Pressure Equipment Research – State, Needs, Challenges

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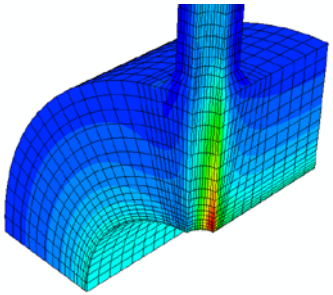
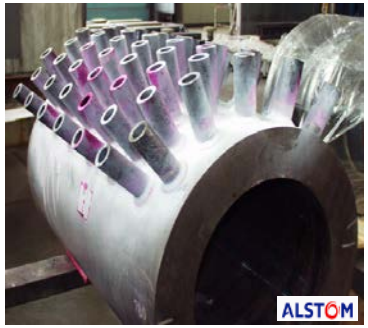
Introduction

- Long tradition in pressure vessel research
- Pressure equipment shows high potential of hazard and risk of failure with consequences of high damage
- Safety and reliability aspects play an important role
- Life cycle of a component has to be considered:
- Design issues
- Life assessment and in service monitoring or recurrent assessment tests and evaluation





Outline

- Introduction
- **EPERC scope and activities - current activities - examples**
  - Risk based maintenance and –inspection
  - Repair Welds
  - Life assessment techniques
- **Actual research activities:**
  - High efficiency plants
  - Flexibility of power plants
- **Summary**

EPERC scope and activities

- Materials issues – qualification, properties and material characterisitcs needed for design and integrity assessment
- Design - codes, standards (see next presentation), new methods (FEA, Damage mechanics)
- Life prediction, Damage prevention
- in service monitoring - new techniques e.g. Small Punch –
- Inspection - Methods especially NDT, inspection intervals…
- Component assessment
- Life cycle issues, reliable operation
- Life assessment
- Special issues: e.g. influence of hydrogen atmosphere or other environmental conditions

Materials and Fabrication

Design and analysis, including damage and failure analysis

Operation, Inspection, Testing, Maintenance

life cycle, reliable operation

EPERC scope and related activities

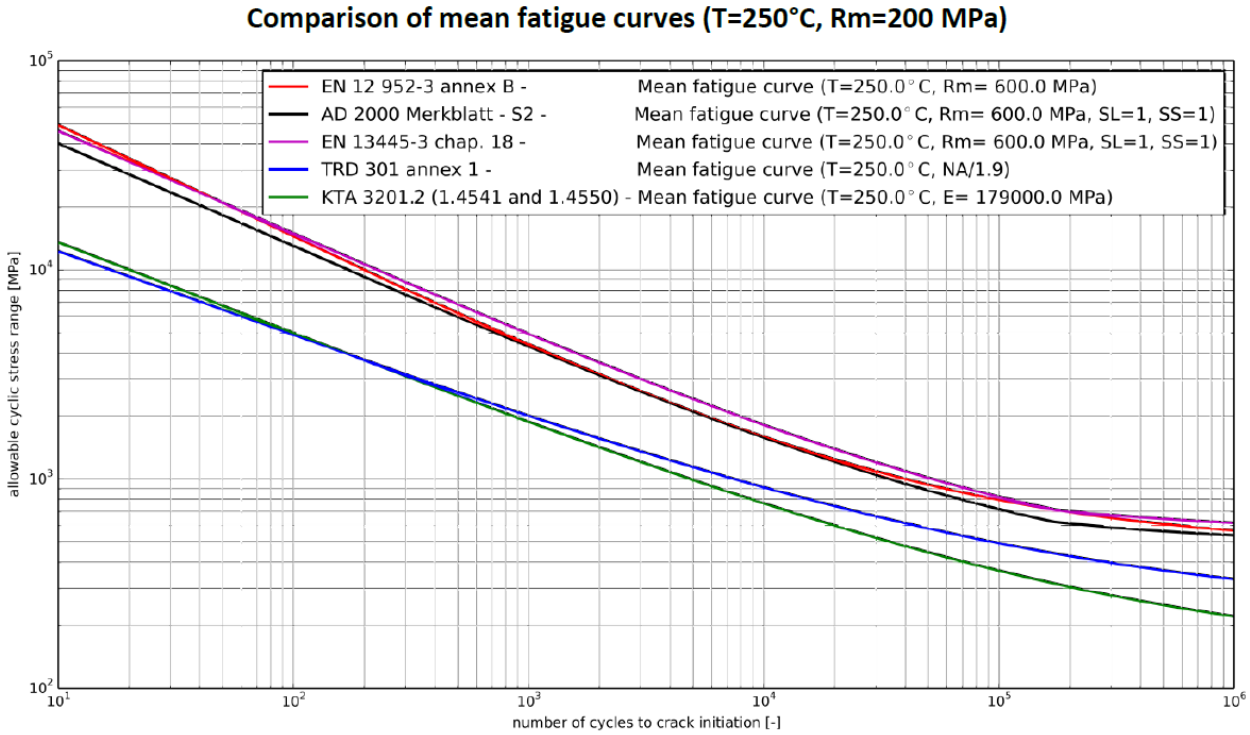
Materials and Fabrication

- Documentation of manufacturing quality

Design and analysis, including damage and failure analysis

- Development of advanced inelastic material laws considering creep, fatigue and creep-fatigue interaction, e.g. Chaboche type
- Implementation of microstructural based damage models
- Improved methods for equipment design (DBF /DBA): Creep design rules
  - Determination of allowable strain criteria (e.g. influence of multiaxiality)
  - Establish a standard method for calculating structural stresses from FEA
  - Fatigue design (e.g. simplified fatigue assessment)
  - Design margins versus different damages, including material properties and examination criteria
  - Limit analysis of equipments
  - Design methods for bolted flange connections

EPERC scope and activities



→ Task Group „ Fatigue“

→ See also research activities for flexible power plant operation

EPERC scope and activities

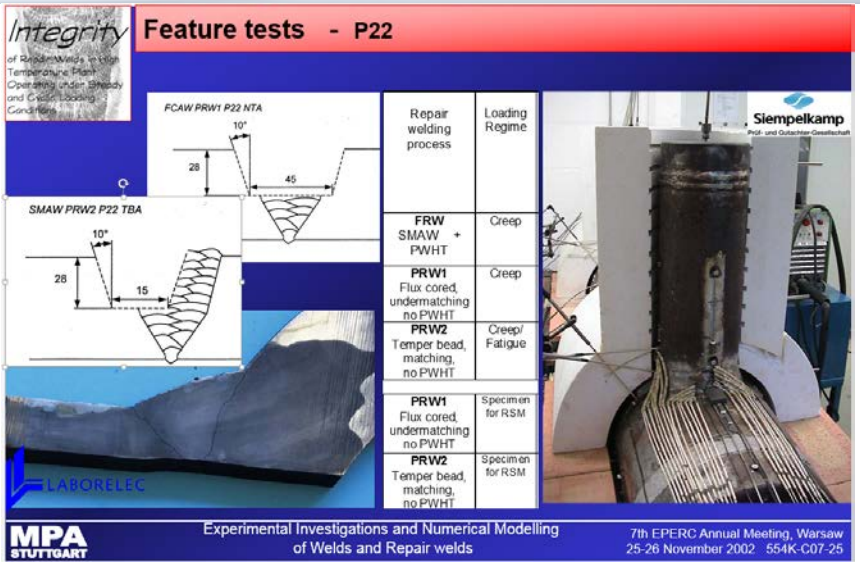
- OPERATION AND MAINTENANCE
- Consequences of repairs: residual stresses and consequences on damage
- Influence on given design characteristics (short term, fatigue, creep)
- Crack acceptance criteria based on an European consensus of harmonized and validated rules for equipment assessment, in connection with past and future Networks
- Validation of damage accumulation rules (eg TRD - EN)
- Advanced damage accumulation approaches: interaction e.g. creep /fatigue, corrosion/erosion:
- Definition of thresholds (cycles/load time) up to which fatigue or creep damage can be neglected
- Implementation of assessment routes for new NDT methods and sensors

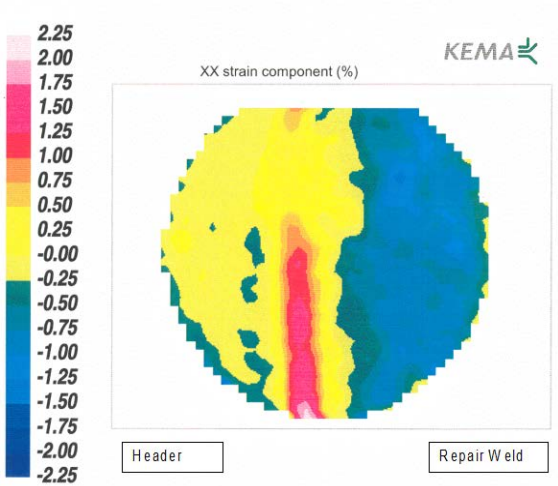
Current achievements - Repair Welds

REPAIR

Results from
EU project „Integrity“
available

Different weld/base
metal combinations and
weld configuration





New monitoring tools

Approaches using numerical simulation