

## Document Preparation Profile (DPP)

### 1. IDENTIFICATION

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

### 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~~ requires 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 ~~NPP~~nuclear installation is constructed in accordance with the approved design and safety commitments as stipulated by ~~NS-R-4~~~~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 ~~systems, structures and components~~ (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-4 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-1 (DS414) requirements on related to construction. For ensuring the newly constructed SSCs or nuclear installations to be commissioned and operated safely after the construction is complete, this safety guide can be valid only with the fulfilment of the relevant requirements such as of DS414 "Safety of Nuclear Power Plants: Design", and 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 and the commissioning is compliant with NS-R-2, 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

- ~~Responsibilities and Organizational Structure~~ **Grading** Application of **Graded Approach** ~~Construction Requirements~~

- 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 ~~and~~ 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*

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*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

**5. AUTHORIZATION AND COMMISSIONING**

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 NUSC/WASSC	Nov/Dec. 2010
Approval of DPP by the CSS*	Mar. 2011
Approval of draft by the Coordination Committee	Sept. 2011
Approval by the NUSC/WASSC for submission to MSs for comments	Nov. 2011
Approval of the revised draft by the Coordination Committee	Aug. 2012
Review in NS-SSCS	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.