

**Document Preparation Profile (DPP)
Version 5 dated 05-11-2014**

1. IDENTIFICATION

Document Category **Safety Guide**

Working ID: **DS487**

Proposed Title: **Design of Fuel Handling and Storage Systems for Nuclear Power Plants**

Proposed Action: **Revision of existing Safety Guide on**

- **“Design of Fuel Handling and Storage Systems for Nuclear Power Plants”, 2003, Safety Standard Series No. NS-G-1.4**

Review Committee(s) or Group: **NUSSC, WASSC, NSGC, TRANSSC**

Technical Officer(s): **K.S. Sim / NSNI**

2. BACKGROUND

The purpose of the Safety Guide is to provide recommendations on how to meet the safety requirements for the design of fuel handling and storage systems in nuclear power plants (NPPs) established in Specific Safety Requirements document (SSR-2/1). The Safety Guide mainly deals with the design of fuel handling and storage systems for both unirradiated and irradiated fuels in the land-based NPPs with water cooled reactors.

After the publication of the new Specific Safety Requirements for NPP Design (SSR-2/1) in 2012, a process has been established for the review and revision of the associated Safety Guides.

As part of the IAEA Action Plan¹ on Nuclear Safety, activities are ongoing to review and strengthen safety standards and improve their implementation. The revision of the Safety Guide is also proposed, under the same framework, to reflect lessons learned from the accident at the Fukushima Daiichi NPP in 2011. For example, as discussed at an international experts' meeting², design and defence in depth evaluations of spent fuel pools and associated structures, systems and components should consider events that may lead to spent fuel damage in storage (e.g., re-criticality, fuel degradation, hydrogen production and explosion, and zirconium fire during loss of cooling or loss of pool inventory). In the past, analysis of such accidents in spent fuel pools was not widely performed. A gap assessment³ for the Specific Safety Requirements SSR-2/1 with respect to the lessons learned from the Fukushima Daiichi accident also showed a need to strengthen means for reliable monitoring and controlling of the water level and means for maintaining the cooling in the spent fuel storage system in accident conditions, with a goal of practical elimination of the severe accidents in spent fuel pools and strengthening level four of defence-in-depth consideration of external hazards.

¹ <http://www-ns.iaea.org/actionplan/default.asp>

² IAEA Report on “Reactor and Spent Fuel Safety in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant”, International Experts Meeting, 19-22 March 2012, Vienna, Austria.

³ “CSS–SECRETARIAT PROGRESS REPORT ON THE REVIEW OF THE IAEA SAFETY STANDARDS IN THE LIGHT OF THE FUKUSHIMA DAIICHI ACCIDENT”, Revision 8, 23 February 2012.

3. JUSTIFICATION FOR THE PRODUCTION OF THE DOCUMENT

Many sections in the governing requirements document SSR-2/1, including a section for fuel handling and storage systems, are revised mainly to reflect lessons learned from the Fukushima Daiichi accident in revision 1 of SSR-2/1. Therefore, the revision of NS-G-1.4 should also take place in line with SSR-2/1 revision 1.

Furthermore, the current NS-G-1.4 was issued in 2003 based on the previous Safety Requirements document NS-R-1 (issued in 2000), which was superseded by the new Specific Safety Requirements document SSR-2/1 in 2012. Hence, additional requirements related to design of fuel handling systems in SSR-2/1 need to be captured in Safety Guide NS-G-1.4.

The document for Long-Term Structure of the IAEA Safety Standards and Current Status⁴ also indicates the necessity of revising the out-dated Safety Guide.

4. OBJECTIVE AND SCOPE

This Safety Guide is intended to provide recommendations on the design of fuel handling and storage systems for NPPs. It presents recommendations on how to fulfil the requirements established in the specific safety requirements for design, SSR-2/1 revision 1, including recommendations on the design to prevent the uncovering of fuel assemblies in all plant states that are of relevance for the spent fuel pool.

This publication is intended for use by organizations designing, manufacturing, constructing and operating fuel handling or storage systems in NPPs, as well as by regulatory bodies. Different types of fuel (e.g., enriched UO₂, natural UO₂, mixed oxide fuels) will be considered in the preparation of the document.

This publication is intended for application to land-based stationary NPPs with water cooled reactors designed for electricity generation or for other heat production applications (such as district heating or desalination). The publication may also be applied, with judgement, to other reactor types, to provide interpretation of the requirements that have to be considered in developing the design. It addresses the following aspects of fuel handling and storage:

- The safe receipt of unirradiated fuel at the NPP;
- The storage and inspection of unirradiated fuel before use;
- The transfer of unirradiated fuel into the reactor core;
- The removal of irradiated fuel from the reactor core;
- The reinsertion of irradiated fuel when required;
- The storage, inspection and repair of the irradiated fuel;
- The removal of irradiated fuel from the spent fuel pool (for long term storage or reprocessing); and
- The handling of the transport casks.

Limited consideration is given to the handling and storage of certain core components, e.g., reactivity control devices.

A consideration will also be given to the management of limiting capability and duration of storage.

The physical protection of fuel or aspects associated with the safeguarding of nuclear material is also considered for information. The interface between nuclear safety and nuclear security will also be considered.

Aspects that are not within the scope of this safety guide include:

- In-core fuel management and associated reactor physics considerations (refer to Safety Guide NS-G-2.4)
- The design of transport casks (refer to Safety Guide SSG-15);
- Design of storage facilities for spent fuel, which are not an integral part of an operating NPP, although such facilities may be located on the same site (refer to Safety Guide SSG-15).

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

This Safety Guide will provide guidance on compliance with the regulatory aspects of the Safety Requirements on: Safety Assessment for Facilities and Activities (GSR Part 4, 2009); and Safety of Nuclear Power Plants: Design (SSR-2/1, 2012).

The following IAEA Safety Standards will interface with the revision of NS-G-1.4 (the list is not intended to be final or exhaustive):

- “Fundamental Safety Principles”, SF-1, 2006.
- “Safety of Nuclear Power Plants: Design”, SSR-2/1, 2012. (To be updated under DS462 and DS465.)
- “Safety of Nuclear Power Plants: Commissioning and Operation”, SSR-2/2, 2012. (To be updated under DS462 and DS467.)
- “Safety Assessment for Facilities and Activities”, GSR Part 4, 2009. (To be updated under DS462 and DS466.)
- “Deterministic Safety Analysis for Nuclear Power Plants”, SSG-2, 2009.
- “Storage of Spent Nuclear Fuel”, SSG-15, 2012.
- “Criticality Safety in the Handling of Fissile material”, SSG-27, 2014.
- “Seismic design and Qualification for Nuclear Power Plants”, NS-G-1.6, 2003.
- “Core Management and Fuel Handling for Nuclear Power Plants”, NS-G-2.5, 2002.
- “Evaluation of Seismic Safety for Existing Nuclear Installations”, NS-G-2.13, 2009.
- “Severe Accident management Programmes for Nuclear Power Plants”, NS-G-2.15, 2009. (To be updated under DS483.)
- “Nuclear Security Recommendations on Physical protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5)”, Nuclear Security Series No. 13, 2011.

- “Safety of Research Reactors”, NS-R-4 revision 1, 2014.
- “Safety of Nuclear Cycle Facilities”, NS-R-5, 2008. (To be updated under DS478.)
- “The Management System for Facilities and Activities”, GS-R-3, 2006. (To be updated under DS456.)
- “Regulations for the Safe Transport of Radioactive Material”, SSR-6. (To be updated under DS480.)

6. OVERVIEW

The table of contents (TOC) is proposed as attached.

The final contents may vary during the revision process. The majority of the text that will be reviewed and incorporated, with revisions where necessary, in the new Safety Guide is available or is being developed concurrently.

7. PRODUCTION SCHEDULE

STEP 1: Preparing a DPP	DONE
STEP 2: Approval of DPP by the Coordination Committee	April 2014 (DONE)
STEP 3: Approval of DPP by the relevant review Committees	Q3, 2014
STEP 4: Approval of DPP by the CSS	Q1, 2015
STEP 5: Preparing the draft	Q3, 2015
STEP 6: Approval of draft by the Coordination Committee	Q4, 2015
STEP 7: Approval by the relevant review Committees for submission to Member States for comments	Q2, 2016
STEP 8: Soliciting comments by Member States	Q3, 2016
STEP 9: Addressing comments by Member States	Q1, 2017
STEP 10: Approval of the revised draft by the Coordination Committee Review in NS-SSCS	Q3, 2017
STEP 11: Approval by the relevant review Committees	Q4, 2017
STEP 12: Endorsement by the CSS	Q1, 2018
STEP 13: Establishment by the Publications Committee and/or Board of Governors (for SF and SR only)	Q2, 2018
STEP 14: Target publication date	Q3, 2018

8. RESOURCES

It is estimated to revise the Safety Guide as:

- P staff (25 man staff weeks)
- Four (4) CS meetings; 20 person weeks of non-staff
- Technical Meeting.

Attachment:

Tentative Table of Contents

The proposed TOC is made, based on TOC of the original document.

1. Introduction
 - Background
 - Objective
 - Scope
 - Structure
2. Fuel Handling and Storage Systems and Their Functions
 - General
 - Unirradiated Fuel
 - Irradiated Fuel
3. General Design Basis
 - General Considerations
 - Operational States
 - Postulated Initiating Events
 - Design Basis Accidents
 - Design Extension Conditions
 - Safety Assessment
 - Safety- Security Interface
 - Other Considerations
4. Systems for the Handling and Storage of Unirradiated Fuel
 - General Considerations
 - System Design
 - Equipment
 - Support Systems
 - Handling Operation
5. Systems for the Handling and Storage of Irradiated Fuel and Other Core Components
 - General Considerations
 - System Design
 - Equipment

- Support Systems
- Operation
- Provision for Dismantling and Reconstitution of Irradiated Fuel
- Provision for Damaged Fuel
- Handling and Storage of Other Irradiated Components

6. Handling of Fuel Casks

- Design for the Handling of Fuel Casks
- Equipment for Handling Fuel Casks
- Handling Operations

7. Fuel Handling at Sites with Several Reactors

8. Management System for Design

- Quality Assurance
- Identification, Location and Movement of Fuel Assemblies and Other Core Components

References

Annex: Flow Charts for Typical Systems for the Handling and Storage of Irradiated Fuel