

Nuclear Safety Standards (NUSS) Programme – Progress Report

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Codes of Practice and Safety Guides for land-based nuclear power plants with thermal neutron reactors are being developed by IAEA under the Nuclear Safety Standards (NUSS) programme. The programme is divided into the five areas of: Governmental Organization, Siting, Design, Operation and Quality Assurance. The development of the programme is supervised by a Senior Advisory Group (SAG). For each of the five areas there is a Technical Review Committee (TRC) and a Scientific Secretary. A Scientific Co-ordinator is responsible for the internal and external co-ordination of the programme.

The development stages of a document in the NUSS programme are summarized below:

The TRC prepares a scope and submits it to the SAG for approval.

The Scientific Secretary prepares a collation of information and submits it to the SAG for approval.

A Working Group (WG) composed of two to four experts is convened to prepare the first draft.

The TRC reviews the WG draft and the amended draft (TRC-1) is sent to SAG members for comments.

The TRC reviews the TRC-1 draft on the basis of the comments received from SAG members (TRC-2 draft).

The SAG reviews the TRC-2 draft document.

The revised text (SAG-1) is sent to Member States for comments.

Member States' comments are incorporated into the text by the TRC and the text (TRC-3) is sent to the SAG for final revision.

The revised text (SAG-2) is transmitted to the Director General for promulgation.

Final editing and translation into the official IAEA languages

Promulgation and publication.

GOVERNMENTAL ORGANIZATION

In the area of "Governmental Organization", the scopes of six safety guides have been approved and the draft documents are at different stages of development. The Code of Practice has been completed and transmitted to the members of the Board of Governors.

List of Draft Documents

50-C-G Code of Practice on Governmental Organization for the Regulation of Nuclear Power Plants.

This gives recommendations on the role and responsibility of the regulatory body and its organization, on the regulations to be adopted and the licensing process and on safety assessment of nuclear power plants.

50-SG-G1 Qualifications and Training of the Regulatory Body Staff

This provides recommendations and guidance for establishing the qualification requirements, and the initial and refresher training necessary for the staff of the regulatory body. The guidance applies also to consultants and advisory committees. This guide is particularly useful for a government which intends to launch a national nuclear programme and has as yet no regulatory body. The guide has been transmitted to the Director General for promulgation.

50-SG-G2 Information to be submitted in Support of Licensing Applications

This guide describes the nature of the information which should be submitted by the applicant to the regulatory body at each major stage of the licensing process. It discusses a possible method for classifying the documents containing this information and for scheduling their submission. The guide has been transmitted to the Director General for promulgation.

50-SG-G3 The Conduct of Regulatory Review and Assessment during the Licensing Process

This provides information, recommendations and guidance for review and assessment by the regulatory body of all information submitted in support of licence applications during the various phases of the licensing process for nuclear power plants. The basic purpose of review and assessment is to determine whether the applicant's submissions comply with the safety objectives and requirements approved by the regulatory body. The review and assessment concerns all safety aspects of siting, construction, commissioning, operation and decommissioning of each nuclear power plant and is one of the most important functions of the regulatory body. This is the first internationally acceptable document ever prepared on the subject and its development can be considered an important step.

50-SG-G4 Inspection and Enforcement by the Regulatory Body

This provides information, guidance and recommendations on: establishing and conducting a nuclear power plant regulatory inspection programme, establishing requirements for the licensee in regard to regulatory inspection and establishing a system for enforcing compliance with the requirements and decisions of the regulatory body.

50-SG-G6 Emergency Preparedness of Public Authorities

This gives guidance on preparing an emergency plan, establishing an emergency organization and maintaining its preparedness, and on implementing emergency actions. This emergency organization should be able to cope with a nuclear power plant accident which might adversely affect the general public and the environment.

50-SG-G8 Licences for Nuclear Power Plants

This guide explains how the licence fits into the overall context of the regulatory system established by the laws of each Member State. It identifies and describes the contents and functions of licences and discusses the sources of licence conditions.

SITING

In the context of "Siting", scopes of eleven safety guides have been approved and the draft documents are at different stages of development. The Code of Practice has been completed and transmitted to the members of the Board of Governors.

List of Draft Documents

50-C-S Code of Practice of Safety in Nuclear Power Plant Siting (NPPS)

This presents the minimum requirements for the selection of a site and describes the methods to be used in defining the necessary, basic parameters needed by the designer to protect the plant against site-related impacts. The necessary investigation for defining the dispersion characteristics in air and water at the site are also described. General guidelines for evaluation of population distribution and the use of land and water are given.

50-SG-S1 Earthquakes and Associated Topics for Nuclear Power Plant Siting

This guide describes the investigation and the method for defining seismic ground motion to be taken as the basis in designing nuclear power plants (design basis earthquake) and gives criteria for protecting the plant against earthquakes and associated phenomena such as tsunami, landslides and liquefaction. Both probabilistic and deterministic approaches are considered, but the deterministic method is recommended for the evaluation of this design basis.

50-SG-S2 Seismic Analysis and Testing of Nuclear Power Plants

This document recommends methods for performing the seismic analysis of structures, systems and components of nuclear power plants. It starts with the classification of items of the plant in different seismic categories, recommends methods for the seismic analysis and gives guidance for seismic design.

50-SG-S3 Atmospheric Dispersion and Nuclear Power Plant Siting

This gives recommendations on the most advanced method for evaluating the atmospheric dispersion at a particular site and on the related programme of investigation.

50-SG-S4 Site Selection and Evaluation for Nuclear Power Plants with Respect to Population Distribution

The guide discusses methodology used in different countries for comparing population distribution of different sites, for allowing a regulatory body to decide on a particular site and for evaluating the adequacy of safety features of a particular plant at a given site.

50-SG-S5 Man-Induced Events Related to Nuclear Power Plant Siting

In this guide, man-induced events such as air crashes, chemical explosives, etc. are discussed, and recommendations are given for selecting a site and for identifying the related design basis. For a preliminary evaluation both deterministic and probabilistic approaches are recommended but for the evaluation of the input parameters for the design, a probabilistic approach is suggested in most cases.

50-SG-S10A Design Basis Floods for Nuclear Power Plants on River Sites

This guide deals with extreme hydrological phenomena and gives methodology for identifying the design basis flood on rivers. Deterministic and stochastic approaches are considered. Combinations of extreme hydrological events are recommended.

50-SG-S10B Design Basis Floods for Nuclear Power Plants on Coastal Sites

This guide also deals with extreme hydrological phenomena related to coastal sites. The protection of the plant against waves, surges and tsunami is discussed. Both deterministic and stochastic methods are presented.

50-SG-S11 Extreme Meteorological Events in Nuclear Power Plant Siting

In this document methods are given for identifying the extreme values of environmental parameters (such as temperatures and wind) and of extreme phenomena (such as tornadoes and hurricanes) to be used in the design of the plant.

DESIGN

Eleven "Design" documents are currently under development. The Code of Practice has been completed and will soon be sent to the members of the Board of Governors.

List of Draft Documents

50-C-D Code of Practice on Design for Safety of Nuclear Power Plants

This code presents general safety criteria for the design of nuclear power plants. It has been developed from the extensive experience of many Member States.

50-SC-D1 Safety Functions and Component Classification for Boiling-Water Reactors (BWR), Pressurized-Water Reactors (PWR) and Pressure Tube Reactors (PTR)

Methods have been developed to classify reactor components according to their importance for nuclear safety. For each level of classification specific design requirements are given. Internationally agreed requirements have been presented for the first time for boiling-water reactors, pressurized-water reactors, and pressure tube reactors.

50-SG-D2 Fire Protection in Nuclear Power Plants

This discusses criteria for fire prevention and protection, methods for detecting and extinguishing fires, and/or mitigating their effects.

50-SG-D3 Protection Systems in Nuclear Power Plants

This safety guide deals with systems which detect abnormal conditions in a plant, determine what to do about this, and then issue commands to other safety systems and equipment to overcome the abnormal condition and/or mitigate its consequences.

50-SG-D4 Protection Against Internally Generated Missiles and their Secondary Effects

Considered in this safety guide are the effects of missiles such as broken turbine blades, ejected valve stems, etc. that could be generated when equipment fails. Methods are given to minimize the likelihood of missile-generated failure and to protect the plant should such a failure occur.

50-SG-D5 Man-Induced Events

At certain sites it is necessary to protect a nuclear power plant from possible aircraft crashes, explosions, toxic or corrosive gases, etc. This guide provides information on how to design against such man-induced events using the recommendations of the safety guide 50-SG-S5.

50-SG-D6 Ultimate Heat Sink and Directly Associated Heat Transport Systems

When a nuclear power plant is shut down, residual heat must be removed. This safety guide establishes design criteria for making the system removing this heat extremely reliable.

50-SG-D7 Emergency Electrical Systems

This deals with emergency power supplies. Special attention has been paid to developing countries since these often do not have very reliable electrical transmission networks and this may affect the safety of nuclear power plants. For the present, only electric power supplies are described in the safety guides, but future editions may include non-electric supplies as well.

50-SG-D8 Instrumentation and Control

This guide deals with the design of the control room, utilization of computers, and determination of the availability requirements of safety related instrumentation and control systems.

50-SG-D9 Design Aspects of Radiological Protection

Methods and design criteria are presented in this guide on how to provide radiological protection for the general public and site personnel under normal operation of a nuclear power plant. A companion guide will be issued later on radiological protection during accident conditions.

OPERATION

With regard to "Operation", scopes of eight safety guides have been approved. The Code of Practice has been completed and transmitted to the members of the Board of Governors.

List of Draft Documents

50-C-0 Safety in Nuclear Power Plant Operation Including Commissioning and Decommissioning

The Code deals with the safe operation of nuclear power plants with particular emphasis on the responsibility of the operating organization.

50-SG-01 Staffing, Recruitment, Training and Authorization of Operating Personnel in Nuclear Power Plants

This deals with the selection and training of personnel and with the type of authorization to be issued. This safety guide has been transmitted to the Director General for promulgation.

50-SG-02 In-Service Inspection for Nuclear Power Plants

This guide concerns in-service inspection for nuclear power plants with reactors of the PWR, PTR, BWR and GCR (Gas-Cooled Reactor) types. Although there are important differences in the design of these reactors, the basic inspection requirements have successfully been identified and recommended in this guide.

50-SG-03 Operational Limits and Conditions for Nuclear Power Plants

This recommends the operational limits and conditions related to safety. The variables on which the limits have to be set and the general criteria for identifying these limits are presented. Recommendations are also given on procedures for developing, modifying and complying with these operational limits.

50-SG-04 Commissioning Procedures for Nuclear Power Plants

This guide recommends methods for developing a programme and organizing testing procedures. It is of particular importance for developing countries, because proper commissioning forms the basis for the safety of the plant during its lifetime.

50-SG-05 Radiological Protection during Operation of Nuclear Power Plants

This discusses the responsibility of the operating organization in establishing an effective radiological programme and the technical measures necessary for its implementation. It takes into account the most recent recommendations of the International Committee on Radiological Protection (ICRP).

50-SG-06 Emergency Arrangements at Nuclear Power Plants

The guide discusses the methods to be used by the operating organization in establishing an effective emergency plan and the administrative measures to be adopted for its implementation.

QUALITY ASSURANCE

In the area of "Quality Assurance" scopes of eleven safety guides have been approved. The Code of Practice has been completed and transmitted to the members of the Board of Governors for approval before publication.

List of Draft Documents

50-C-QA Quality Assurance for Safety in Nuclear Power Plants

The Code contains the principles of quality assurance to be implemented in all activities affecting quality and safety of nuclear power plants.

50-SG-QA1 Quality Assurance Programme Preparation

This guide provides the requirements and recommendations for establishing a quality assurance programme for nuclear power plants. It covers programme planning and programme documentation.

50-SG-QA2 Quality Assurance Records System for Nuclear Power Plants

This deals with identification, collection, indexing, filing, storing, maintenance and disposition of quality assurance records.

50-SG-QA3 Quality Assurance in Procurement of Items and Services for Nuclear Power Plants

The guide deals with the establishment, implementation and administration of quality assurance programmes for various procurement activities, such as document preparation, supplier evaluation and surveillance, and acceptance of items and services.

50-SG-QA4 Quality Assurance during Site Construction of Nuclear Power Plants

The guide covers the establishment and implementation of a quality assurance programme for site construction activities such as fabrication, installation, handling, storing, cleaning, flushing, inspection, testing, modification, repair and maintenance.

50-SG-QA5 Quality Assurance during Operation of Nuclear Power Plants

This document covers management, control and quality assurance during commissioning, operation and decommissioning of a nuclear power plant.

50-SG-QA6 Quality Assurance in Design of Nuclear Power Plants

This deals with the quality assurance requirements and recommendations for the design of items to provide the safety of a nuclear power plant. It covers both the technical and management process, extending from identification of the design input, to the issuance of design output documents.

50-SG-QA7 Quality Assurance Organization

This guide provides recommendations and illustrative examples of organizational structures which affect the quality of a nuclear power plant. It also covers recommendations concerning qualifications of quality assurance personnel.

50-SG-QA8 Quality Assurance in Manufacturing of Items for Nuclear Power Plants

This concerns quality assurance functions performed by manufacturers of items for nuclear power plants, which are related to the verification of the required product quality.

50-SG-QA10 Quality Assurance Auditing for Nuclear Power Plants

This provides recommendations for the planning, performance, reporting and follow-up of the quality audit activities.

Comments on the Difficulty Faced in the Programme

The development of an internationally agreed set of Codes of Practice and Safety Guides for nuclear power plants is an important programme of the IAEA. The programme has been organized to produce the documents in a systematic way. This means that the development and revision procedures are the same for all documents. The standing committees (SAG and five TRCs) meet four times a year each and give the scrutiny needed for completeness, uniformity and quality to the documents. While each document has always presented particular problems to be solved, the development procedure has the inherent capability of coping with these difficulties and of co-ordinating the documents relating to two or more areas of the NUSS programme.

In each new step of the development phase considerable time is required to streamline the procedures. However, the difficulties encountered in the earlier stages of development of the codes and safety guides have now been solved and the programme is working smoothly.

The initial TRC meetings presented some problems. The first review of a draft required one whole week of meetings and sometimes two. Now, due to the fact that the discussions are more concentrated and the material is presented in a more efficient way, a draft document is usually reviewed during two or three days.

The first discussion of a draft document within the SAG was a very difficult step because there were many comments and limited time to deal with them. A revision of the SAG members' comments on the draft is now done by the TRC group before the SAG meets and this has now practically solved the problem.

The preparation of approved translations of draft documents in the official languages of the Agency before sending them to Member States for comment represented a substantial difficulty. Specialized technological subjects were being dealt with, in which every word had particular importance and every technicality had to be translated, with all subtle shades of meaning taken into account.

This difficulty has been overcome with the assistance of SAG members having French, Spanish or Russian as mother tongue and also with improved co-operation between translators and scientific secretaries.

We are now in the course of streamlining the final stage of the development procedure which includes editing, final translation, promulgation and publication. As in previous stages, this has also presented difficulties, some within the programme, as for example, finalization of common definitions for all codes, others outside the programme, such as in the final editing.

Two of the five Codes of Practice were transmitted to the Director General two years ago and will be published in the second half of this year. It is foreseen that the period required to reach this stage will be much shorter for subsequent documents because the various organizational difficulties faced in the final stage have now been resolved.

Comments on the Characteristics of the Draft Documents

At this point it is appropriate to have an overall look at the programme. The NUSS documents are intended to be sufficiently precise to provide guidance in dealing with a particular problem and sufficiently general to take into account the different practices used in Member States. At the same time they should also be suitable in other situations.

When experts in a particular field meet to write the draft of a document, the variety of approaches used in Member States is initially brought to light. These differences can then usually be reconciled and common ground rules identified which represent the recommendations given in the document. Often it is necessary to give more than one acceptable approach for the solution of a problem. As a result of this process the recommended approach may lack some detail but the fundamental guidance which is given usually represents a sufficiently detailed set of recommendations.

However, the interpretation of these documents requires a thorough knowledge of the topic and sound engineering judgement since in the nuclear safety field the rules are seldom simple and experience always plays an important role.

Comments by Member States on the drafts usually indicate that a large majority consider the documents detailed enough and suitable for their use. However some have requested the preparation of more detailed documents having the characteristics of a manual, rather than of general recommendations.

Quantitative Assessment of the Status of the Programme

In the NUSS programme, no attempt has been made to prepare a complete list of safety guides to be developed, so it is difficult to estimate what percentage of the NUSS programme is under way. The decision to develop a particular safety guide is based on the need for such a document and the amount of information available on the particular topic. This is the method used by other national and international bodies.

However, taking a closer look at the set of safety guides under preparation in the NUSS programme and the number of identified topics in each area, the following observations can be made. In the area of Siting, Quality Assurance and probably Governmental Organization, there is a feeling that approximately three quarters of the total number of topics to be considered have been started. With regard to Operation, the scopes identified and the drafts developed probably represent more than half the possible total. Design is very different from the other four areas, since although the number of draft documents already under development is larger than in other areas, it probably does not represent more than a third of the total subjects which could be considered

Future Development of the Programme

As nuclear technology is developing very fast, a safety guide on a technical subject may have to be revised every few (4–5) years. Practical implementation of NUSS documents may also show where they need revision.

To meet these needs, the Secretariat intends to organize procedures in the future for periodically reviewing the codes and safety guides.

Extension of the Programme

At present the Agency considers only thermal nuclear reactors but it has been requested to enlarge the NUSS programme to cover other fuel cycle facilities and other types of reactors, such as high temperature and fast reactors.

Some of the codes and guides which have been developed for thermal reactors, for instance in the area of Siting and Governmental Organization, will require only minor changes to adapt them to these other fields. In areas like Design however, substantially new documents may have to be developed. Plans for developing these other documents are under consideration by the Secretariat

In conclusion, it is considered that international agreement on five Codes of Practice for nuclear power plants will be available in a few months. Four to six Safety Guides are expected to be published by the end of 1978 or early in 1979. Most of the Safety Guides presented above may be published during the next three to four years.

Table 1 Status of the NUSS Documents in Draft Form

| Draft Documents Code | Working Group (WG) | Technical Review Committee 1 (TRC 1) | Technical Review Committee 2 (TRC 2) | Senior Advisory Group 1 (SAG-1) | Member States (MS) | Technical Review Committee-3 (TRC 3) | Senior Advisory Group 2 (SAG 2) | Transmitted to the IAEA Director General | Promulgation | Publication |
|----------------------------------|--------------------|--------------------------------------|--------------------------------------|---------------------------------|--------------------|--------------------------------------|---------------------------------|--|--------------|-------------|
| Governmental Organization | | | | | | | | | | |
| 50 C G | | | | | | | | | | |
| 50 SG-G1 | | | | | | | | | | |
| 50 SG G2 | | | | | | | | | | |
| 50-SG G3 | | | | | | | | | | |
| 50 SG G4 | | | | | | | | | | |
| 50-SG G6 | | | | | | | | | | |
| 50-SG G8 | | | | | | | | | | |
| Siting | | | | | | | | | | |
| 50 C S | | | | | | | | | | |
| 50 SG S1 | | | | | | | | | | |
| 50 SG S2 | | | | | | | | | | |
| 50 SG S3 | | | | | | | | | | |
| 50 SG S4 | | | | | | | | | | |
| 50-SG S5 | | | | | | | | | | |
| 50 SG-S10A | | | | | | | | | | |
| 50 SG S10B | | | | | | | | | | |
| 50-SG S11 | | | | | | | | | | |
| Design | | | | | | | | | | |
| 50 C-D | | | | | | | | | | |
| 50 SG D1 | | | | | | | | | | |
| 50-SG D2 | | | | | | | | | | |
| 50-SG-D3 | | | | | | | | | | |
| 50 SG D4 | | | | | | | | | | |
| 50 SG-D5 | | | | | | | | | | |
| 50-SG-D6 | | | | | | | | | | |
| 50 SG-D7 | | | | | | | | | | |
| 50 SG-D8 | | | | | | | | | | |
| 50 SG-D9 | | | | | | | | | | |
| Operation | | | | | | | | | | |
| 50 C O | | | | | | | | | | |
| 50-SG-O1 | | | | | | | | | | |
| 50 SG-O2 | | | | | | | | | | |
| 50 SG-O3 | | | | | | | | | | |
| 50-SG O4 | | | | | | | | | | |
| 50 SG O5 | | | | | | | | | | |
| 50 SG O6 | | | | | | | | | | |
| Quality Assurance | | | | | | | | | | |
| 50 C QA | | | | | | | | | | |
| 50 SG QA1 | | | | | | | | | | |
| 50 SG QA2 | | | | | | | | | | |
| 50 SG QA3 | | | | | | | | | | |
| 50 SG QA4 | | | | | | | | | | |
| 50 SG QA5 | | | | | | | | | | |
| 50 SG QA6 | | | | | | | | | | |
| 50 SG-QA7 | | | | | | | | | | |
| 50-SG QA8 | | | | | | | | | | |
| 50 SG QA10 | | | | | | | | | | |