

Development of Regulatory Review Plan for Plant Design Systems

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1. Introduction

The importance of safety review by the regulatory body for all aspects of NPP cannot be overemphasized, especially for countries without experience, as it is difficult for reviewers to obtain information on what to review. Most countries develop their regulations using the guidelines provided in IAEA documents, such as Nigeria but face difficulty in the direction of review, which causes poor and inconsistent reports resulting in delayed approval of NPP licenses [1]. For this reason, an effective safety review plan for each stage of NPP is required to achieve nuclear safety objectives, reduce the review time, and improve the review's quality. This paper tends to develop the regulatory review plan for plant design systems considering the International Atomic Energy Commission (IAEA) Safety Standard SSR 2/1 with the adoption of the United State Nuclear Regulatory Commission (USNRC) Standard Review Plan (SRP) NUREG-0800. This plan aims to address the challenges faced by the regulatory body in establishing safety reviews, assessing the first NPP for embarking countries, and the timely approval of construction permits for the operating organization.

1.1 Overview of IAEA SSR2/1

The IAEA SSR2/1 establishes requirements applicable to the design of NPP and elaborates on the safety objective, principles, and concepts that provide the basis for deriving the safety requirements required for the design of a nuclear power plant. It is necessary for organizations involved in the design, manufacture, construction, modification, maintenance, operation, and decommissioning of nuclear power plants and regulatory bodies [2]. The IAEA SSR2/1 contains 82 requirements that address specific safety requirements for the structures, systems, and components of NPP. The plant system design requirements in R43-R82 for the operating organization compliance.

1.2 Overview of USNRC SRP

The USNRC SRP constitutes 19 chapters describing what is reviewed, the basis of the review, how the review is accomplished, and the conclusions sought [3]. It describes the methods and criteria

acceptable for the design, construction, operation, inspection, and repair of NPP. The combination of the IAEA requirements and the USNRC SRP-0800 gives the embarking countries an insight into NPP's safety aspects. It stabilizes the licensing process that benefits the public and the nuclear industry. The regulatory review plan is to serve as a guide to the regulatory body in performing safety reviews of early site permit (ESP), design certification (DC), construction permit (CP), operating license (OL), and standard design approval (SDA), or manufacturing license (ML) applications of the SRP to assure the quality and uniformity of staff safety reviews [3]. Similarly, it makes assessing NPP seamless with the intent to make information about regulatory matters widely available and improve communication between the regulatory bodies, operating organizations, and interested public members, thereby increasing the competence in the review process.

2. Methods and Results

2.1 Adaption of Review plan for SSR2/1 R43-R82 using the USNRC SRP-0800

The deduction of the review plan from the USNRC SRP format for IAEA requirements is summarized in Table 1 as follows:

- Review Area: describes the purpose and scope of the review and includes a list of review interfaces that define the expected flow of information in the review process.
- Acceptance Criteria: describe the guides determining the acceptability of the applicant's submission concerning the topic under review.
- Review Procedures: describe the methods and the level of detail the staff should use in conducting the review.
- Evaluation Findings: a guide on summarizing the review's conclusions.
- Implementation: guides applicants and licensees regarding the SRP section's regulatory plans.

Table 1: USNRC SRP format

Requirements	Review Plan
R43-R82	<ol style="list-style-type: none"> 1. Review Area 2. Acceptance criteria 3. Review procedure 4. Evaluation findings 5. Implementation

2.2 Establishment of the Review plan

The proposed review plan outcome concerning the SRP format for R43-R82 of the IAEA SSR2/1 is tabulated in Table 2 as follows:

Table 2: Proposed Review Plan

IAEA SSR2/1: Requirements for Plant system design	USNRC Standard Review Plan	IAEA SSR2/1: Requirements for Plant system design	USNRC Standard Review Plan
R43: Performance of fuel elements and assemblies	Chapter 4: Reactor	R63: Use of computer-based equipment in systems important to safety	Chapter 6: Engineered Safety Features
R44: Structural capability of the reactor core	Chapter 4: Reactor	R64: Separation of protection systems and control systems	Chapter 7: Instrumentation and Controls
R45: Control of the reactor core	Chapter 4: Reactor	R65: Control room	Chapter 7: Instrumentation and Controls
R46: Reactor shutdown	Chapter 4: Reactor	R66: Supplementary control room	Chapter 7: Instrumentation and Controls
R47: Design of reactor coolant systems	Chapter 5: Reactor Coolant System and Connected Systems	R67: Emergency response facilities on the site	Chapter 13: Conduct of Operations
R48: Overpressure protection of the reactor coolant pressure boundary	Chapter 5: Reactor Coolant System and Connected Systems	R68: Design for withstanding the loss of off-site power	Chapter 8: Electric Power
R49: Inventory of coolant system	Chapter 5: Reactor Coolant System and Connected Systems	R69: Performance of supporting systems and auxiliary systems	Chapter 9: Auxiliary Systems
R50: Cleanup of reactor coolant	Chapter 5: Reactor Coolant System and Connected Systems	R70: Heat transport systems	Chapter 10: Steam and Power Conversion System
R51: Removal of residual heat from the reactor core	Chapter 5: Reactor Coolant System and Connected Systems	R71: Process sampling systems and post-accident sampling systems	Chapter 11: Radioactive Waste Management

R52: Emergency cooling of the reactor core	Chapter 7: Instrumentation and Controls	R72: Compressed air systems	Chapter 9: Auxiliary Systems
R53: Heat transfers to an ultimate heat sink	Chapter 6: Engineered Safety Features	R73: Air conditioning systems and ventilation systems	Chapter 9: Auxiliary Systems
R54: Containment system for the reactor	Chapter 6: Engineered Safety Features	R74: Fire protection systems	Chapter 9: Auxiliary Systems
R55: Control of radioactive releases from the containment	Chapter 6: Engineered Safety Features	R75: Lighting systems	Chapter 9: Auxiliary Systems
R56: Isolation of the containment	Chapter 6: Engineered Safety Features	R76: Overhead lifting equipment	Chapter 9: Auxiliary Systems
R57: Access to the containment	Chapter 6: Engineered Safety Features	R77: Steam supply system, feedwater system, and turbine generators	Chapter 10: Steam and Power Conversion System
R58: Control of containment conditions	Chapter 3: Design of Structures, Components, Equipment, and Systems	R78: Systems for treatment and control of waste	Chapter 11: Radioactive waste management
R59: Provision of instrumentation	Chapter 7: Instrumentation and Control	R79: Systems for treatment and control of effluents	Chapter 11: Radioactive waste management
R60: Control systems	Chapter 7: Instrumentation and Controls	R80: Fuel handling and storage systems	Chapter 9: Auxiliary Systems
R61: Protection system	Chapter 7: Instrumentation and Controls	R81: Design for radiation protection	Chapter 12: Radiation Protection
R62: Reliability and testability of instrumentation and control systems	Chapter 7: Instrumentation and Controls	R82: Means of radiation monitoring	Chapter 12: Radiation Protection

3. Conclusion

Developing a regulatory review plan using the IAEA safety standards and the USNRC SRP is the right step for the regulatory body to improve its regulatory obligations and demonstrate competency and professionalism. Nonetheless, there is a need to establish a review plan that commiserates with the national regulation of the country and for other aspects of nuclear facilities to enhance efficiency and guidance.

REFERENCES

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- [3] US Nuclear Regulatory Commission, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition, NUREG 0800, p1-7, March 2007.