

Abstract

Nigeria is actively embarking on a Nuclear Power Program (NPP) to compensate for the power deficit in the country. In preparation for the NPP, the regulatory body is establishing an adequate framework for its control, including developing regulations. An efficient way of implementing these regulations, especially in Safety Analysis, is using review guides. This research proposes a new approach for developing Nigerian regulatory review guides for reviewing Safety Analysis using IAEA Standards and the format of the USNRC Standard Review Plan, NUREG 0800. Upon comparing the relevant IAEA and USNRC documents, there were significant similarities in the areas relevant to the Safety Analysis review. Hence, this new approach for developing review guides from IAEA standards using the NUREG 0800 format is feasible. This approach would benefit Nigeria's regulatory body in developing its review guide because it adopts both IAEA and USNRC regulations.

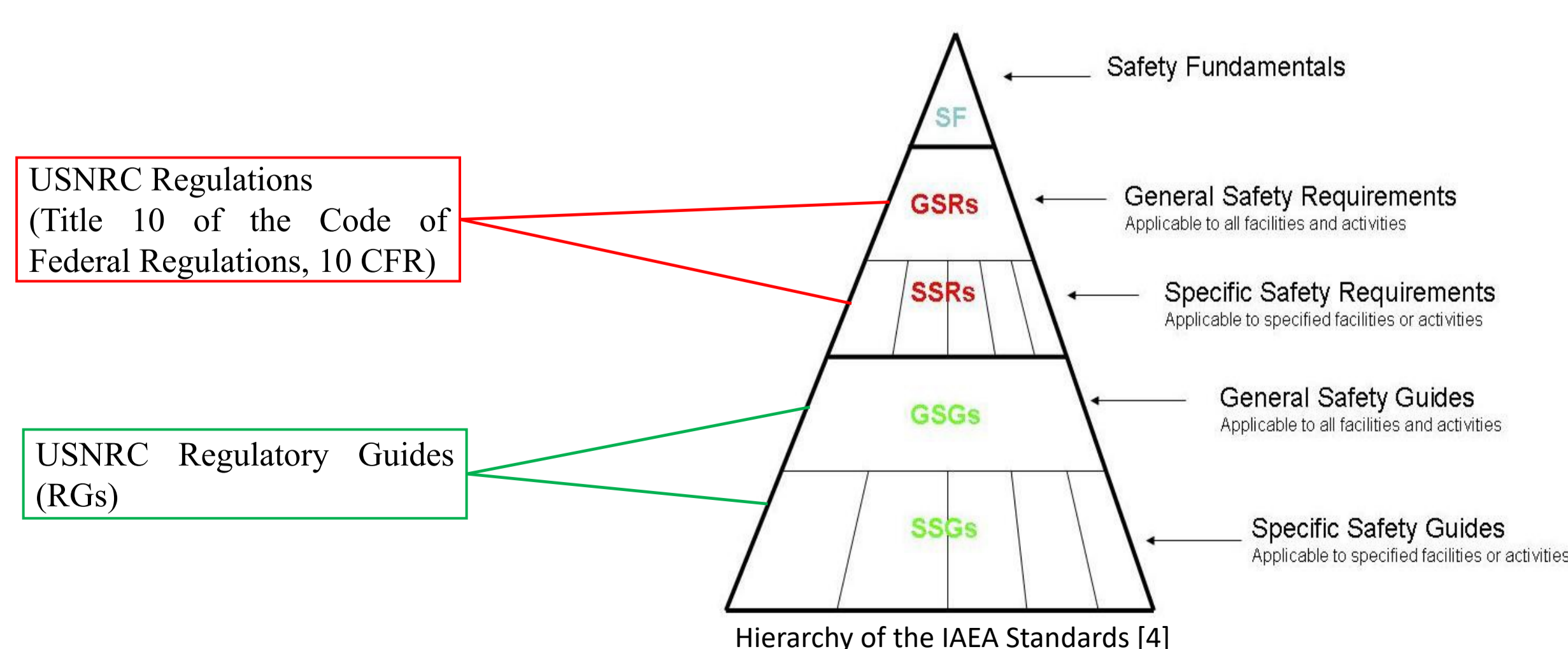
Introduction

- Safety Analysis Report (SAR) is a mandatory document required to be submitted to and approved by the Regulatory Body (RB) before constructing and operating a Nuclear Power Plant (NPP). The SAR can comprise 19 or 21 chapters [1,2], depending on the national-specific format.
- Chapter 15 of the SAR: Safety Analysis or Transient and Accident Analysis is the focus of this research.
- The lack of technical knowledge and appropriate national-specific regulatory requirements for these chapters of the SAR can cause difficulty in providing a standardized, high-quality review by the regulatory staff.
- The Nigerian Nuclear Regulatory Authority (NNRA) adopts standards from the International Atomic Energy Agency (IAEA) and the United States Nuclear Regulatory Commission (USNRC) to develop regulations peculiar to the country's needs. These standards can be used to develop regulatory review guides to attain a more precise, uniform, and standard review.
- USNRC developed a review guide, which is titled "Standard Review Plan (SRP)" [3], based on USNRC Regulations and Guides.
- This research proposes a new approach for developing Nigerian regulatory review guides for Safety Analysis review using IAEA standards and the SRP format (NUREG 0800).

Methodology

Step 1: Identify the IAEA Standards relevant to Safety Analysis Review

Step 2: Compare applicable IAEA Standards (GSRs, SSRs, GSGs, and SSGs) to the appropriate USNRC Regulations and Regulatory Guides as shown in the figure below.



Step 3: Replace the USNRC Regulations and Guides used in Chapter 15 of the Standard Review Plan (NUREG 0800) with the applicable IAEA GSRs, SSRs, GSGs, and SSGs.

Results

Table I: USNRC regulations and equivalent IAEA GSRs applicable to SA

| USNRC: 10 CFR Part 20 | IAEA: GSR Part 3 | Comparisons: Both documents are highly similar and contain the acceptance criteria for protection against radiation. |
|--|------------------|--|
| <ul style="list-style-type: none"> 10 CFR Part 20: Standards for Protection Against Radiation GSR Part 3: Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards | | |

Table II: USNRC regulations and equivalent IAEA SSRs applicable to Safety Analysis

| USNRC | IAEA | Comparisons |
|----------------------------|---------|--|
| 10 CFR Part 100 | SSR-1 | Both documents are similar and contain criteria that must be met in siting NPPs. |
| 10 CFR Part 50, Appendix A | SSR-2/1 | These two documents are very similar and consist of requirements for NPP design. |

- 10 CFR Part 100: Reactor Site Criteria
- 10 CFR Part 50, Appendix A: General Design Criteria (GDC) for NPPs
- SSR-1: Site Evaluation for Nuclear Installations
- SSR-2/1: Safety of Nuclear Power Plants: Design

Table III: USNRC regulatory guides and equivalent IAEA SSGs applicable to Safety Analysis

| USNRC | IAEA | Comparisons |
|----------|--------|--|
| RG 1.206 | SSG-12 | RG 1.206 provides recommendations on USNRC licensing methods. SSG-12 provides an overview of different types of licensing methods. |
| RG 1.29 | SSG-67 | These documents are similar and contain recommendations for the design of nuclear reactors exposed to seismic hazards. |

- RG 1.206: Applications for Nuclear Power Plants
- SSG-12: Licensing process for nuclear installations
- RG 1.29: Seismic Design Classification for Nuclear Power Plants
- SSG-67: Seismic Design for Nuclear Installations

Example of How to Develop Review Guides using IAEA Standards and the NUREG 0800 Format

USNRC-based Review Guide

The following is a specific criterion necessary to meet the requirements of **General Design Criteria** for Anticipated Operational Occurrences (AOOs): Pressure in the Reactor Coolant System (RCS) and main steam systems should be maintained below 110% of the design values in accordance with the ASME Boiler and Pressure Vessel Code [5].

IAEA-based Review Guide

For AOs, the following requirement is mandatory to fulfill the **requirements of SSR-2/1**: The pressure in the RCS and main steam systems is maintained below a prescribed value (typically 110% of the design pressure) [6].

Conclusion

- Upon the identification and comparison between the IAEA Standards and USNRC Regulations and Guides applicable to the Safety Analysis review, it is observed that high similarities exist between these documents.
- This new approach for developing review guides from IAEA standards based on the NUREG 0800 format is feasible.
- This proposed approach and experience in developing the review guide would benefit the embarking countries trying to adopt IAEA Standards as their National Regulatory Requirements and Guides.
- This regulatory review guide can also be extended to other chapters of the SAR for future research.

References

- [1] United States Nuclear Regulatory Commission, Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants, LWR Edition, Regulatory Guide 1.70, Revision 3, USNRC, 1978.
- [2] International Atomic Energy Agency, Format and Content of the Safety Analysis Report for Nuclear Power Plants, IAEA Specific Safety Guide No. SSG-61, IAEA, Vienna, 2021.
- [3] United States Nuclear Regulatory Commission, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, LWR Edition, NUREG-0800, USNRC, 2007.
- [4] International Atomic Energy Agency, Long Term Structure of the IAEA Safety Standards and Current Status August 2022.
- [5] United States Nuclear Regulatory Commission, Standard Review Plan, Introduction-Transient and Accident Analyses, NUREG 0800, Chapter 15.0, Revision 3, USNRC, 2007.
- [6] International Atomic Energy Agency, Accident Analysis for Nuclear Power Plants with Pressurized Water Reactors, IAEA Safety Report Series No. 30, IAEA, Vienna, pp. 8-9, 2003.