Safety re-evaluation and relicensing of the HFR-Petten

P.M. Stoop

NRG, Petten, The Netherlands

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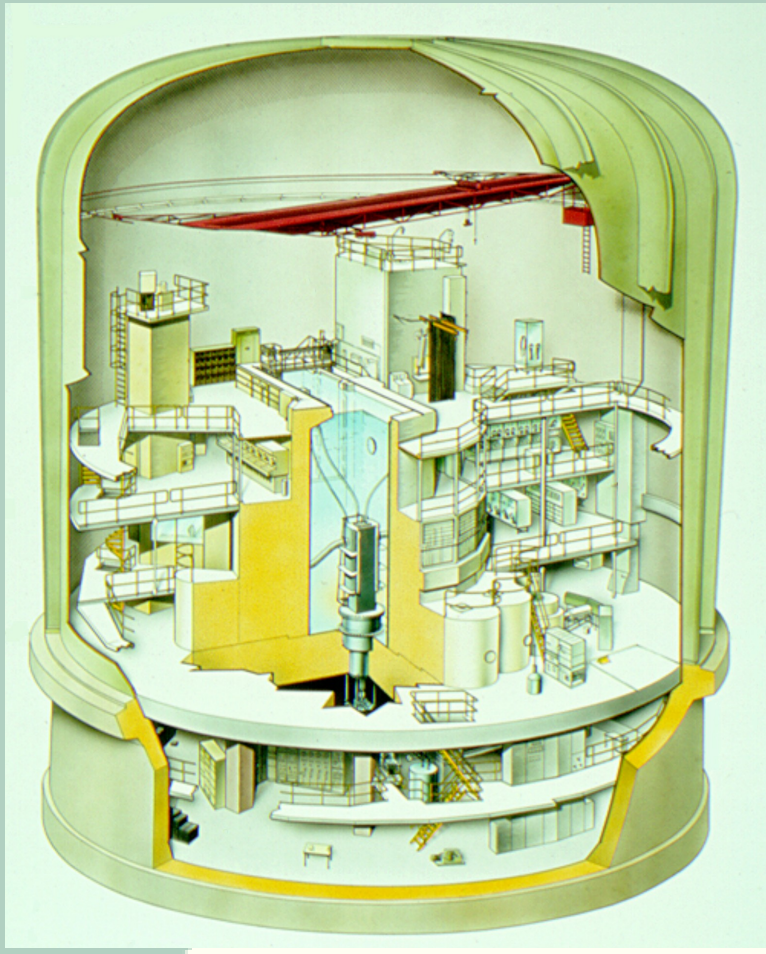
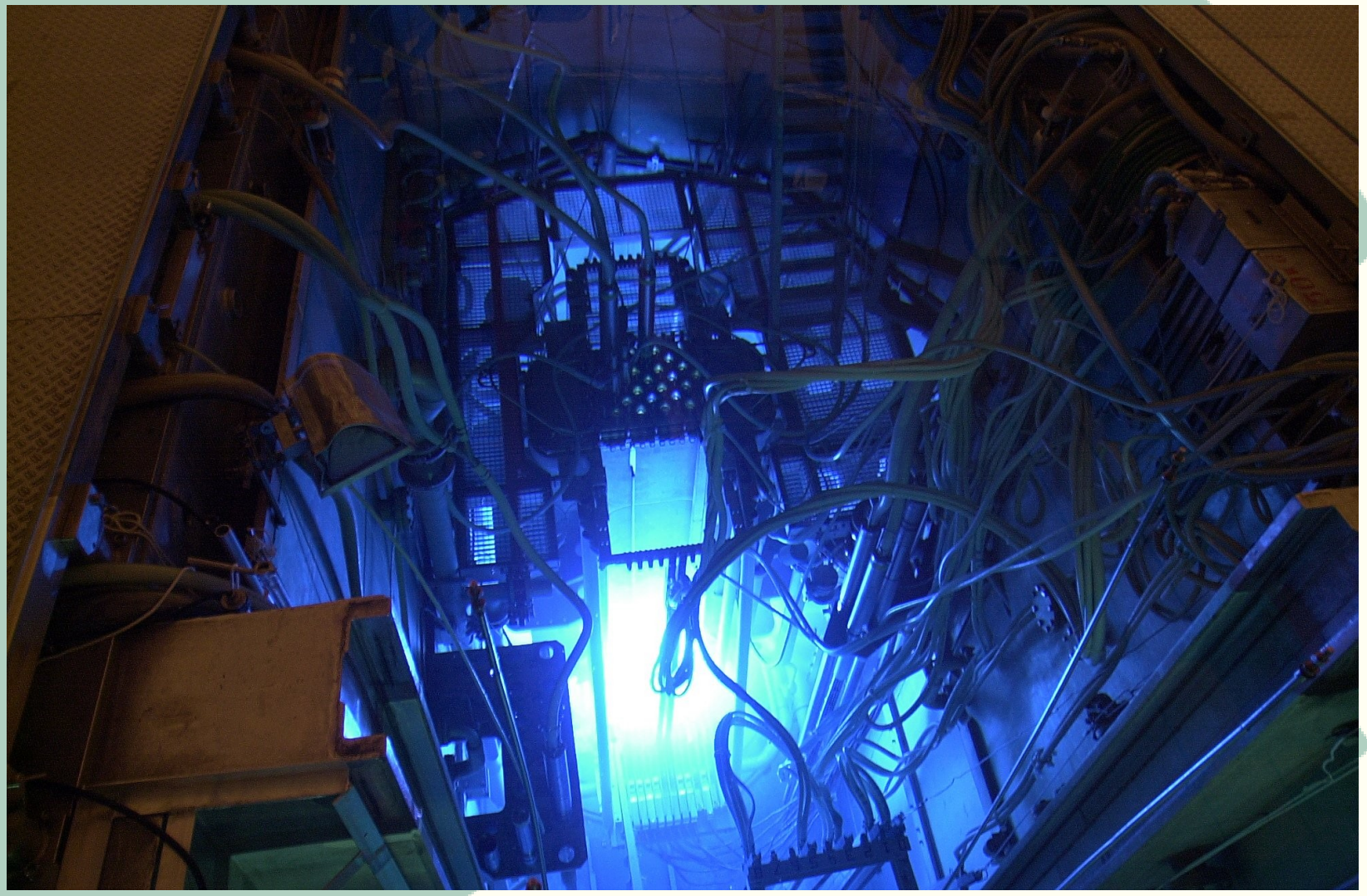
HFR General characteristics

- 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

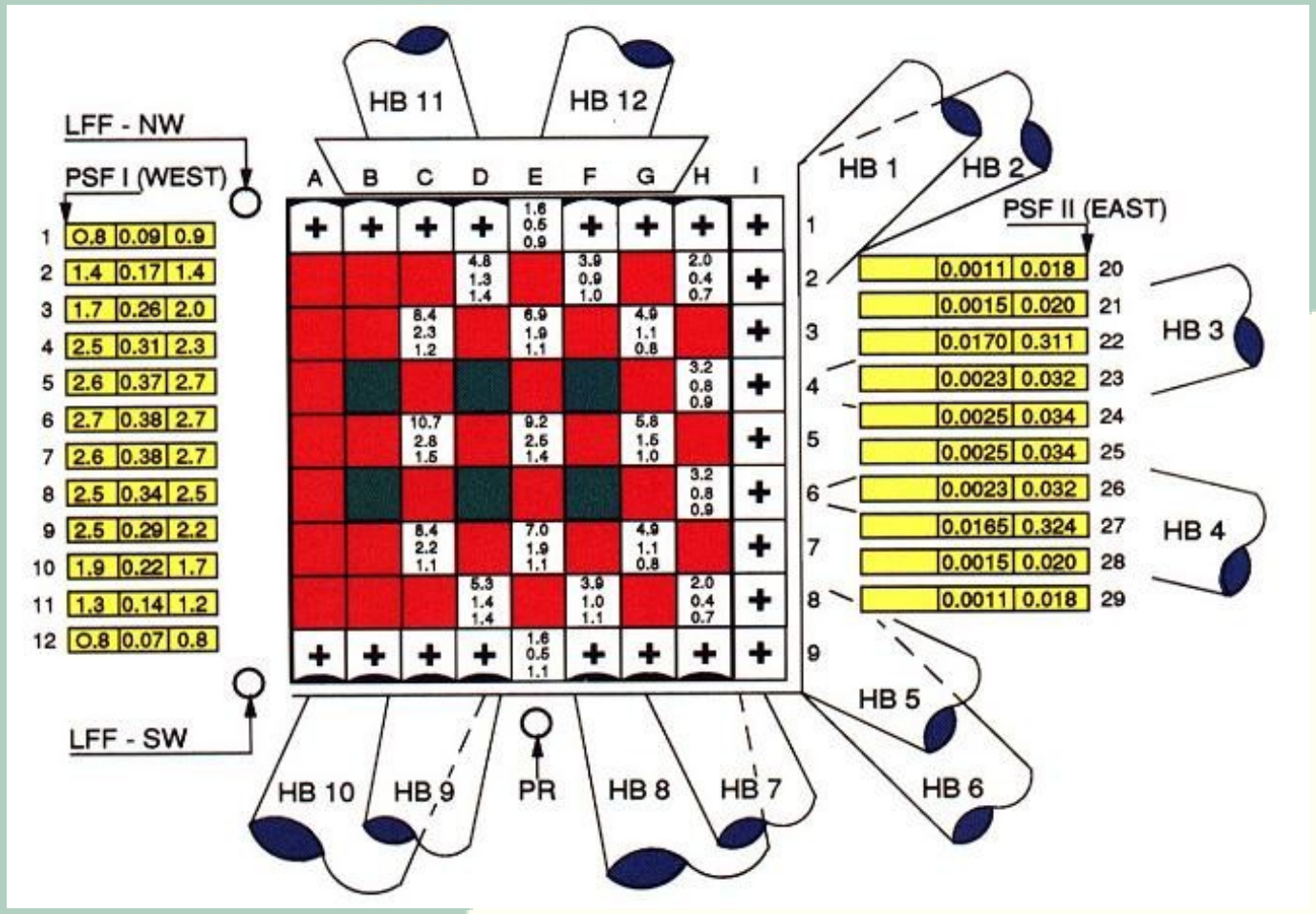
View containment building



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

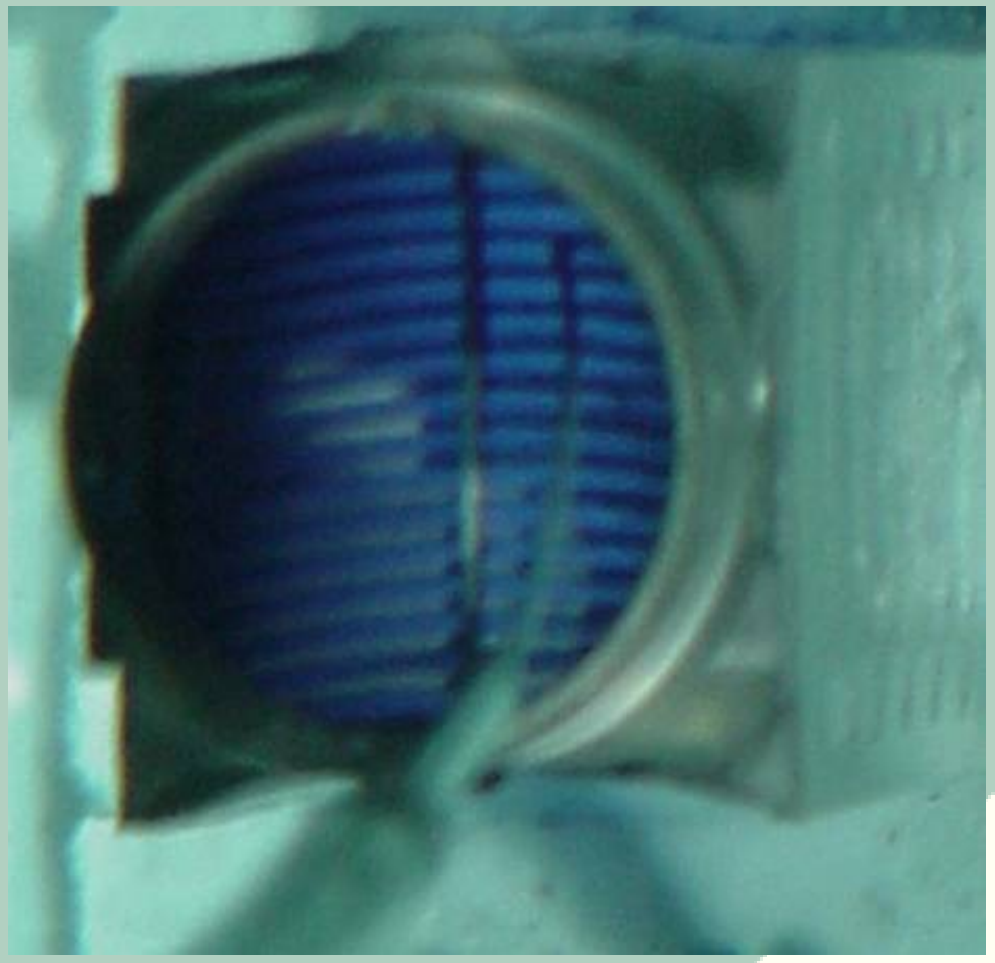
HEU-LEU conversion (2)

- 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

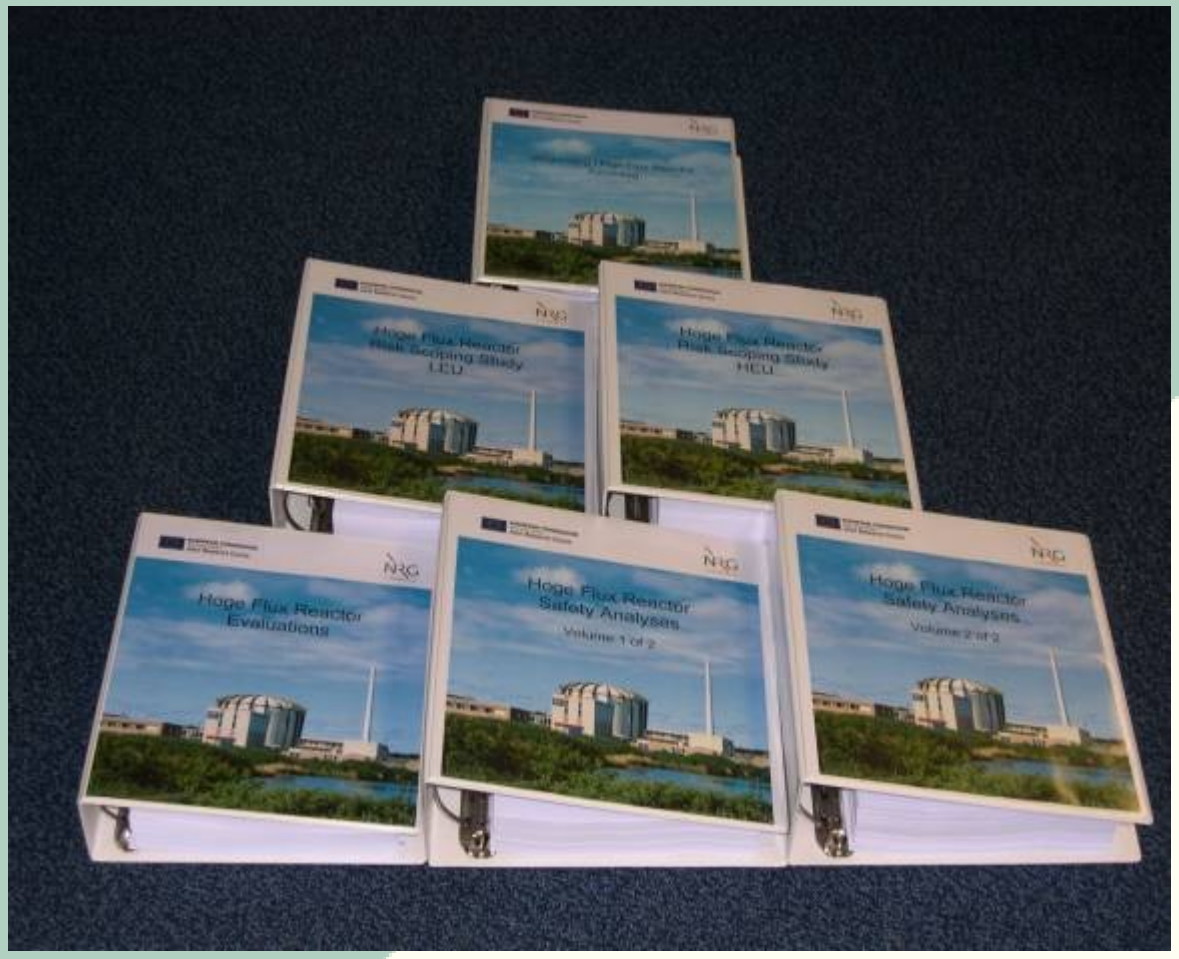
HFR license renewal

- 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 floading 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

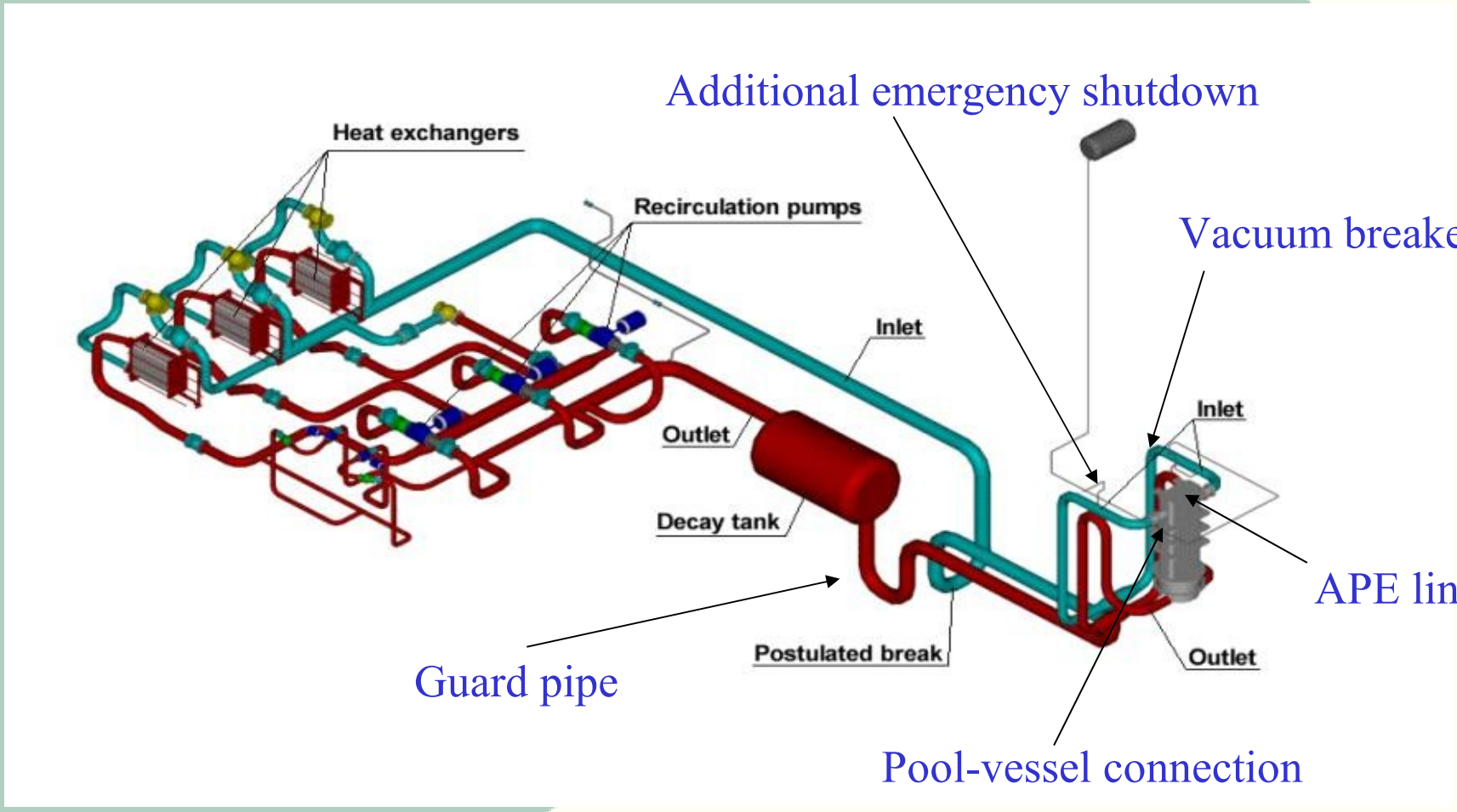
Licensing documents



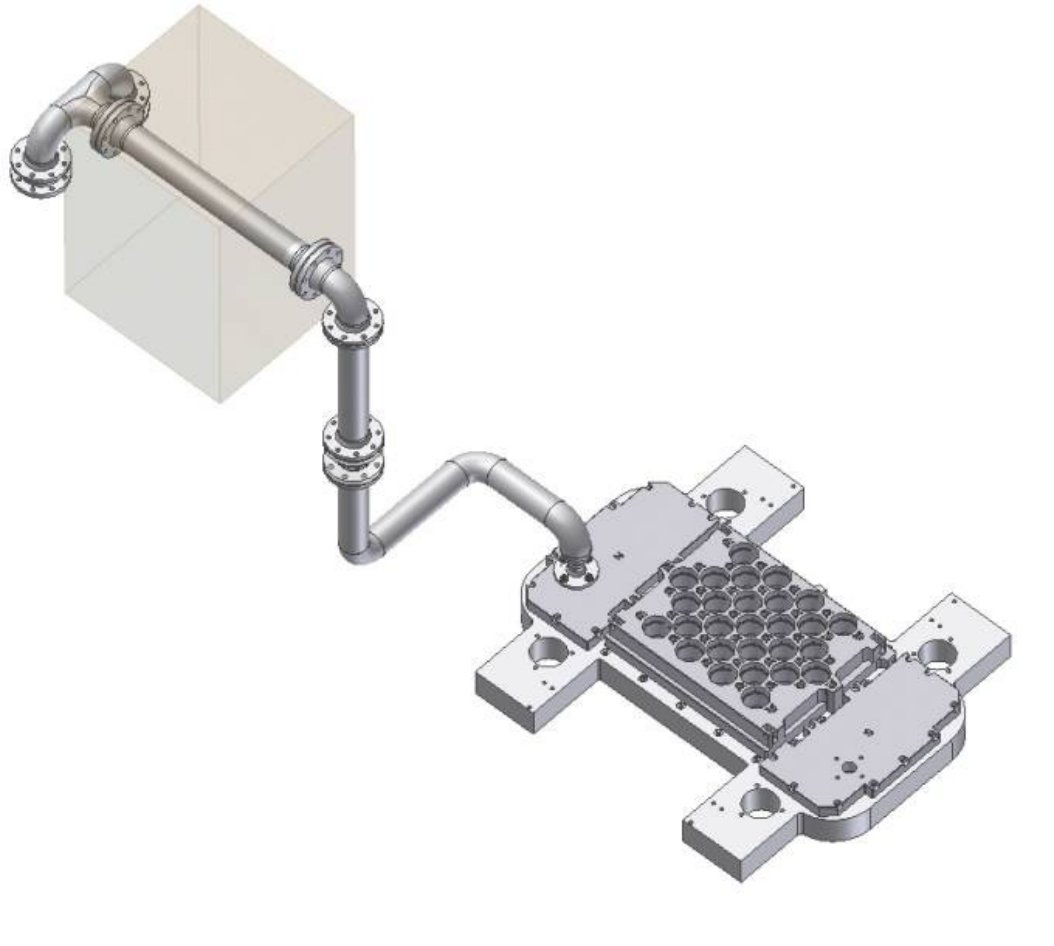
Major Technical Modifications

- 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



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 cilindrical 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 openess, 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

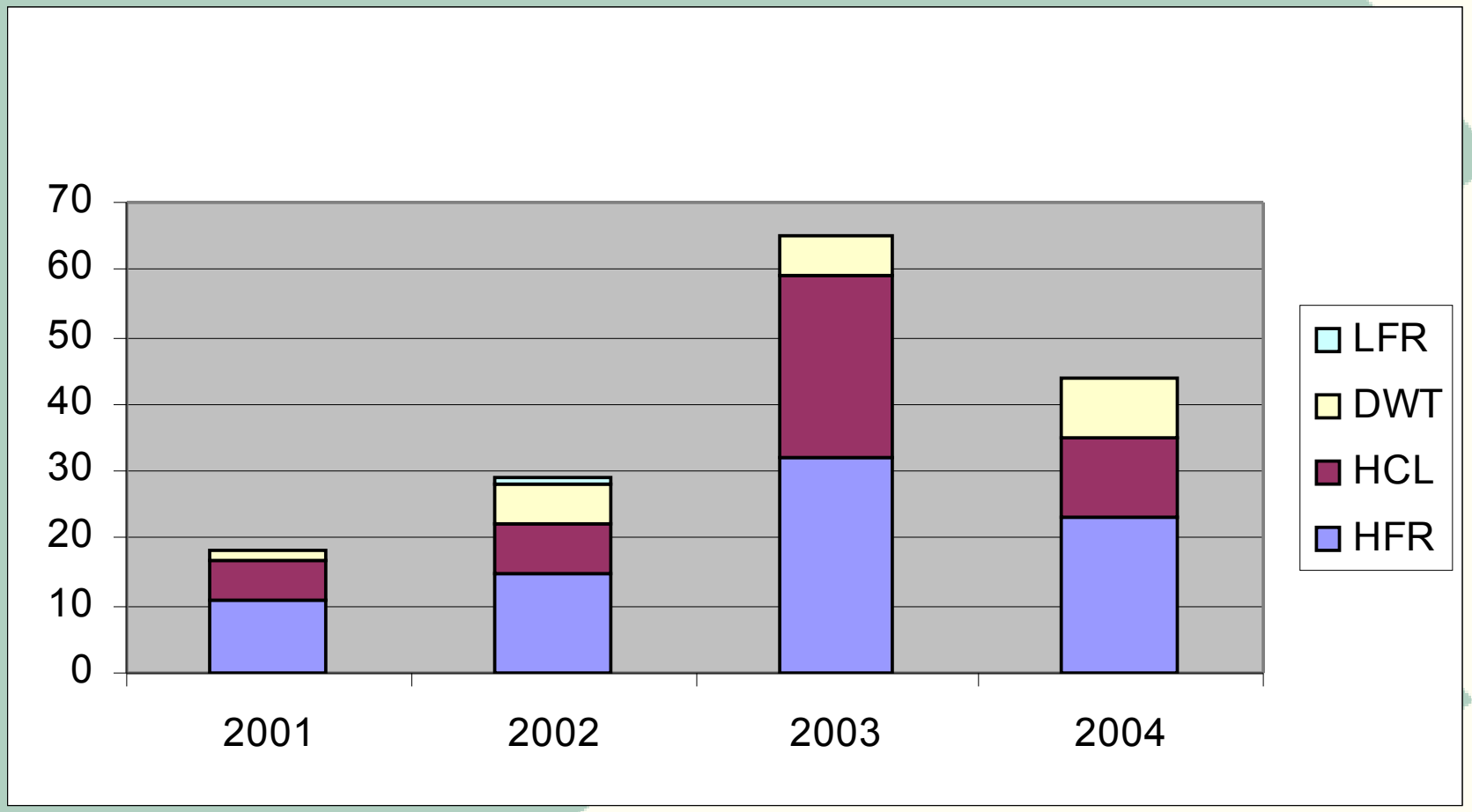
Technocratic plus Human/ Learning

Safety Culture (3)

- Safety culture is a continous 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."

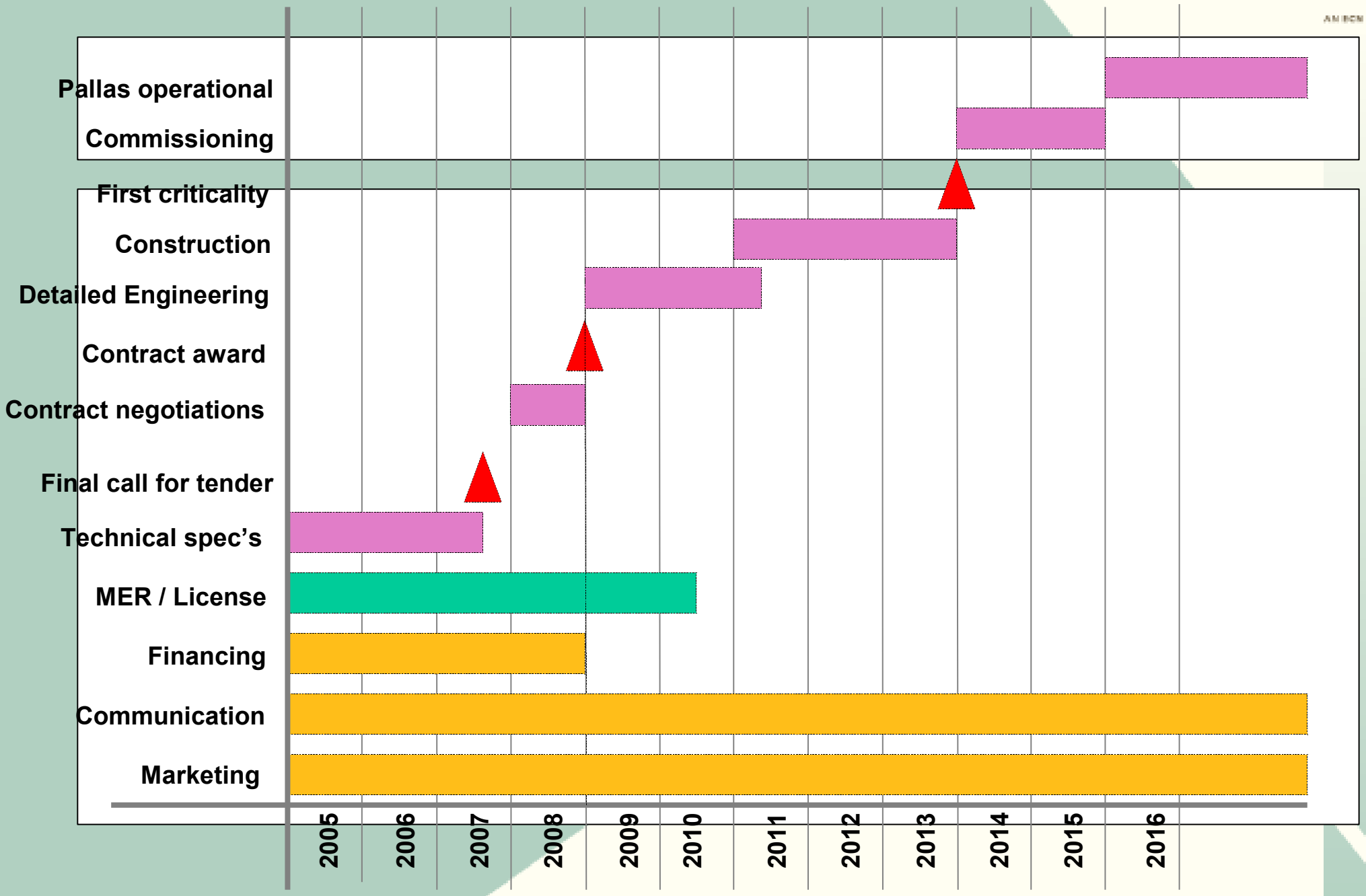
  "All the interviewed people showed a high commitment to safety and a high level of technical knowledge."

PALLAS reactor

- Lifetime current HFR: 2015-2020
- Successor of HFR necessary for continuation of NRG activities
- Preliminary feasability study performed in 2004
- PALLAS project started 01-01-2005
- Ready for operation 2015

PALLAS (artist impression)

PALLAS time-schedule



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