Status of a Periodic Safety Review of HANARO

Dec. 4, 2017
Jinwon Shin
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Brief History of Legal Requirement

- **Oct. 1996**  Korea’s ratification for PSR of NPP during IAEA Convention on Nuclear Safety
- **Dec. 1999**  National Nuclear Safety Committee decided to implement PSR for operating NPPs
- **Dec. 2000**  Establishment of basic plan for PSR in KHNP
- **Jan. 2001**  PSR for NPP was legalized
- **Dec. 2014**  Amendment of National Nuclear Safety Act, PSR for RR included, No. of SFs (11→14)
Establishment of Project Management Team

Many engineers and researchers who worked in the design & construction stage are no longer available.

The remainders are assigned to new other projects.

Task Force Team has been set up for managing this project, whose members are mainly the staffs of HANARO Management Division.

External companies and other divisions in KAERI perform the review of safety factors and the global assessment.

Quality Assurance Team is also involved in the project.
Tasks of Project Management Team (1)

- Project planning
- Budget planning
- Time scheduling
- Preparation of the basis document for PSR
- Preparation of specifications for making contracts with engineering companies for a review of safety factors and a global assessment
- Gathering input documents for the review of safety factors and offering to engineering companies and other divisions in KAERI
Tasks of Project Management Team (2)

- Review of the safety factor review report
- Review of the global assessment report
- Preparation of the integrated implementation plan of safety improvements
- Submission of the PSR documentation to the regulatory body, which includes the summary report covering review of each safety factor, the global assessment report, and integrated implementation plan
Quality assurance team prepares a quality assurance plan that defines the requirements for the preparation and verification of the PSR documentation.

The quality assurance plan ensures that all reviewers use the same input data to maintain consistency across all areas of the review.
Establishment of budget

- Estimation of the overall budget for the PSR project
- Consideration of the scope of the review, the schedule, the human resources available in the organization, and the amount of payment to contractors.
- KAERI consulted domestic engineering companies about an expected expense for the PSR project.
- The project manager submitted a final proposal to the senior & executive management for the required budget.
- The approval from the government in 2015.
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Establishment of a project management team, detail plan of the review, and preparation of budget</td>
<td>Jun. 30, 2015</td>
<td></td>
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<tr>
<td></td>
<td>Understanding between the KAERI and the Regulatory body on the PSR</td>
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<td></td>
<td>Tendering process for contracts</td>
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<td>4</td>
<td>Search and Retrieval of PSR input data such as design documents, construction drawings, analysis report and input/output data</td>
<td></td>
<td>Sep. 30, 2016</td>
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<td>5</td>
<td>Review of 14 safety factors</td>
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<td></td>
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<td>Jun. 30, 2018</td>
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<td></td>
<td>- Review by contractors</td>
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<td></td>
<td>- Review by internal staff</td>
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<tr>
<td></td>
<td>Preparation of Global Assessment Report</td>
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<td>6</td>
<td>Preparation of final PSR report including summaries from the safety reports, global assessment report and integrated implementation plan</td>
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<td>Dec. 15, 2018</td>
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<td>7</td>
<td>Submission of the final PSR report and summary report to the regulatory body</td>
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<td>Dec. 31, 2018</td>
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<td>8</td>
<td>Assessment of PSR reports submitted and preparation of assessment reports</td>
<td></td>
<td></td>
<td>Dec. 31, 2018</td>
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<td>Approval by the regulatory body</td>
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<td></td>
<td>(End of the PSR)</td>
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<td>9</td>
<td>Execution of the integrated implementation plan</td>
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Date of PSR report submission: by Dec. 31 2018 according to the decree

Subjected period of PSR: Feb. 8, 1995 (First Criticality) ~ June 30, 2017

Effective Code cut-off date: June 30, 2018

- Reflection of experience of PSR on NPP: 6 months before the end of PSR report submission
The IAEA Specific Safety Guide No. SSG-25 recommends that a basis document should be produced.

Contents of a basis document (IAEA Guides)

- The scope and objectives of the PSR
- The current national and international standards and codes
- Project plan
- The plant licensing basis at the time of initiation of the PSR
- A description of the systematic review approach
- Process for identifying, categorizing, prioritizing, and resolving negative findings
PSR basis document (2)

- Major milestones, methodology of the PSR, the safety factors to be reviewed, and the structure of the documentation
- The methodology & document structure of the global assessment
- Guidance to prepare the integrated implementation plan
- A plan for communicating and gaining relevant approval from the regulatory body

Contents of a basis document (HANARO)

- The scope and objectives of the PSR
- National regulations and codes and standards
- Safety factors to be reviewed
- A list of SSCs
- Methodology of the PSR
- Major milestones
PSR - Safety Factors

Plant
1. Plant design;
2. Actual condition of the structures, systems and components (SSCs) important to safety;
3. Equipment qualification;

Safety analysis
5. Deterministic safety analysis;
6. Probabilistic safety assessment;

Performance and feedback of experience
8. Safety performance
9. Use of experience from other plants and research findings.

Management
10. Organization, the management system and safety culture;
11. Procedures;
12. Human factors;

Environment
14. Radiological impact on the environment
Classification of Safety Factors (Group 1)

- 7 safety factors to be reviewed by a contractor (KEPCO E&C)
  1. Plant design (SF#1)
  2. Actual Condition of SSCs important to safety (SF#2)
  3. Equipment Qualification (SF#3)
  4. Ageing (SF#4)
  5. Probabilistic safety assessment (SF#6)
  6. Hazard analysis (SF#7)
  7. Use of experience from other plants and research findings (SF#9)
Classification of Safety Factors (Group 2)

- 5 safety factors to be reviewed by another contractor (FNC Technology)
  1. Deterministic safety analysis (SF#5)
  2. Safety performance (SF#8)
  3. Organization, the management system and safety culture (SF#10)
  4. Procedures (SF#11)
  5. Human factors (SF#12)
Classification of Safety Factors (Group 3)

- 2 safety factors to be reviewed by KAERI’s Nuclear Emergency and Environmental Protection Division
  1. Emergency planning (SF#13)
  2. Radiological impact on the environment (SF#14)
The review of safety factors (2016 ~ 2017)
- 7 factors: KEPCO E&C
- 5 factors: FNC Technology
- 2 factors: KAERI’s internal division

The first draft of safety factor review report (Dec. 2017)

Global assessment (2018)
- Collaboration between KAERI and engineering companies

Integrated implementation plan for safety improvements (2018)
- KAERI

Submission of PSR report to regulatory body (2018)
- KAERI
The list of SSCs

- Safety Class 3 items + Safety related items
  - Too many safety related items
- The extent of including experimental facilities those interface with reactor
  - Thermal neutron scattering instruments
  - Cold neutron research facilities
Graded Approach

- Regulatory Guide for PSR of PWRs (KINS/GE-N70) is applied as a only available guide for review of PSR of research reactor
  - Graded approach is not mentioned in this guide although Safety Review Guideline for research reactor and Testing Reactor Facilities (KINS/GE-N10) implies graded approach.
  - Application of this guide may result in excessive findings and recommendations
- The regulatory body is preparing a regulatory guide for PSR of RR
Issues on implementation (3)

- PSA (Probabilistic safety assessment)
  - Not a licensing requirement
  - Haven’t been recommended for 20-years operation
  - Became a legal requirement for PSR

- Planning of PSA
  - A level 1 PSA which addresses the risks associated with the core damage.
  - Include only internal initiating events like a loss of normal electric power in full-power operation.
Conclusions

- The first PSR project for HANARO commenced in 2015 after operating 20 years
- Review of 14 safety factors is being performed by two domestic engineering companies and KAERI’s internal division.
- Graded approach is the common issue for the operating organization and the regulatory body
- PSR report including an integrated implementation plan for safety improvements will be submitted to the regulatory body by the end of 2018
Thank you
Classification of Safety Class

10 CFR 50

App.B (QA)  App.A (GDC)

Regulatory Guide

ASME NQA-1

ASME, ANSI/ANS, IEEE, NUREG

Quality Class

Q
T
R
S

Safety Class

SC-1
SC-2
SC-3
NNS

Seismic Class

Seismic Category - I
Seismic Category - II
Non-Seismic

Electrical Class

Class-1E
Non-class-1E

IAEA Safety Requirements NS-R-4

ANSI/ANS 51.1 (1983)
### Classification of HANARO SSCs

<table>
<thead>
<tr>
<th>Safety Class</th>
<th>Seismic Category</th>
<th>Quality Class</th>
<th>Electrical Class</th>
<th>Systems. Structures, Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC-1</td>
<td>I</td>
<td>Q</td>
<td>1E</td>
<td>Not applicable to HANARO</td>
</tr>
<tr>
<td>SC-2</td>
<td>I</td>
<td>Q</td>
<td>1E</td>
<td>Not applicable to HANARO</td>
</tr>
<tr>
<td>SC-3 (Safety)</td>
<td>I</td>
<td>Q</td>
<td>1E</td>
<td>Reactor Structure Assembly, Primary Cooling System, CRDM, Primary Purification System valves, EWS valves, Horizontal Beam Ports</td>
</tr>
<tr>
<td>NNS (Safety-related)</td>
<td>II</td>
<td>T</td>
<td>Non-1E</td>
<td>Reflector cooling, cover gas system, In-pool Structures &amp; components, chimney support, pool cover, HTS piping, PTS</td>
</tr>
<tr>
<td>Non-seismic</td>
<td>T</td>
<td>Non-1E</td>
<td>RRS, Heavy water leakage monitoring &amp; collection, Primary purification system, Spent fuel cooling &amp; purification, EWS tank &amp; sump pump,</td>
<td></td>
</tr>
<tr>
<td>NNS</td>
<td>Non-seismic</td>
<td>S</td>
<td>Non-1E</td>
<td>Experimental facility cooling, Helium Supply system, Hot water layer system,</td>
</tr>
<tr>
<td>N/A (Safety related)</td>
<td>I</td>
<td>Q</td>
<td>Non-1E</td>
<td>RX concrete structure, RPS cable support</td>
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<tr>
<td></td>
<td>T</td>
<td>Non-1E</td>
<td>Seismic Monitoring System</td>
<td></td>
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<td></td>
<td>II</td>
<td>T</td>
<td>Non-1E</td>
<td>Stack, Pool gate, sump liner, reflector cooling system, man-bridge, NTD, RX Crane</td>
</tr>
<tr>
<td>Non-seismic</td>
<td>S</td>
<td>Non-1E</td>
<td>Fire protection, cooling tower basin, pump room, DG fuel Tank, pipe gallery, Electric power supply system, lighting system, conduit &amp; tray, RMS, CCTV, Meteorological Monitoring, control panel, RX control computer, Secondary cooling, ventilation system, Water supply system, compressed air system, sump etc.</td>
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