CHALLENGES IN THE LICENSING OF NEW NUCLEAR POWER PLANT, AND SERVICE LIFE EXTENSION OF OPERATING ONES

Safeguards, safety and security aspects

Kristóf Horváth, PhD
Hungarian Atomic Energy Authority
Co-authors: M. Lehota, G. Petőfi
Paks Nuclear Power Plant

Paks NPP

- Four VVER-440/213 type reactors
- Commissioned in 1983, 84, 86, 87, designed for 30 years
- Six-loop, horizontal steam-generators
- Provides cca. 40% of domestic electric energy production
- Load factor – overall: 80-90%
- Power increase in two steps to 500-510 MWe completed
- LTO to 50 ys is underway
Licensing of new NPP units
The first steps towards a new NPP

**Act CXVI of 1996 on Atomic Energy**

7. § (2) Preliminary consent in principle of the Parliament shall be required for the commencement of preparatory actions for the construction of a new nuclear facility or radioactive waste repository, or for the expansion of an existing nuclear power plant with an additional unit containing nuclear reactors.
New National Energy Strategy

**Goal:** to ensure the long term sustainability, security and economic competitiveness of energy supply in Hungary

‘Nuclear-Coal-Green’ scenario

- the long-term preservation of nuclear energy in the energy mix

- **LTO**
- **New Units**

14 Febr 2012
New National Energy Strategy
New Units
1. Preparation and regular review of Regulation
2. Regulatory control (authorization, inspection, assessment, enforcement)
   - of nuclear installations and storage facilities (HAEA NSD)
   - of nuclear and radioactive materials (HAEA GND)
3. Emergency response and preparedness
4. Technical support
5. International relations
6. Public information

Safety
Security
Safeguards
The Nuclear Safety Regulation in Hungary

Act No. CXVI/1996 about Nuclear Energy

Gov. Decree No. 118/2011

Nuclear Safety Codes

Safety Guidelines

Local Regulations

1 2 3 ... 9 10

Legally binding

Non-legally binding

Other regulations
Key events

2008: New Energy Policy Concept
30th March, 2009: decision-in-principle of the Hungarian Parliament on new NPPs


2012: establishment of MVM Paks II. Nuclear Power Plant Development Ltd

2013- : Collation with the EC based on Euratom Treaty

January 2014: Intergovernmental agreement on the peaceful use of nuclear energy by Russia and Hungary -> Act II/2014

- Two VVER-1200 type reactors at the Paks site
- Russian loan for the 80% of construction costs
Key events

March 2014: Financial IGA about the interstate loan for the extension of Paks NPP → Act XXIV/2014

June 2014: Nomination of a government commissioner on the Paks-2 project

December 2014: Implementation agreements with Russia

- MVM Paks II. Nuclear Power Plant Development Ltd.
- Russian Joint-Stock Company Nizhny Novgorod Engineering Company Atomenergoproekt
  - EPC contract
  - Operation and maintenance support contract
  - Agreement detailing fuel supply and the handling of spent fuel
Assessment of the AES-2006

- **Paks 1-4**
  - Generation I
    - VVER-440
      - NVAES-3
      - 1966
    - VVER-70
      - Reinsberg, East Germany
      - 1966
- **Paks 5-6**
  - Small series
    - VVER-1000
      - NVAES-5
      - 1980
  - Great series
    - VVER-1000
      - Zaporizhzhia-1
      - 1984
    - VVER-440
      - Loviisa, Finland
      - 1977
    - VVER-365
      - 1969
  - AES-92
    - First unit
      - NPP Kudankulam
      - 2 units
      - 2010
  - AES-2006
    - Leningrad-2
      - 2013
The main sources of revision

• lessons from use of existing regulations,
• recently issued IAEA standards, guides
• WENRA, OECD NEA,
• EUR, MDEP documents,
• recommendations from the international reviews
Lessons learned from Fukushima

DS462 - Amendments to the IAEA Safety Requirements:
The main sources of revision

Experience of the ongoing licensing and construction activities

- France
  - Flamanville 3
- Finland
  - Olkiluoto 3
- Russia
  - Novovoronyezs-II
  - Leningrád-II
- USA – ESP, COL, DC
  - Vogtle
  - VC Summer
- UK – Generic Design Assessment
New sets of Regulation

Act CXVI of 1996 on Atomic Energy

Government Decree No. 118/2011. (VII. 11.)
(on the nuclear safety requirements of nuclear facilities and related regulatory activities)

Annexes (Nuclear Safety Regulation)

Guidelines
Planned time schedule for the project

Planned milestones of the licensing process:
- 2014: site assessment and program licence
- 2015: environmental licence (pending due to Espoo procedure)
- 2016: site permit
- 2017: construction licence

Planned milestones of the design and construction process:
- 2014: EPC contract
- 2015: general design and detailed design by the general contractor
- 2016: review of design
- 2018: start of construction
- 2025: start of commercial operation at Unit 1
- 2026: start of commercial operation at Unit 2
The main licensing steps

**Safety**
- **Site Evaluation**
  - Licensing of Site Investigation and Evaluation
  - Licensing of the Site
- **Construction licence**
  - Licensing on level of SSCs
- **Commissioning licence**
- **Operational licence**

**Security**
- **Determination of Design Bases Threats**
- **Licensing of Physical Protection Plan**

**Safeguards**
- **Preliminary supplying data**
- **Preliminary supplying data**
- **Safeguards registration** (7m prior the fuel)
Program
Natural External Hazards

Earthquakes and permanent surface displacements

Geotechnical hazards

• Slope instability
• Collapse, slumping, settlement, or emergence of the surface of the site
• Soil liquefaction
Program
Natural External Hazards

Extreme weather conditions,
Meteorological phenomena

Flooding
• Due to rainfall or flood
• Hazards caused by damage of water structures

Nebraska NPP, USA, Missouri, 2011
Program
Man-made External Hazards

*Human-made external events*

- Aircraft crash (unintentional)
- Explosion of hazardous chemical agents, cloud of toxic gases, smoke and thermal impacts
- Other significant human-made events (neighbouring nuclear and other industrial facilities, forest fire and car fires, road-, river-, rail transport, electromagnetic interference, ...)
Dispersion of radioactive materials

- Atmospheric dispersion of radioactive materials
- Dispersion of radioactive materials via surface waters
- Dispersion of radioactive materials via subsurface waters
Program

Determination of site characteristics for emergency plans

- assessment of feasibility of the emergency actions
Survey Areas

Regional investigation
Investigation of the neighbouring area of the site
Investigation on the site
Survey on the site

Hungarian Atomic Energy Authority

4th meeting of MDEP
WWER-TESG-FUKU
March 8-10, 2016 Helsinki, Finland
Licensing of LTE of operating units
Key events

2000- NPP declares its intention
2001- strategy decision
2001- HAEA starts preparation
2002- NPP reliability study
2006- environmental license
HAEA preparation

Limited international references
Development of regulations and guidelines

Combined approach
  License renewal
  Periodic Safety Review
Four legs of LTE

Design basis
Ageing management
Equipment qualification
Maintenance effectiveness monitoring
New regulations

- NPPs
- Research and Training Reactors
- Spend Fuel Storage Facilities

Volume 1. – Regulatory procedures of Nuclear Facilities
Volume 2. – MS of Nuclear Facilities
Volume 3. Design of NPPs
Volume 4. Operation of NPPs
Volume 5. Design and Operation of Research and Training Reactors
Volume 6. Design and Operation of Spend Fuel Storage Facilities
Volume 7. – Siting of Nuclear Facilities
Volume 8. – Decommissioning of Nuclear Facilities
Volume 9. – Construction of New Nuclear Facilities
Volume 10. – Definitions
Two-step approach

Approval of the LTE programme
  Establishment of conditions
  Five years prior to submission of LTE application
  Common for four units
  Check the way forwards
Licensing of LTE
  Individually for each unit
  Application to be submitted 1 year in advance
  Based on the approved programme
International validation
Challenges

Determination of the scope
Ageing management programme
Time-limited safety analyses
Equipment qualification
Maintenance effectiveness monitoring
Lessons learned: SLE programme

No major obstacle for later licensing
315 findings and 101 further comments
Programme follow up
  Regular progress reports
  Special emphasis: maintenance effectiveness monitoring, AMPs, TLAAs
Specific technical issues
  scoping (system boundaries), replacement of secondary piping containing copper, service cycle numbers, thermal stratification, primary piping support problems, carbon steel collectors remained in the steam generators
Lessons learned: SLE programme

Both parties benefited to better prepare for licensing complex documentation technical and administrative issues devote due time and resources authority opinion and requirements conducted the operator

Targeted inspections time limited ageing analyses maintenance effectiveness monitoring environmental qualification of electric equipment
SLE application review

Same project structure
Documentation
>21000 pages (+ 50000)
Still with lacking information.

Public hearing (inhabitants within impact area of 3 km)
Competent environmental co-authority procedure
Modification of other documents (EP, TS, FSAR etc.)
Disaster management co-authority for EP
Changes legal background (new Govt. Decree in 2011)
Lessons learned during review of license application

Many TLAAs were not real TLAAs, the scope was wider than in any other known international examples.

In many cases, a one-time review could not be possible.

Review was mainly focused on safety class 1 components.
Lessons with SLE licensing

Most problematic areas
  - Introduction of maintenance rule
  - Equipment qualification
  - DB reconstruction strength calculations
Several supplements and parallel procedures
1 year regulatory procedure (15.12.11-15.12.12)
21000 pages + supplements (over 50000)
25 inspectors, at least 750 inspector-days
Impossible to be overviewed by a single person
Involvement of environmental authority
Stress tests vs. Service life extension

Post-Fukushima stress tests completed in 2011
Safety improvements have been decided by operator
Approved and supplemented by authority
Results were confirmed by international peer review
Not interconnected with life extension, shall be carried out as part of „normal business”
Some preconditions were accelerated (H-recombiners)
Additional inspections served also SLE purposes
Thank you for your attention!