Thermal ageing and EAC research for plant life management, THELMA

SAFIR2018 final seminar 21-22.3.2019
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THELMA objectives

- Understanding and measuring the long-term effects of LWR environments on the behaviour of SSC materials (structures, systems and components)

- THELMA focusses on
  - The effect of thermal ageing, of irradiation and of LWR environment on SSC materials
  - Knowledge building
  - National knowledge transfer

- Knowledge built in THELMA (and preceding and successive SAFIR projects) are used for
  - Securing safe NPP operation / good enough SSC properties
  - Root cause analyses
  - Ageing management
  - Design, maintenance and ageing mitigation of SSC component
  - Recognition of raising topics concerning ageing
Thermal ageing of cast stainless steels and stainless steel welds

All materials change properties with time – how much, how fast and how. Plant temperatures results in different results compared to accelerated ageing.
Thermal ageing of Alloy 690

Can short-range ordering (SRO) degrade Alloy 690 properties during 60 y operation? YES it can

The risk for SRO depends on the Fe-content

EPRI is now looking into this issue also
Ageing of internals

Bolt cracking at Loviisa NPP:1 (8); France (numerous), Indian Point, 227/832; Salem, 189; D.C. Cook, 181. IASCC in other components...

Localisation of deformation is key for IASCC
Defects by neutron irradiation affects deformation
THELMA investigated how deformation occurs
304SS is less stable than other types, and this affects deformation
EAC precursors and mitigation thereof

EAC in Ni-based dissimilar metal welds is a continuous issue, also in Finland.

- **DMW Alloy 182**
- **SS primary piping**
- **RPV nozzle**

**Method verification**

Round Robin testing: Polished surface have higher initiation threshold stress in BWR environment than ground surface. PWR seems to be the opposite!

EU-MEACTOS Mitigation of EAC through surface optimisation 2017-2021
Combine mechanical and microstructural characterisation of RPV steels (BRUTE)

All Uddcomb RPVs are welded using a high-Ni filler metal

From macro- to micro to nanoscale, microstructural factors affect mechanical properties

Kristina Lindgren thesis, Dec. 2018: Thermal ageing and irradiation cause different defect structure – they can be identified
International co-operation and knowledge transfer

Invited lecture(s) at Eurocorr 2017, to be published in 2019 as a book

- Benchmarking
- YG education
- International recognition
- Network
- Latest news to Finland
Thank you for
- listening
- for the funding
- for the materials
- for the opportunity
- for excellent work, project team