

Status of a Periodic Safety Review of HANARO

Dec. 4, 2017
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IGORR 2017/IAEA Workshop

- Brief History of Legal Requirement
- Project Management Team
- Quality Assurance
- Establishment of Budget
- Project Schedule
- PSR Basis Document
- PSR - Safety Factors
- Review of Safety Factors
- PSR Implementation Status
- Issues on implementation
- Conclusions

- 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










- 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

- 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.

- 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.

Project Schedule

| | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|--|---|--|---|---|---|---|
| 1 Establishment of a project management team, detail plan of the review, and preparation of budget |  Jun. 30, 2015 | | | | | |
| 2 Preparation of PSR basis document Understanding between the KAERI and the Regulatory body on the PSR | |  Jun. 30, 2016 | | | | |
| 3 Preparation of Technical Specifications for Safety Factor Review Tendering process for contracts | |  Jun. 30, 2016 | | | | |
| 4 Search and Retrieval of PSR input data such as design documents, construction drawings, analysis report and input/output data | |  Sep. 30, 2016 | | | | |
| 5 Review of 14 safety factors - Review by contractors - Review by internal staff Preparation of Global Assessment Report | | |  Jun. 30, 2018 | | | |
| 6 Preparation of final PSR report including summaries from the safety reports, global assessment report and integrated implementation plan | | | |  Dec. 15, 2018 | | |
| 7 Submission of the final PSR report and summary report to the regulatory body | | | | |  Dec. 31, 2018 | |
| 8 Assessment of PSR reports submitted and preparation of assessment reports Approval by the regulatory body (End of the PSR) | | | | |  Dec. 31, 2019 | |
| 9 Execution of the integrated implementation plan | | | | | |  |

- 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

- 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
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- 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

Plant

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

Safety analysis

5. Deterministic safety analysis;
6. Probabilistic safety assessment;
7. Hazard analysis.

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;
13. Emergency planning.

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

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

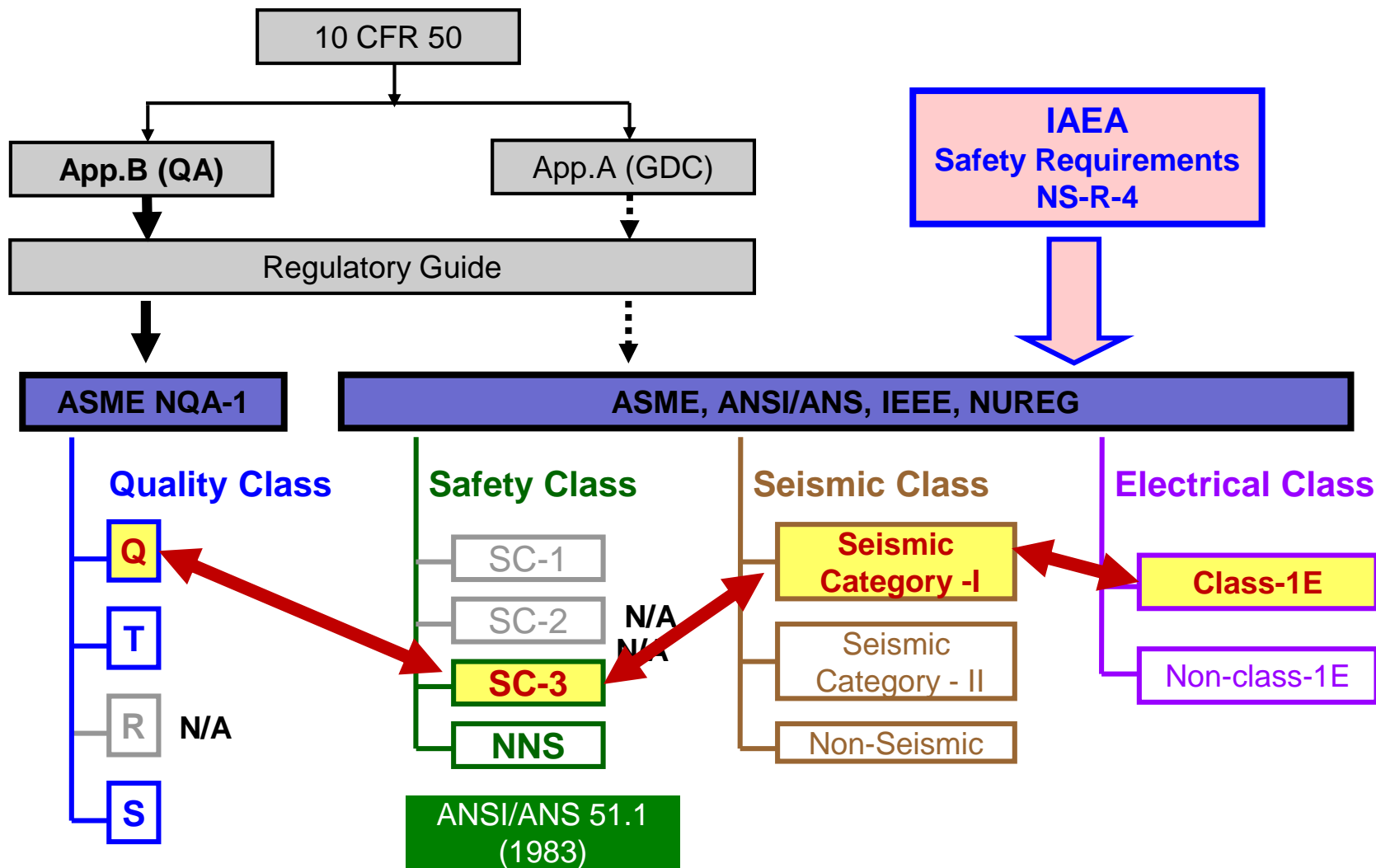
- Planning of PSA
 - A level 1 PSA which addresses the risks associated with the core damage.
 - Include only internal initiating events like a loss of normal electric power in full-power operation.

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



Classification of Safety Class





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