1. IDENTIFICATION

Document Category: Safety Guide
Working ID: DS 441
Proposed Title: Construction of Nuclear Installations
Proposed Action: New document
Review Committee(s) or Group: NUSSC (Leading Committee), WASSC
Technical Officer(s): Yuichiro Inoue

2. BACKGROUND

With the recent world wide trend of increasing demand for nuclear energy, there exist high expectations of stake holders for a safe and sound construction of nuclear installations, ensuring safety as the top priority. The status of safety and quality of newly built nuclear installations in countries embarking on a nuclear energy programme or countries with no recent construction for many years has been a global concern, as relevant parties involved in nuclear construction processes may lack experience or resources, while cost reduction by higher efficiency and strict schedule adherence are always emphasized.

NS-R-1, NS-R-4 and NS-R-5 require that systems, structures and components (SSCs) be constructed such that their quality and reliability are commensurate with their safety significance (NS-R requirements on construction). Ensuring that SSCs are constructed with the required quality and reliability involves the application of management systems and technical processes. Management system requirements and guidance are provided by GS-R-3, “The Management System for Facilities and Activities”, GS-G-3.5, “The Management System for Nuclear Installations”, and GS-G-3.1, “Application of the Management Systems for Facilities and Activities”. However, an additional guidance is needed to designate the technical processes and complement the existing guidance on management systems necessary to ensure that the nuclear installation is constructed in accordance with the approved design and safety commitments as stipulated by NS-R requirements on construction.

Such guidance is particularly important in today’s environment of global supply chains. Recent construction experience has emphasized the importance of the management and supervision of contractors (incl. subcontractors and vendors) and also the issues related to risk management, safety culture, leadership, oversight and management for the design process, experience feedback and handling of non-conformances during construction.

3. OBJECTIVE

The objective of this Safety Guide is to make recommendations based on international good practices in construction of nuclear installations, as currently followed in Member States, which will enable construction to implement the design so that safety requirements are met and the SSCs important to safety are produced with a high quality, consistent with applicable codes and standards. It will also provide the necessary assurance that SSCs or nuclear installations as constructed can be commissioned and operated safely.
This safety guide is neither a technical guide describing how to construct a nuclear installation nor does it provide any technical specifications related to the construction. It identifies safety significant construction activities which construction organisation should ensure to be planned, specified, checked and reviewed in preparation for and during construction in the areas of civil, architectural, mechanical, electrical, I&C and software for ensuring safety, security and quality.

4. JUSTIFICATION

The IAEA Safety Guides on site evaluation (NS-G-3.1 to 3.6), design (NS-G-1.1 to 1.13), commissioning, operation and maintenance (NS-G-2.1 to 2.15) provide guidance on how each respective Safety Requirements can be met to ensure nuclear safety in each respective phases of the nuclear installations. However, a similar Safety Guide for providing guidance on what safety significant construction activities should be considered during fabrication, installation and pre-commissioning tests to ensure NS-R requirements on construction is not yet covered by any safety standard.

To address this, the proposed Safety Guide will provide practical guidance on what needs to be considered in preparation for and during construction with regards to proper fabrication and assembly of the SSCs; the civil works; the installation of components and equipment; tests; inspections; and verifications as per authorized design.

To respond to the rapid development of the construction projects, this new Safety Guide also supplements and elaborates the guidance provided by GS-G-3.1 and GS-G-3.5 on preparation for and implementation of construction activities via management system to incorporate latest construction experience. It may be used to assist any organization in oversight and evaluation of the specific activities; to assist in providing construction management guidance to a vendor; and to assist in the understanding of the construction management aspects that should be considered when assessing vendors' qualifications and performance.

This guide is needed to take into account the changes in the global nature of the construction industry where, in addition to importing design from other countries, skilled workers, construction materials and modular parts may also be imported across international boundaries.

The recommendations will embody best practices derived from internationally recognized standards using the latest construction experience and the insights of technical experts in disciplines including civil, mechanical, electrical, I&C and computer related software.

5. PLACE IN THE OVERALL STRUCTURE OF THE RELEVANT SERIES AND INTERFACES WITH EXISTING AND/OR PLANNED PUBLICATIONS

This safety guide will provide recommendations with regards to NS-R requirements on construction. For ensuring the newly constructed SSCs or nuclear installations to be commissioned and operated safely, this safety guide can be valid only with the fulfilment of the relevant requirements such as DS414 “Safety of Nuclear Power Plants: Design”, NS-R-2 (DS413) “Safety of Nuclear Power Plants: Commissioning and Operation”, NS-R-4 “Safety of Research Reactors” and NS-R-5 “Safety of Nuclear Fuel Cycle Facilities.” In addition, the regulatory authorization described in GS-R-1 “Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety” must be granted according to each country’s regulatory framework. It is recognized that even if the design and commissioning is fully compliant with NS-R-1, NS-R-2, NS-R-4 and NS-R-5, the high level of safety can only be achieved if all the details of the construction are carried out with high quality and care, since commissioning can not test all aspects.
The publication will not supersede any existing IAEA document. This will be the first guide that provides more detailed recommendations for the construction management of nuclear installations in the areas of civil, architectural, mechanical, electrical, I&C and software. The general management system guidance for facilities and activities during construction are presented by GS-R-3, GS-G-3.1 and GS-G-3.5. This guide closely interfaces with Appendix III to GS-G-3.1 and Appendix V to GS-G-3.5. It provides more practical guidance on project and site management on recent construction experience from Member States which will ensure that the construction is in accordance with approved design and applicable codes & standards for construction.

In terms of nuclear installation life phases from siting to decommissioning, the proposed safety guide will be positioned between safety guides on the design and the commissioning of nuclear installations.

For any construction work which utilizes radiation and radioactive materials such as nondestructive testing of welding, the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources will be referenced.

The new guide must also consider new and revised IAEA safety standards and other guides that are currently under development. The proposed Safety Guide must be consistent in particular with the following most relevant IAEA publications (in addition to the general requirement of maintaining consistency with all Safety Standards):

- NS-R-1(DS414): Safety of Nuclear Power Plant: Design
- NS-R-4: Safety of Research Reactors
- NS-R-5: Safety of Nuclear Fuel Cycle Facilities
- DS424: Establishing Safety Infrastructure for Nuclear Power Programme
- GSR Part 1: Governmental, Legal and Regulatory Framework for Safety
- DS416: Licensing Process for Nuclear Installations
- NS-R-2(DS413): Safety of Nuclear Power Plant: Commissioning and Operation
- NS-G-1.1 to 1.13 (All design related Safety Guides)
- NS-G-2.4: The Operating Organizations for Nuclear Power Plants
- NS-G-2.12: Ageing Management for Nuclear Power Plants
- NS-G-4.5: The Operating Organization and the Recruitment, Training and Qualification of Personnel for Research Reactors
- SSG-5 to 7 (Specific Safety Guides on safety of conversion facilities, uranium enrichment facilities, uranium fuel fabrication facilities and uranium and plutonium mixed oxide fuel fabrication facilities)
- NS-G-2.9: Commissioning for Nuclear Power Plants
- NS-G-4.1: Commissioning of Research Reactors
- GS-G-1.3: Regulatory Inspection of Nuclear Facilities and Enforcement by the Regulatory Body
- NS-G-1.12 and SSG-10 (Ageing management for nuclear power plants and research reactors)

6. OVERVIEW
Summary of proposed scope

This Safety Guide will provide recommendations for the construction of high quality nuclear installations as intended by design. The guidance will be broadly applicable to nuclear installations and is intended for application to both the construction of new and the modification of existing nuclear installations. The recommendations of this Safety Guide are general and applicable to all types of nuclear installations.

Nuclear Installations vary greatly in type, size, utilization and other characteristics so that judgement has to be exercised on the measure of applicability of particular requirements to a specific installation. In this safety guide it is considered that all relevant safety requirements must be complied with, in all applications of the graded approach. The graded approach should be used to determine the appropriate manner to comply with a requirement; it is not used to provide relief from meeting the requirement.
Draft Outline
Topics shown in italics represent proposed ideas or concepts to be discussed under respective sections, and exact names of these topics are subject to change as draft guide is developed.

1. INTRODUCTION
   Background
   Objective
   Scope
   Structure

2. PREREQUISITES FOR THE CONSTRUCTION OF NUCLEAR INSTALLATION

3. THE GENERAL CONSIDERATIONS
   The Management System during Construction
   Safety Culture
   Project Management
   Application of Graded Approach
   Responsibilities and Organizational Structure
   Authorizations, Licenses and Permits
   Regulatory Body Involvement
   Contractual Approaches
   Control and Supervision of Contractors
   Transfer of Ownership and Responsibility
   Change and Configuration Control
   Confirmation of Construction Activities
   Non-Conformance and Corrective Actions
   Security
   Construction Resources
   Training and Qualification
   Control of Apparatus and Tools
   Receipt, Storage, Preservation and Maintenance
   Construction Processes
   Work and Environmental Conditions
   Procurement Specifications
   Vendor Qualification
   Fabrication Shop Qualification
   Scheduling and Work Sequence
   Site Management
   Construction Records
   Construction Experience Feedback
   Risk Management
   Factory Tests, Construction Tests & Inspections and Pre-Commissioning Tests
   Suitability of the Site and the As-Built Nuclear Installation after Completion

4. CONSTRUCTION MANAGEMENT PROGRAMMES FOR STRUCTURES, SYSTEMS AND COMPONENTS
   Civil and Architectural Works
   Scope
   Site Preparation (Excavation and backfill)
   Site Preparation
   Site preparation Planning and Scheduling
   Control of Work and Component Conditions
   Components required for Special Cares
   Test and Record Keeping
   Installation of Structures
   Installation of Structures
   Installation Planning and Scheduling
   Procurement
   Control of Work and Conditions
Management of Installation Process Required for Special Cares
Test and Record Keeping
Identification and Correction of Deficiencies

Mechanical SSCs
Scope
Fabrications
  Shop/Area Qualification
  Instructions of Fabrications
  Inspection and Tests for Fabrication Products
Installation
  Work Instructions for Installations
Testing
  Mechanical System Leak and Pressure-Tests (Integrity Tests)

Electric, I&C and Computer Based Systems and Components
Scope
  Manufacture of Computer Based Systems and Components
Fabrications and Installations
  Components and Parts
  Environmental Control for Sensitive Equipment
  Installation Sequences and Instructions
  Work Tools
  Identifications of Component and Parts
  Components Required for Special Cares
  Work Activity Oversights
  Confirmations after Completion
  Security
Pre-Commissioning Test / System Function Test
  Establishment of Test Procedures
  Test Schedule
  Organisations and management of pre-operational tests

Welding
Scope
  Technical Consideration
  Design Basis that Influence Welding
Procurement
  Procurement and Receipt Inspection of Base and Weld Filler Metals
Fabrication and Installations
  Document Control for Welding
  Instructions
  Performance Qualification of Welders and Welding Operators

Modular Construction
  Modular Scope
  Modularization
  Module Fabrication, Transportation and Storage
  Installation

REFERENCES

GLOSSARY
7. PRODUCTION SCHEDULE:

Provisional schedule for preparation of the document, outlining realistic expected dates for:

- Approval of DPP by the Coordination Committee: Sep. 2010
- Approval of DPP by the NUSSC/WASSC: Nov./Dec. 2010
- Approval of DPP by the CSS*: May 2011
- Approval of draft by the Coordination Committee: Aug. 2011
- Approval by the NUSSC/WASSC for submission to MSs for comments: Oct./Dec. 2011
- Approval of the revised draft by the Coordination Committee: Aug. 2012
- Approval by the Safety Standards Committees for submission to the CSS: Nov. 2012
- Endorsement by the CSS*: Mar. 2013
- Approval by the Publications Committee: Apr. 2013
- Target publication date: Summer 2013

*Note: * is necessary only for the Safety Standards.

8. RESOURCES

It is estimated that development of the new guide would involve approximately 50 weeks of effort by member states experts. This is based upon assuming 5 one-week expert meetings involving average of 5 experts and an average of 1 week of work per expert between meetings.

Secretariat resources involved are estimated at 20 weeks of effort by agency staff plus support for expert travel and honoraria for experts whose effort is not otherwise funded.