Safety re-evaluation and relicensing of the HFR-Petten

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Contents

• HFR General characteristics
• HEU-LEU conversion
• HFR relicensing
• Technical Modifications
• Extension of irradiation capacity
• Spent fuel
• Safety Culture
HFR General characteristics

- Owner JRC-EC, operator NRG
- MTR-pool type, 45 MW
- Operating since 1962
- Wide range of experimental positions
  - In-core
  - Poolside facility
  - Horizontal beam tubes
- Material research and radioisotopes production
- ~ 300 full power days per year
- Technical lifetime beyond 2015
View containment building
View in reactor pool
Cross section reactor core
HEU-LEU conversion (1)

- Non-proliferation of HEU
- USA spent fuel return program
- Availability of HEU
- JRC decision to convert in 1999
HEU-LEU conversion (2) - LEU fuel element -

- $U_3Si_2$ in Al matrix
- 19% enrichment
- 550/440 g $^{235}U$ in F/CR
- 20/17 fuel plates in F/CR
- $^{113}Cd$ wires burnable poison
- 50 (45) MW power
HEU-LEU conversion (3)
- Prototype testing, 75% burn-up -
HEU-LEU conversion
- Core management -

• Fully qualified and licensed fuel
• Increase of cycle length (28 > 31 d)
• Minimum loss of thermal flux for isotopes
• Progressive core conversion
• Start conversion cycle 2005-10
HFR license renewal

- 10 yearly safety re-evaluation on request of Dutch regulator
  - TOPA evaluation
  - Safety Analyses (incl. LB-LOCA)
  - Risk Scoping Study (level 1,2,3)
  - Seismic analyses
  - Fire and flooding analyses
  - Aging analyses (M, E, C)

- HEU-LEU conversion requires new license

- Licensing documents:
  - Safety Report
  - Environment Impact Statement Report
Licensing procedure

- Licensing project started 01-01-2001
- License renewal request 23-12-2003
- Public hearing 15-03-2004
- Receipt of new license 23-02-2005
- Licensee: NRG iso JRC
- Implementation of hardware modifications 2005-2007
Licensing documents
Major Technical Modifications

- Additional set of vacuum breakers on reactor vessel
- Redundant vacuum breakers on existing outlet lines
- Jacket pipes at lowest part of primary system
- Accident pressure equalisation lines
- Controlled use of poolwater through additional pool cooling valves
- Replacement of diesel driven ECS by electrical pump
- Limitation on crane movements
- Redundant/divers shutdown system (RSS)
- Remote control room
Modified primary system

- Additional emergency shutdown
- Vacuum breakers
- APE lines
- Guard pipe
- Pool-vessel connection
Installed primary system modification (1)
Installed primary system modification (2)
Extension of irradiation capacity

• HFR is one of the main producers of radio isotopes in the world
• Increase of $^{99}$Mo irradiation capacity
• In-core $^{99}$Mo irradiation facilities
  – INCOMODO, for cylindrical targets, operating since 2001
  – TYCOMO, for plate type targets, operating since cycle 2005-05
• Modification of Pool Cooling System: May 2005
Upgrade Pool Cooling System
Spent fuel

• Transports recent years:
  – USA transport 117 FE’s, 2001
  – 6 MTR-2 transports of 33 FE’s to COVRA 2003-2004
  – USA transport of 210 FE’s: May 2005

• Planning:
  – USA transport of 210 FE’s in 2006 in preparation
  – Routine transports to COVRA using MTR-2

• Currently ~ 600 spent FE’s in stock
US-transport May 20, 2005
Standard MTR-2 container
Safety Culture (1)

- INSARR mission of 2002 starting point for Safety Culture improvement program
- More emphasis on human factor
- Training programs/workshops supported by IAEA
- Lots of progress achieved in terms of openness, transparency, human performance
- Instruments: Potential Unsafe Situation system, Root Cause Analyses
- Monitoring by personnel enquiry, self assessment, Safety Performance Indication, audits
Safety Culture (2)
- Kind of organization -

Technocratic

Technocratic plus Human/ Learning
Safety Culture (3)

- Safety culture is a continuous improvement process
- Requires a learning attitude from anyone in the organization
- Training program on development of leadership skills
- Bottom-up implementation of Code of Conduct
- Installation of International Safety Experts Team
Safety Culture (4)
- Potential Unsafe Situations -
Safety Culture (5)

• New INSARR mission 13-18 Febr. 2005
• Full scope: largest ever done for a research reactor
• Draft mission report:
  “In general the operating organization showed a high commitment to a continuous improvement of the reactor safety and a high level of Safety Culture.”

“All the interviewed people showed a high commitment to safety and a high level of technical knowledge.”
PALLAS reactor

- Lifetime current HFR: 2015-2020
- Successor of HFR necessary for continuation of NRG activities
- Preliminary feasibility study performed in 2004
- PALLAS project started 01-01-2005
- Ready for operation 2015
PALLAS (artist impression)
PALLAS time-schedule

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Conclusion (1)

• Achievements reached last few years
  – New HFR license for converted reactor
  – Safety re-evaluation / safety assessment
  – Update of all safety documentation
  – Major safety culture improvement
  – Extension of $^{99}$Mo irradiation capacity
  – Shipments of spent fuel
  – Start of the PALLAS project
Conclusion (2)

- Plans for the near future
  - HEU-LEU conversion 2005-2006
  - Implementation of technical modifications 2005-2007
  - Further reduction of spent fuel
  - Continuous improvement of safety culture including follow-up on INSARR recommendations
  - Set-up of a Joint Undertaking for the HFR
  - Design and technical specifications of PALLAS reactor