Radioactive Transport forms submitted by users allowing, in this way, to have the orientative information about the quantity of land, air and water transports of these materials in Egypt.

The transport must be done with special care, i.e. the previous arrangement between consignor, consignee and carrier, specifying the time, place and procedures for transferring transport responsibility, detailing the mode of transport, routes to be used and reporting points in transit if necessary, and also under constant surveillance by escorts and under conditions that ensure communication at any time with the response personnel. In the case of trans-boundary movements, it must ensure the continuity of security measures during transport and storage in transit and during the crossing of the border, complying also the requirements established by Regulatory Body.

Security awareness training is required for all persons engaged in the carriage of radioactive material. This training shall include the actions to be taken in the event of a security breach. In the event of a security breach, the duty holder shall report the occurrence to the competent authority in accordance with the requirements. It should be aware of the procedures for reporting occurrences to the competent authority. Security training shall be periodically supplemented with refresher training. Records of all security training received shall be kept by the employer and made available to the employee or competent authority, upon request. Training records should be retained in a secure location.

Abstract ID: 247

Physical Security Proposing for Risk Reduction in Hypothetical Nuclear Fuel Cycle Facility

Salem, M.[1]

[1] EAEA; Egypt

Corresponding Speaker: M. Salem

Abstract - Physical security in nuclear fuel cycle facility means detection, prevention and response to threat, theft, sabotage, unauthorized access and illegal transfer involving radioactive and nuclear material. This paper proposes a physical security system designing concepts to reduce the risk associated with variant threats to nuclear fuel cycle facility. So, we will study the unauthorized removal and sabotage in a hypothetical nuclear fuel cycle facility considering deter, delay and response layers. Also, we will perform any required upgrading to the security system by investigating the nuclear fuel cycle facility layout and considering all physical security layers design to enhance the weakness for risk reduction.

Abstract ID: 250

Security of Radioactive Sources: Establishing Legislative Framework in Serbia

Babović, I.[1], Janjić, V.[1]

[1] Serbian Radiation Protection and Nuclear Safety Agency; Serbia

Corresponding Speaker: I. Babović

National legislative framework which regulates all activities with radioactive sources is consisted of the Law on radiation protection and nuclear safety and following bylaws. Aldo security of radioactive sources is mentioned in legislation, it lacks provisions for further development of legal obligations regarding protection of radioactive sources and related facilities.

During the years of practical implementation of legal provisions, drawbacks of legislation has been recognized and currently laws and bylaws are under revision. Development of new Law is in development process with special focus on provisions regarding security of radioactive sources. Beside legal provisions and obligations, an in-detailed guidelines for establishing security system need to be developed. National regulatory authority has drafted Rulebook for security of radioactive sources, which prescribes how security system for radioactive sources should be established and what physical protection measures should be implemented by licensee. Special attention is dedicated to category I sources in medicine, as well as mobile sources and transport in general. All changes in the law and bylaws has been made in compliance with international standards and guidelines.

Serbian radiation protection and nuclear security agency, together with international partners, has conducted a number of activities in the country, with a goal to inform and educate users of radioactive sources about general concept of nuclear security, potential threats and risks, and future legal framework and obligations obligations. By awareness rising through workshops, traninig courses, meetings regulatory authority tries to compensate legislation drawbacks and to keep overall security system at satisfactionary level.

Abstract ID: 251

Building a Security Vulnerability Assessment Program for the Greek Research Reactor

Tsourounakis, I.[1], Sfetsos, A[1], Xintavelonis, I.[1], Stamatelatos, I.[1] Kovatsos, K.[1], Varvayanni, M.[1], Katsaros, N.[1]

[1] I.N.R.A.S.T.E.S N.C.S.R. Demokritos; Greece

Corresponding Speaker: I. Tsourounakis

GRR-1 is a 5 MW, MTR type, Research Reactor, operated by NCSR Demokritos, and sited in Aghia Paraskevi, Greece. GRR-1 is in a status of extended shut down. Since fuel assemblies are stored, the facility retains its characterization as a critical infrastructure. For the protection and safeguarding of the fuel assemblies, a Physical Protection System (PPS) is implemented.

Under the perspective of strengthening the PPS of GRR-1, a Security Vulnerability Assessment (SVA) project was set off.

In this work, the GRR1 SVA program will be presented, providing emphasis on the methodology adopted in order that this program to be carried out. The main topics to be discussed are:

- Criteria for the selection of the SVA working team (field expertise, country legislation, facility regulations, emergency response procedures knowledge, etc.)

- Establishing a project plan (objectives, scope, time frame)

- Facility characterization (site description, main activities, critical assets, attractive assets, security policy)

- Assets analysis (identification/ characterization of the principal assets, highest critical targets, their importance for the facility, their dependences)

- Classification of attractiveness (according to asset attractiveness and asset impact)

- Threat analysis (threat definition, adversaries' identification, attack methods, extracting information from past events). Possible cooperation with State's competent authorities.

• Security Vulnerability Assessment (definition of a threat scenario, definition of vulnerability, definition of the like hood of a threat scenario, creation of threat scenarios, severity of a threat scenario).

• Vulnerability analysis. The results of previous topics will be embedded in various lists (high critical assets, vulnerability, like hood, severity), which will be projected in the different threat scenarios. A risk level determination will be evaluated and the most relevant threat scenarios then will be chosen. According to those scenarios, a list of suggestions to reduce the like hood and severity of a malicious act will be the final outcome.

• Additional security countermeasures identification and implementation. Modification in existing security and strategic policies of the facility. Improvements in the existing PPS, adding new state of the art technological equipment. Design of new training courses for enhancing safety culture to security personnel/employees.

The completion of the SVA program for the GRR-1 provided the required hands-on experience, team confidence, as well as collaboration and communication skills in order to achieve the next stage program, which is to implement a holistic security approach dealing with the entire NCSR Demokritos campus consisting of several buildings with unique and individual characteristics as well as different security requirements and policies.

The expected outcome is the evaluation of the present Security Management System, taking into account the contemporary universal threats, and the remedy of its vulnerable points.

Abstract ID: 257

Specific Legal Provisions on Sharing of Information/Intelligence Regionally and Close Coordination among All Stakeholders Locally are Key to Prevent Sabotage of Radioactive Material

Dharmaratne, N.[1]

[1] Defence; Sri Lanka

Corresponding Speaker: N. Dharmaratne

Introduction

Almost every country uses some level of radioactive material for various purposes even in sectors such as industrial and medical. Radioactive material, similar to potent chemicals and biological material, poses a significant threat if used maliciously. The study that was conducted examines whether the efforts taken and relevant procedures put in place by the state are sufficient to deal with the perceived threats, risks and possible emergencies in regard to sabotage of radioactive material by non-state actors. The study recognized two areas that require special emphasis for ensuring security against misuse or mismanagement of radiological material used in a country. Firstly, it is the sharing of information/intelligence on all aspects of radioactive material among countries in a given region and secondly, the proper integration among all stakeholders of a country dealing with security of radioactive material. These are two indispensable elements in dealing with the threat of radioactive material associated with malicious use. Hence the international legal framework that is focused on ensuring the security of radioactive material as specified in the Nuclear Security Series should mandate such provisions covering the above risks and help member countries of the International Atomic Energy Agency (IAEA) to incorporate them in to their national nuclear security regimes.

Assumed by the premise that one country's state of insecurity could spill across boundaries over to its neighbouring countries and threaten their national security too, there requires a coordinated effort regionally in terms of sharing of intelligence to take effective precautions. As is realized that today's security threats are transnational in nature, a single country cannot survive in isolation without having an alliance with its neighbours and garnering their support. South Asian region for instance is infested with terrorism, therefore the intelligence authorities of India, Pakistan, Bangladesh, Maldives, Sri

Lanka, Nepal and Bhutan must be constantly in touch with each other and share intelligence efficiently to be ahead of any adversary attempting to acquire radioactive material for an act of sabotage. To this end periodic reviews and meetings and genuine exchange of information among the regional countries must be insisted by international law, so as to minimize complications to carry out such a task purely on bilateral basis. Heavy and growing prevalence of nuclear reactors in India is exemplary to this where currently there is no discussion between Sri Lanka and India on contingency measures.

The study also reveals that there is no common understanding by all stakeholder organizations about all the actions of the state on fulfilling state's obligations towards IAEA. It is not only the stakeholders of national nuclear security programme but also many other agencies of a country, both private and public, should be aware of the efforts and developments. Such a shortcoming could be attributed to a number of reasons such as inadequate training, absence of regular meetings among relevant parties, and the matter been limited to a small community. Better coordination of all stakeholder organizations could overcome this shortcoming.

The IAEA guidelines specify that all citizens should be aware of the national security plans on radioactive threats. However, such an awareness is not there at present. In Sri Lanka, radioactive materials are used mainly for agriculture, human health, industrial sector and water resource management. Each of these areas have their future development plans such as establishment of a national centre for nuclear-based agriculture. Similarly, there are many new policies with regard to Radioactive Waste Management in Sri Lanka. Awareness of the above should be given to public through various means, if support of majority is to be harnessed.

Objectives

- To facilitate individual member countries of IAEA to establish a vibrant National Nuclear Security Regime.
- To ascertain the effectiveness of individual member countries in implementing the resolution on nuclear security (GC(61)/RES/9)
- To identify additional legal assistance that could be provided by the IAEA to member countries to further strengthen their security measures.
- To identify potential risks and relevant precautionary measures to be taken specifically on the security of radioactive material.
- To analyse inconsistencies in the local mechanisms and organizations in keeping with the above objectives.

Hypothesis

Unless assisted through strictly enforced international law most of the member countries cannot guarantee their complete fulfillment of the obligations of the IAEA for effectively preventing sabotage of radioactive material.

Variables
DEPENDENT VARIABLE

• Effectively preventing sabotage of radioactive material

INDEPENDENT VARIABLES

- Enforced International Law
- Stakeholder Awareness
- Public Awareness
- Emergency Procedures
- Regional Cooperation
- Consistent Gap Analysis

Material and Methods

- The study was based on numerous credible sources, which are explained in details supported by in the main discussion with diagrams.

- Information was mainly gathered through interviews with officials of National Atomic Energy Bureau, intelligence agencies, armed forces and other relevant stakeholders.

Abstract ID: 262

Nuclear Security in Developing Countries

Elsalamouny, N.[1]

[1] Egypt

Corresponding Speaker: N. Elsalamouny

Transport of nuclear materials, as well as radio-isotopes is something associated with the nuclear technology. for many reasons this need to be done either for depleted fuel transportation to the vault of storage, or transportation of radio-isotopes for different industrial or medical applications.

the culture and the understanding of the responsible parties of the transport include all security measures to eliminate or even mitigate any risk associated with the transport process is very essential. lack of knowledge and lack of security culture may be considered as a major risk on its own.

In the developing countries, managing and developing transportation plans from the security point of view are not accurate due to the lack of knowledge about the nuclear security. different incidents occurred in a way or another in these countries and even civilians were exposed in these incidents due to lack of knowledge and wrong handling of the transportation security plans.

this paper will be discussing some of these incidents and the mistakes that was the main reasons for these incidents and the connection with the knowledge and nuclear security cultures and how to develop a road map for resolving these issues.

Abstract ID: 269

The Legal Basis for Combating Nuclear Terrorism in Indonesia

Surachmat, S.[1]

[1] Nuclear Energy Regulatory Agency (BAPETEN)); Indonesia

Corresponding Speaker: S. Surachmat

Introduction

Terrorist acts have become enemies with the international community. Wherever acts of terrorism are committed, the world will condemn it as a cruel act that can not be tolerated under any pretext. Indonesia as part of the international community has a number of infliction caused by acts of terror. The list of terrorism cases in Indonesia has been started since 1981 as can be seen in https://en.wikipedia.org/wiki/Terrorism_in_Indonesia. Although the total cases of terrorism that happened in Indonesia is still conventional in nature, but the rapid development of technology requires every country including Indonesia to be wary of the possibility of terrorism attacks using nuclear material or radioactive substances. Moreover, cases of theft and illicit trafficking of nuclear material or radioactive substances have often happened. It is therefore necessary to prevent, detect, and respond to criminal acts and intentional unlawful acts involving or directed against nuclear material, other radioactive materials, related facilities or related activities. One of the efforts to be undertaken as stated in the IAEA Nuclear Security Series No. 15 and No. 21 that in order to have an effective nuclear security system, each country must have comprehensive legislation regulating the competent authority as well as regulations governing penalties for perpetrators of criminal acts that have implications for nuclear security. Under the recommendations of the IAEA, each state will develop its nuclear security system. Indonesia as a member of the IAEA is also continuously developing legislation relating to the nuclear security system as a legal basis to prevent, detect and respond criminal acts and intentional unlawful acts involving or directed against nuclear material, other radioactive materials, related facilities or related activities.

Legal Framework

Legislation related to nuclear security in Indonesia such as Law No. 10 of 1997 on Nuclear Energy, Government Regulation No. 54 Year 2012 on Safety and Security of Nuclear Installations, Government Regulation No. 2 Year 2014 on Licensing of Nuclear Installation and Utilization of Nuclear Material, Government Regulation No. 58 of 2015 on the Safety and Security of Transport of Radioactive Substances. The entire regulation is the legal framework for controlling the use of nuclear material and radioactive substances. As for nuclear material or radioactive substances out of regulatory control, then the regulatory framework can not be applied.

Therefore, to detect the circulation and possession of nuclear material or radioactive substances out of regulatory control, BAPETEN as the regulatory authority initiated the establishment of The Indonesian Center of Excellence on Nuclear Security and Emergency Preparedness (I-CoNSEP) which consists of various competent authority in support of the implementation of nuclear security system. Through coordination among competent authorities within I-CoNSEP, it is expected that nuclear material or radioactive substances out of regulatory control and intended for criminal purposes can be detected and handled quickly through law enforcement to be performed by relevant agencies such as customs, police and attorney general as can be seen in https://www.bapeten.go.id/?page_id=26418&lang=en.

Indonesian legislation applicable in law enforcement against criminal and unlawful acts intentionally involving or directed to nuclear material or radioactive material is Law No. 15 of 2003 on Combating Terrorism. In that law there is one article relating to criminal acts involving nuclear material or radioactive substances. Currently Law no. 15 of 2003 itself is in the process of amendment in the Parliament. The draft amendments regulate that any person who unlawfully submits to Indonesia, makes, receives, obtains, assigns, carries, stores, transports, conceals or excludes from Indonesia with the intention to commit Criminal Acts of Terrorism can be imprisoned. It also regulates that any person who intentionally trades nuclear or radioactive material to commit Criminal Acts of Terrorism also can be imprisoned.

Challenge

The challenges facing Indonesia with regard to detection of criminal/unauthorized acts involving nuclear and other radioactive material out of regulatory control is how far the legal infrastructure aligned with the international recommendations ex ante. For example the establishment of I-CoNSEP itself is not supported by a comprehensive and complete set of legislative provisions for providing relevant administrative and enforcement powers to the various competent authorities within the State so that they can undertake their acitivities in effective manner. In addition, how far the law on combating terrorism has aligned with the International Convention for the Suppression of Acts of Nuclear Terrorism as a legal instrument in the law enforcement ex post.

Abstract ID: 290

Impact of International Cooperation on Security of Radioactive Sources in Kenya

Mundia, I.[1], Kaboro, B.[1]

[1] Radiation Protection Board; Kenya

Corresponding Speaker: I. Mundia

Over the years, safety culture has been promoted in the country. Some years back, it seemed safety had overridden security culture in the country due to misconception. Kenya is a country has made efforts in nurturing security culture. small quantity protocol country. However, in recent years, security has steadily gained momentum partly due to terrorism risk in our country but mainly due to increased awareness among the stakeholders in the country and embrace of security culture by the regulatory, Radiation Protection Board. International cooperation has played a key role in assisting the regulatory body and stakeholders to embrace the security culture. Close cooperation with the International Atomic Energy Agency, and other partners such as the government of United States has enhanced the security regime of the radioactive sources in the country.

Some of the benefits include hosting of peer review missions, national training courses and workshops among other nuclear security initiatives whose benefits are felt to date. The increased awareness among Government stakeholders assisted the Radiation Protection Board to be assigned by the Government the role of regulating nuclear security in Kenya.

This paper will share with the International community the benefits Kenya has gained from the international cooperation. It will also share the challenges faced in sustaining benefits made in nurturing security culture and effort made to achieve its sustenance.

Abstract ID: 300

Radioactive Source Security Regulation in Hungary and the Improvement of the Detection and Prevention Capabilities in the National Regulatory Framework

Viplak, A[1], Vincze, A[1], Hódosi, V[1], Stefanka, Z.[1]

[1] Hungarian Atomic Energy Authority; Hungary

Corresponding Speaker: V. Hódosi

The Govt. Decree 190/2011. (IX. 19.) Korm. on physical protection requirements for various applications of atomic energy and the corresponding system of licensing, reporting and inspection entered into force on 4 October 2011.

According to Section 31 of the Govt. Decree on physical protection the Hungarian Atomic Energy Authority (HAEA) is responsible for licensing and inspection of construction, operation and modification of the physical protection system of nuclear facilities, interim storage or final repository of radioactive wastes and nuclear materials, radiation sources and radioactive wastes with the involvement of the National Police Headquarters (NPH) as a co-authority.

The Govt. Decree on physical protection describes a performance based requirement system for nuclear facilities (with the exemption of the training reactor) and a prescriptive system for all other users. The minimum compulsory security requirements depend on the category of the nuclear material and the ratio of the isotope specific activities to the D values of the source. Four physical protection levels are established and the physical protection requirements are prescribed according to these four levels (e.g. Level A is the most stringent and it applies to the use, storage and transport of nuclear materials in Category I).

The paper describes the Hungarian security regime regarding to radioactive source security and the actions taken by the HAEA since the Govt. Decree on physical protection came into force, in order to improve the regulatory framework focusing on the improvement on detection and prevention capabilities.

Abstract ID: 306

The Joint Research Centre's Contribution to Strengthen Nuclear and other Radioactive Material Security

Abousahl, S.[1], Goulart, M.[1], Gonçalves, M.[1]

[1] European Commission

Corresponding Speaker: S. Abousahl

Within the international security context, the prevention and mitigation of chemical, biological, radiological or nuclear (CBRN) hazards have become an important area of activity. The European Union (EU) recognized the importance of CBRN security more than a decade ago and, since then, has developed several action plans and initiatives to mitigate the risks associated with radioactive and nuclear materials, both internal and external, in cooperation with partners including the IAEA.

In this context, the European Commission's Joint Research Centre (JRC) is well positioned to support the technical implementation of the EU actions, by being a facilitator in aggregating the various technical perspectives expressed by the EU Member States (MS), as well as acting as the EU partner of the IAEA and GICNT concerning technical cooperation in the field of RN security. Recognizing the added value of demonstrations, exercises and scenario-based analysis to provide an opportunity for discussions and exchange of experiences, the first EU High Level Scenario-Based Exercise on Nuclear Security – APEX EUROPA was organized by the European Commission in November 2016. It was the first exercise of its kind, focusing on nuclear security and involving different levels of responsibility at EU level. As follow-up, new initiatives on training, field/table top exercises, nuclear forensics or detection technologies are being developed under the newly adopted EU CBRN Action Plan. JRC will contribute to these new initiatives, building on its experience in the field.

One of these flagship activities is the Illicit Trafficking Radiation Detection Assessment Programme – ITRAP+10, making significant contributions to the international effort to mitigate the threat and risks associated with RN materials. In this framework, the JRC carried out an evaluation and comparison of the performance of commercially available radiation detection equipment relevant to nuclear security against international standards. This test campaign allowed the JRC to provide scientific and technical data on available detection systems to policy makers; to present recommendations to manufacturers to improve performance of the equipment; to propose a list of suggestions for improvement of the standards to the standardisation organisations; and to promote the capacity-building in selected EU MS

laboratories for the testing of radiation detection equipment through the organisation of a round robin exercise, as a first step towards a European certification scheme. This project is a relevant example of how research input can have a significant impact at different levels.

Together with the availability of advanced and fit-for-purpose border detection technologies, the adequate use of detection equipment by front line officers is also crucial for an adequate prevention of illicit trafficking of RN material: training and capacity building activities remain therefore a cornerstone of an effective implementation of nuclear security systems. The overarching goal of the European Nuclear Security Training Centre – EUSECTRA, a JRC infrastructure tailored to the specific needs of nuclear security training, is to improve EU MS capabilities to address the threats associated with illicit incidents involving RN materials. This includes the development and validation of training programmes, in consultation with EU MS and international partners, and the provision of hands-on training (using live materials) for operational agents.

In the field of nuclear forensics, the JRC has a leading position within the international community based on its long standing involvement in nuclear forensics analysis, its first-hand experience in case work and its strong research activities. The JRC has developed various methods that allow identification of the origin of intercepted material and provides basic trainings in nuclear forensics. EU MS (or non-EU countries) in the need for nuclear forensics support have also the opportunity to benefit from JRC's expertise in the investigation of nuclear security incidents. The JRC's leading position is also underlined by its participation in international initiatives and its contributions to the work of international organisations.

Outside EU borders, the EU CBRN Centres of Excellence (CoE) initiative launched in 2010 by the EU, in line with its commitment to promote internationally a culture of CBRN security and safety, is an unique platform that provides for voluntary regional cooperation on all CBRN-related hazard issues. Currently 60 partner countries work together to identify risks, gaps and needs and give input on the activities to be implemented. 66 projects have been launch under the CBRN CoE initiative, and 25 are currently on going. Many of them are focused on RN security and implemented in coordination with the IAEA. As technical implementer of the initiative, the JRC ensures the coherency between EU internal and external technical actions.

In conclusion, the JRC plays an important role by providing scientific and technical support to EU's nuclear security policy by facilitating training and capacity building activities, as well as by addressing standardisation and harmonisation processes in this field. Acknowledging nuclear security as a major European and global concern, the JRC can strongly contribute to strengthen EU MS nuclear security through its expertise, support and training.

Abstract ID: 312

Activity Quantification for Source Security Applications with the Spir-Ace RID

Sullivan, D.[1], Jaderstrom, H.[1], Spruytte, J.[1]

[1] Mirion Technologies; USA

Corresponding Speaker: D. Sullivan

Mirion Technologies, with the acquisition of Canberra, is currently in the process of merging the best technologies from their combined portfolios. The Spir-Ace is one product receiving such treatment. The Spir-Ace is a scintillator based portable Radionuclide Identification Device in an IP64 rated enclosure that has been tested to show ISOCS compatibility. With options that include alpha, beta and neutron detection, this comprehensive device meets or exceeds ANSI N42.34, IEC62327and IAEA NSS 1 for detection of radionuclides. This modernized platform adds accessibility to contemporary portable systems such as GPS, accelerometer positioning, and wireless communications that allow remote reporting.

Recently, Mirion has characterized both the NaI and LaBr3 detectors for ISOCS efficiency calibrations, allowing the development of a platform that both identifies radionuclides and quantifies the activities with accuracy that is consistent with the Inspector 1000 products. Initial testing has shown the Spir-Ace able to quantify known quantities of mixed nuclide radioactivity contained in a standard drum to within 25% or better of the certified activity, in a 10 minute sampling time.

The Spir-Ace allows for the same performance in activity calculation that has been established with the Inspector 1000, and combines it with a modern platform that complies with regulatory needs found in many countries. It is ruggedized for operations in the field, allowing for remote monitoring and reporting. It has been deployed on remote stations that are either static or in motion. Both safeguard and security applications could make significant use of the wide range of capability found in this small device.

Abstract ID: 314

Status on Security of Radioisotopes Security in Korea

Han, S.[1]

[1] Korea Institute of Nuclear Security; Republic of Korea

Corresponding Speaker: S. Han

Radiation is being used widely in industrial, medical, research and education field in Korea. About 8,100 licenses are valid and the number of license have been increased about 10 percent in average annually.

Legal system was launched in 1953 for radiation safety. Nuclear Safety Act (NSA) is based on IAEA BSS (1996). Basic requirements are including licensing processes (review & inspection) and radiation protection for safety and security.

Security was ancillary measure for safety in the former version of this act. But, introducing new requirements in 2015 based on IAEA security recommendations, the act have got well organized security measures.

Basic security is adopted all radiation handling for prevention of loss and robbery. And special requirements are added for high risk radiation sources such as category 1, 2 of IAEA categorization. These requirements are including security system (based on the concept of detection & assessment, delay and response, etc.) and management (preparation of a security plan, security zones, access control, trustworthiness, information protection etc.)

About 180 licensee are having category 1, 2 radiation sources such as Co-60, Cs-137, Ir-192 for medical or industrial purpose in Korea and each licensee is implementing security measures based on own security management plan.

National level efforts are implementing also. The regulatory authority (Nuclear Safety and Security Commission & Korea Institute of Nuclear Safety) is checking status and encouraging security strengthen. Korea have expressed support for Code of Conduct on Safety and Security of Radioactive Sources including Guidance on the Import and Export of Radioactive sources since 2004. Korea was inspected International Physical Protection Advisory Service(IPPAS) of IAEA in 2012 successfully and adopted IAEA security requirements to legal system by publishing 'Requirements for radioisotope security management' in 2015.

Regulatory review and annual inspection to licensee is general activity for security implementation. But special activities were carried when national events were held such as U-20 FIFA soccer games in 2017 and 2018 Pyeong Chang Olympic winter games in order to prevent malicious use.

Korea have been making an effort to establish and implement security policy and is going to improve consistently. These efforts are going to contribute spread of security culture.

Abstract ID: 316

Effective Security of Radioactive Materials in Port Harcourt Refining Company Limited: Threat, Challenges and Prospect

Ahmad, K.[1], Bestman, K.[1]

[1] Port Harcourt Refining Company Limited (A subsidiary of Nigerian National Petroleum Corporation); Nigeria

Corresponding Speaker: K. Ahmad

Identification and management of security threat, challenges and prospect is an essential part of the process to ensure sustainable security of radioactive sources in any facility. Port Harcourt Refining Company (PHRC) Limited (a subsidiary of Nigerian National Corporation) is one of the Nigerian refineries with nameplate refining capacity of 210,000 barrels of crude per stream day. The refinery has two (2) units namely Continuous Catalyst Regeneration Unit (CCR) and HF-Alkylation Unit that use radioactive sources as level measurement (level switches, indicators and transmitter) with total number of thirteen (13) sealed radioactive sources comprising of ten (10) Cs – 137 and three (3) Co – 60. The ten (10) Cs – 137 have activity ranging from 111 - 740 MBq while the Co – 60 has 18 – 131 MBq.

With the militancy in the Niger Delta region of Nigeria where the PHRC is located and the threat of Boko Haram in Nigeria, the security of radioactive sources is a paramount concern to Nigerian government and the management of PHRC. The need to ensure that all decommissioned radioactive sources are secured prior to disposal would require effective monitoring from the decommissioning to disposal, knowing that if the radioactive sources get to the hands of an unauthorized person, it could endanger the public as well as adverse financial implication and negative publicity to PHRC. The zeal to secure the spent sources became a paramount concern and it became the motivating factor that led to the enumeration of the security measures in place to secure the spent radioactive sources in facility prior to shipment to the source manufacturer.

To achieve the security objective, a Probabilistic Risk Assessment (PRA) approach was utilized to assess the level of existing security, security threats, challenges and prospect of the facility in order to strengthen the security of these sources. Based on the above, the available security measures were evaluated to identify its impact on security. The assessment revealed that the Plant is protected by Physical Protection System, Computer based System, 24 hours patrol and response service, as well as

dedicated two way communication systems. However, there might be the likelihood of militancy act, terrorism, and sabotage as the potential threat to the facility; most especially during decommissioning and transport of radioactive sources to the source manufacturer. In addition to these security threats, there are other challenges associated with the handling of the radioactive sources in the Plant. For example, there is need to have a sophisticated tacking system that would speedily identify missing radioactive sources rather than using survey meter to locate a missing radioactive source. Also the plant does not have a localized radioactive waste management facility within the Plant. Additionally there is no intruder detection system in the temporary storage facility (bunker); however, there is twenty four hour guard operation.

To mitigate some of these security threats, several safe guards are put in place to ensure that the spent radioactive sources safely get to the source manufacturer. First, once the spent radioactive source has been decommissioned, and ready to be exported to the source manufacturer, the spent radioactive source is temporary stored and secured in a bunker appropriate for that radioactive source. Second, a credible transporter and freight forwarder with experience in handing radioactive material was selected through due diligence. Although, the transportation and logistics were subcontracted, however, the information related to the radioactive sources are restricted between PHRC and the contractor by signing a confidentiality clause in the contract agreement. Third, to ensure the security and tracking of the radioactive source during transit to point of export in Nigeria, the representatives of the Nigerian Nuclear Regulatory Authority has to conduct pre-shipment inspection and the Anti-bomb Squad of Nigerian Police Force must escort the transportation process. Four, there is also an awareness campaign on the danger of radioactive source. Finally, the processes as enumerated are performed by certified PHRC radiation workers and guided by a radiation consultant as part of the regulatory requirement.

Adopting the above security measures have the potential to ensure that the spent radioactive source would be delivered to the source manufacturer safely. However, auto tracking system for missing sources and intrusion detection system in the temporary storage facility remain the areas for continuous improvement. Unquestionably, without effectively securing these spent radioactive sources and it gets into unauthorized hands, there would be severe consequences to PHRC and Nigeria as a nation.

Abstract ID: 331

Strengthening the Security of Radioactive Material and Implementing Nuclear Security Detection Architecture in Madagascar

Zafimanjato, N.[1], Zafimanjato, J.[1]

[1] Institut National des Sciences et Techniques Nucléaires (INSTN); Madagascar

Corresponding Speaker: N. Zafimanjato

Radioactive Sources are being used in Medicine, Industry, Agriculture, Research and Education in Madagascar. Relevant legislation and regulations for Safety and Security of radioactive sources are in place but partly consistent with the IAEA standards. All radioactive materials are imported, most are under regulatory control. Madagascar has developed its national radiological security regime to strengthen and sustain the security of radioactive material. In order to establish effective and sustainable the radiological security, Madagascar has participated to the Integrated Nuclear Security Support Plan (INSSP). The integrated set of security regime and measures, based on an appropriate legal and regulatory framework, needed to implement a national strategy for the detection of radioactive material out of regulatory control (MORC).

However, the full nuclear security spectrum includes Prevention, Detection and Response. Detection is the awareness of criminal and unauthorized acts with nuclear security implications or measurements indicating the unauthorized radioactive material at an associated facility. Prevention, detection, and response to a nuclear security event requires the development of effective and sustainable nuclear security systems and measures. The nuclear security detection architecture (NDSA) promotes a holistic and integrated State-level approach to detection of MORC. In Madagascar, development and establishment of national detection strategy started by the design of a NSDA Roadmap which has been established in 2016. It includes the identification of country-specific risks, and constraints. The Ivato International Airport, Antananarivo, has been selected to implement the NDSA Roadmap. In order to provide the information needed for the relevant authorities to agree on, and plan for, the nuclear security detection operation at the Airport, the Site Information and Design Document (SIDD) is established in May 2017 with the IAEA assistance. It includes comprehensive set of radiation detection systems, concepts of operations, human resources and supporting infrastructure.

Some radiation detection capabilities are available and embedded in many agencies.

Moreover, for Major Public Event, the IAEA provide radiation detector. It used to sweep venues before event and Monitor activities during the event.

The Amendment to the Convention on Physical Protection of Nuclear Material (CPPNM/A) and the International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT) have been ratified and entered into force in 2017. The revision of the existing legal and regulatory framework by adding dispositions to Nuclear Security is in progress and it expect the establishment of an interim secure centralized storage facility with proper physical protection elements for disused and orphan sources. Madagascar has joined ITDB in 2004 and reported five incidents. A comprehensive inventory of radioactive sources is maintained and has been proved to be a necessary condition for their effective regulatory control in the country. It will enhance also the security.

Abstract ID: 336

Role of Sea Ports Corporation as a FLO

Omer, R.[1]

[1] SPC; Sudan

Corresponding Speaker: R. Omer

Introduction

Port Sudan is situated on latitude (º19 ˈ39) north and longitude (º73 ˈ13)east on the middle red sea coast. Local time G.M.T. plus(3)hours. Port Sudan Harbor considered as natural port which occupies strategic site in the center of the west.Port Sudan is mainly handling general cargoes , Livestock , Cement , Containers , Oil Products , Wheat , Pesticides and Cars .

Since its foundation in 1974, the Sea Ports Corporation has started to develop its services and promote the operational capacity according to a well prepared plan in order to be at the international ports standards.

There are two types of Sudanese ports :-sea ports South Terminal.

Located south of the entrance to Port Sudan, and the length of the fold of the southern port (1765) meters and an average width of 500 meters, and the total area of the southern port (1480000) square meters . They are (6) berths with total length of (1545.8) m , it includes a container terminal in addition to a grain silo with a capacity of (50000) tons.

North Terminal

It is dedicated for handling general cargo, edible oil,molasses,dry bulk cargo, liquid bulk and vehicles. Its design capacity is (5) million tons per year.

Osman Digna Terminal

Located within the historical town of Suakin (60) km south of port Sudan (19°,07′)N (37°, 20′)E, consisting of (9) berths .The Passenger Terminal consists of two halls ,one for arrivals and the other for departures, both of them are equipped with all service facilities required by passengers .

Alkhair Petroleum

this terminal is dedicated for handling petroleum products and ethanol , it design capacity is (2.67)million tons per years , capable of receiving petroleum products tankers with tonnage ranging between (101000)m and (501000)m with maximum length off (221)m width (22)m and a draft of (13.2)m dry ports

Kusti Terminal

Port of Kosti Dry is a branch of the sea ports and is designed to support the movement of trade and facilitate the flow of exports and imports for the areas south and west and central Sudan and came to choose the city of Kosti. Salloum Terminal Was created after the Saloum region (10) kilometers west of Port Sudan, to provide integrated logistics services to reduce the duration of the container port south courtyards.

Target

In sea port corporation we Will redouble our efforts to develop technology that can detect radiation and determine the danger it poses, and will work with the maritime transportation industry to integrate this technology into their operations so as to maximize security without causing economic disruption.

Detecting radioactive materials at sea ports corporation remains a big challenge for authority . sea ports corporation intended to improve the detection of threats while decreasing the number of false positives

The sea ports corporation focuses on security-related issues concerning border control in the sudan. Among the most important issues on its agenda are: developing of practical forms of cooperation, simplifying communication routines between the parties , sea exercises and operations, exchanging information about the tasks and authorities of border services in the area of security controls at sea ports, marinas and sea areas , counteracting terrorism, and exchanging experiences and evaluations of existing standards of security controls.

Role and responsibility

We are committed to providing safe and healthy working environments for our employees, contractors, stakeholder and all users of SPC facilities.

We continually work to:

- Promote health, safety, security and environmental protection as an integral part of administration duties.
- Supply appropriate information, instruction, and training to promote awareness of health, safety, and environmental concerns – and of the responsibility of each employee to prevent injury to themselves .
- Comply with all laws and regulations covering l health ,safety, security and the environment
- Develop and implement policies and procedures designed to promote safe working practices and environmental protection

- Implement practices and procedures for the safe use, handling, storage, and transportation of all materials .

Cargo containers are checked for radioactive material that could pose a threat to national security or public safety. Security measures include:-

- Licensing requirements for the import and export of radioactive material.
- Prescreening all cargo.
- Further inspection of any potentially threatening shipments with radiation detectors.

Several different types of radiation detectors are used by shipping port security officials. include:-

- Personal Radiation Detectors: Small, highly sensitive devices that sound an alarm when radiation is detected.
- Radiation Portal Monitors: Monitoring stations scan a range of vehicles and their cargo as they drive through the portals. Portal monitors can detect radiation hidden inside shipping containers.
- Radiation Isotope Identifiers: These hand-held instruments can identify specific radionuclides, including nuclear weapons, medical and industrial isotopes. Security officers use these devices to identify the type of radionuclide that triggered an alarm.

Abstract ID: 338

A Proposed Regulatory Requirements for Insider Threats Concerning Security of Radioactive Material and Associated Facilities

Hazzaa, M.[1], El-Tayebany, R.[1], Shaban, S.[1]

[1] Egypt

Corresponding Speaker: M. Hazzaa

An Insider has a greater threat to the security system of radioactive material facility due to their ability to get benefit of their rights to access, authority and knowledge of a facility. Insiders may be have the capability to by-pass many detection measures, because of their access for entry or by other available ways. An insider may be in any position at a radiological facility, they may be high level employee or low level, where the factors affecting insider attempt insider opportunity and motivation. The security plan introduces the physical protection systems at a facility and depend on the regulations and best practices for protection against both the insider and external adversary. The description includes the fundamental principles that are used to establish the physical protection system at the facility and should contain a description of the principles for an effective insider mitigation program, then identifies the policies and, subsequently, defines the operations and procedures which control physical protection at the facility. This paper views measures for the preventive and protective actions against insider related to security of Radioactive Material (RM) and associated facilities where the design and evaluation of physical protection system against threats posed by outsiders and insiders, where proposed requirements include the general requirement, identification of potential insider threats, which defined the design basis threat (DBT) or the national threat assessment about insider threats so as to identify the potential insider threats for facilities, identification of target process for insider, insider characterization and measures against potential insiders comprises firstly, Preventive measures aiming to exclude potential adversaries and to reduce the likelihood of insiders trying to commit a malicious act, so for example the licensee before hiring any employee in job shall check the trustworthiness of the persons (background check "criminal and ideological"- financial obligations- work history – alcohol testing- psychological) and during career progression who have knowledge of sensitive information. Also trustworthiness of personnel – inspect vetting procedures and records (including contractors) including pass issue and updating for this check all five years or when take place change in DBT . As

well as behavioral observation programs will be implemented for personnel with access to RM, vital areas and sensitive information. Secondly, Protective measures where the target is for detection, to improve the detection anti-insider may be by integration with different systems existence in facility, such as physical protection system, NMAC system, operations system, safety system, so for example the licensee should protect RM against insider by using a passive and active RFID tags system to avoid tampering by an insider, the system should prevent individuals (e.g., monitoring station operators) from deleting saved events. In addition, the system should be designed or programmed to ensure that an alarm station operator or system administrator cannot change the status of a detection point or deactivate a locking or access control device without the knowledge and concurrence of another approved individual, A radiation detector should be separate from the security zone alarm system, should always be armed with no ability to disarm it, and should be able to send a separate signal/alarm to the monitoring stations, the system should be designed with redundant to mitigate all attempts of insider, delay and respond to malicious acts after their initiation, and to mitigate or minimize their results, licensee shall be recognize that any persons involved in response teams " whether, operations personnel and security personnel", which, may themselves be insiders, and therefore response procedures should be developed and update with this assumption.

Finally, Evaluation of measures to protect against the Insider Threat for abrupt theft, protracted theft and sabotage and we recommend details to deeply improve the Insider Threats measures Concerned with Security of Radioactive Material and Associated Facilities.

Abstract ID: 362

Strengthening Domestic Interfaces and Leveraging Existing Capabilities for Detecting Material Out Of Regulatory Control

Hamed, M.[1]

[1] Sudanese Nuclear & Radiological Regulatory Authority; Sudan

Corresponding Speaker: M. Hamed

Peaceful use of nuclear and other radioactive materials widely increased this materials could became out of regulatory control. Sudan has large border and surrounded by seven countries some of this countries has no political stability and some of them have civil war. Those countries have nuclear material and other radioactive materials. Effective regulatory system is needed for detecting material out of regulatory control. The Nuclear and Radiological Regulatory Control Act, inter into force on February 2017. Sudan established strong collaboration, exchange of relevant information and interfaces between authorities involving in nuclear security through nuclear security committee, nuclear security executive committee, memorandum of understanding and etc. This collaboration and interfaces lead to manage available detection capabilities and detect some material out of regulatory control.

Abstract ID: 386

Inter-Agency Collaboration in Combating Illicit Trafficking of Radioactive Materials in Kenya

Atogo, M.[1]

[1] Radiation Protection Board; Kenya

Corresponding Speaker: M. Atogo

An effective nuclear security infrastructure in a country requires an appropriate integration and coordination of responsibilities among the government agencies. In Kenya, the Radiation Protection Board is the national competent authority on matters of radiation safety, security of radioactive and nuclear materials, control of consumer products contaminated with radioactivity, and other related matters. To effectively carry out these mandate, the Board set up the department of Nuclear Security and Coordination Centre (NSCC). This centre coordinates the activities of other agencies to ensure effective surveillance to combat illicit trafficking of radioactive and nuclear materials in the country and through the border posts. Kenya is strategically located to serve some land locked countries within the East and Central African region. These countries import radioactive sources some of which pass through the Kenyan territory destined for use in industrial and other facilities. This has led to a challenge in tracking the movement of radioactive materials from their points of entry to the end users in other countries. However, through the coordination of agencies, coupled with a robust legislative and regulatory framework, some of the previously identified challenges have been addressed. This paper will give an overview on how these government agencies coordinate in ensuring that illicit trafficking of radioactive and nuclear materials is eliminated in the country. Some of the challenges identified were highlighted and possible solutions recommended.

Keywords: Nuclear Security, Radioactive Material, Illicit Trafficking,