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IAEA Safety Standards

for protecting people and the environment

Site Evaluation for Nuclear Installations

Safety Requirements

No. NS-R-3 (Rev. 1)

IAEA
International Atomic Energy Agency

This publication has been superseded by SSR-1.

IAEA SAFETY STANDARDS AND RELATED PUBLICATIONS

IAEA SAFETY STANDARDS

Under the terms of Article III of its Statute, the IAEA is authorized to establish or adopt standards of safety for protection of health and minimization of danger to life and property, and to provide for the application of these standards.

The publications by means of which the IAEA establishes standards are issued in the **IAEA Safety Standards Series**. This series covers nuclear safety, radiation safety, transport safety and waste safety. The publication categories in the series are **Safety Fundamentals**, **Safety Requirements** and **Safety Guides**.

Information on the IAEA's safety standards programme is available on the IAEA Internet site

http://www-ns.iaea.org/standards/

The site provides the texts in English of published and draft safety standards. The texts of safety standards issued in Arabic, Chinese, French, Russian and Spanish, the IAEA Safety Glossary and a status report for safety standards under development are also available. For further information, please contact the IAEA at: Vienna International Centre, PO Box 100, 1400 Vienna, Austria.

All users of IAEA safety standards are invited to inform the IAEA of experience in their use (e.g. as a basis for national regulations, for safety reviews and for training courses) for the purpose of ensuring that they continue to meet users' needs. Information may be provided via the IAEA Internet site or by post, as above, or by email to Official.Mail@iaea.org.

RELATED PUBLICATIONS

The IAEA provides for the application of the standards and, under the terms of Articles III and VIII.C of its Statute, makes available and fosters the exchange of information relating to peaceful nuclear activities and serves as an intermediary among its Member States for this purpose.

Reports on safety in nuclear activities are issued as **Safety Reports**, which provide practical examples and detailed methods that can be used in support of the safety standards.

Other safety related IAEA publications are issued as **Emergency Preparedness and Response** publications, **Radiological Assessment Reports**, the International Nuclear Safety Group's **INSAG Reports**, **Technical Reports** and **TECDOCs**. The IAEA also issues reports on radiological accidents, training manuals and practical manuals, and other special safety related publications.

Security related publications are issued in the **IAEA Nuclear Security Series**.

The **IAEA Nuclear Energy Series** comprises informational publications to encourage and assist research on, and the development and practical application of, nuclear energy for peaceful purposes. It includes reports and guides on the status of and advances in technology, and on experience, good practices and practical examples in the areas of nuclear power, the nuclear fuel cycle, radioactive waste management and decommissioning.

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SITE EVALUATION FOR NUCLEAR INSTALLATIONS

This publication has been superseded by SSR-1.

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The Agency's Statute was approved on 23 October 1956 by the Conference on the Statute of the IAEA held at United Nations Headquarters, New York; it entered into force on 29 July 1957. The Headquarters of the Agency are situated in Vienna. Its principal objective is "to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world''.

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IAEA SAFETY STANDARDS SERIES No. NS-R-3 (Rev. 1)

SITE EVALUATION FOR NUCLEAR INSTALLATIONS

SAFETY REQUIREMENTS

This publication includes a CD-ROM containing the IAEA Safety Glossary: 2007 Edition (2007) and the Fundamental Safety Principles (2006), each in Arabic, Chinese, English, French, Russian and Spanish versions. The CD-ROM is also available for purchase separately. See: http://www-pub.iaea.org/books

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 2016

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FOREWORD

by Yukiya Amano
Director General

The IAEA's Statute authorizes the Agency to "establish or adopt… standards of safety for protection of health and minimization of danger to life and property" — standards that the IAEA must use in its own operations, and which States can apply by means of their regulatory provisions for nuclear and radiation safety. The IAEA does this in consultation with the competent organs of the United Nations and with the specialized agencies concerned. A comprehensive set of high quality standards under regular review is a key element of a stable and sustainable global safety regime, as is the IAEA's assistance in their application.

The IAEA commenced its safety standards programme in 1958. The emphasis placed on quality, fitness for purpose and continuous improvement has led to the widespread use of the IAEA standards throughout the world. The Safety Standards Series now includes unified Fundamental Safety Principles, which represent an international consensus on what must constitute a high level of protection and safety. With the strong support of the Commission on Safety Standards, the IAEA is working to promote the global acceptance and use of its standards.

Standards are only effective if they are properly applied in practice. The IAEA's safety services encompass design, siting and engineering safety, operational safety, radiation safety, safe transport of radioactive material and safe management of radioactive waste, as well as governmental organization, regulatory matters and safety culture in organizations. These safety services assist Member States in the application of the standards and enable valuable experience and insights to be shared.

Regulating safety is a national responsibility, and many States have decided to adopt the IAEA's standards for use in their national regulations. For parties to the various international safety conventions, IAEA standards provide a consistent, reliable means of ensuring the effective fulfilment of obligations under the conventions. The standards are also applied by regulatory bodies and operators around the world to enhance safety in nuclear power generation and in nuclear applications in medicine, industry, agriculture and research.

Safety is not an end in itself but a prerequisite for the purpose of the protection of people in all States and of the environment — now and in the future. The risks associated with ionizing radiation must be assessed and controlled without unduly limiting the contribution of nuclear energy to equitable and sustainable development. Governments, regulatory bodies and operators everywhere must ensure that nuclear material and radiation sources are used beneficially, safely and ethically. The IAEA safety standards are designed to facilitate this, and I encourage all Member States to make use of them.

This publication has been superseded by SSR-1.

This publication has been superseded by SSR-1.

PREFACE

The accident at the Fukushima Daiichi nuclear power plant in Japan followed the Great East Japan Earthquake and Tsunami of 11 March 2011. The IAEA Action Plan on Nuclear Safety (GOV/2011/59-GC(55)/14) was developed in response to the Fukushima Daiichi accident[1] and was approved by the IAEA Board of Governors and endorsed by the IAEA General Conference in September 2011 (GC(55)/RES/9). It includes an action headed: Review and strengthen IAEA Safety Standards and improve their implementation.

This action called upon the Commission on Safety Standards (CSS) and the IAEA Secretariat to review, and revise as necessary, the relevant IAEA safety standards in a prioritized sequence, and called on Member States to utilize the IAEA safety standards as broadly and effectively as possible.

This review covered, among other topics, the regulatory structure, emergency preparedness and response, and nuclear safety and engineering aspects (site selection and evaluation, assessment of extreme natural hazards, including their combined effects, management of severe accidents, station blackout, loss of heat sink, accumulation of explosive gases, the behaviour of nuclear fuel and the safety of spent fuel storage).

In 2011, the Secretariat commenced such a review of Safety Requirements publications in the IAEA Safety Standards Series on the basis of information that was available on the Fukushima Daiichi accident, including two reports from the Government of Japan, issued in June 2011 and September 2011, the report of the IAEA International Fact Finding Expert Mission conducted in Japan from 24 May to 2 June 2011, and a letter from the Chair of the International Nuclear Safety Group (INSAG) to the Director General dated 26 July 2011. As a priority, the Secretariat reviewed the Safety Requirements publications applicable to nuclear power plants and to the storage of spent fuel.

The review consisted first of a comprehensive analysis of the findings of these reports. In the light of the results of this analysis, the Safety Requirements publications were then examined in a systematic manner in order to decide whether amendments were desirable to reflect any of these findings.

On that basis, the CSS approved, at its meeting in October 2012, a proposal for a revision process by amendment for the following five Safety Requirements publications: Governmental, Legal and Regulatory Framework for Safety (IAEA Safety Standards Series No. GSR Part 1, 2010); Safety Assessment for Facilities and Activities (GSR Part 4, 2009); Safety of Nuclear Power

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[1] For further information, see INTERNATIONAL ATOMIC ENERGY AGENCY, The Fukushima Daiichi Accident: Report by the Director General, IAEA, Vienna (2015).

This publication has been superseded by SSR-1.

Plants: Design (SSR-2/1, 2012); Safety of Nuclear Power Plants: Commissioning and Operation (SSR-2/2, 2011); and Site Evaluation for Nuclear Installations (NS-R-3, 2003).

Additional inputs were considered in preparing the draft text of the proposed amendments to these five safety standards in 2012 and 2013, including the findings of the IAEA International Experts Meetings and presentations made at the Second Extraordinary Meeting of the Contracting Parties to the Convention on Nuclear Safety, in August 2012. Several national and regional reports were also considered.

On the review of the Safety Requirements, the Commission's conclusion, reflected in a letter from the CSS Chair to the Director General dated 6 January 2014, was that:

> "the review has confirmed so far the adequacy of the current Safety Requirements. The review revealed no significant areas of weakness, and just a small set of amendments were proposed to strengthen the requirements and facilitate their implementation. The CSS believes that the IAEA Safety Standards should be enhanced mainly through the well-established review and revision process that has been in use for some years. At the same time, CSS members highlighted that the basis for the review and revision of the IAEA Safety Standards should not be limited to the lessons of the Fukushima Daiichi accident. This basis should also include other operating experience from elsewhere as well as information gained from advances in research and development. The CSS also stressed that greater attention needs to be paid to the implementation of IAEA safety standards by and in Member States."

The draft amendments were reviewed by the Secretariat in consultants meetings, as well as by the Nuclear Safety Standards Committee, the Radiation Safety Standards Committee, the Transport Safety Standards Committee and the Waste Safety Standards Committee, in the first half of 2013. They were also presented for information to the Nuclear Security Guidance Committee in 2013. The draft amendments were then submitted to IAEA Member States for comment and revised in consultants meetings in the light of comments received. The proposed amendments were then approved by all four Safety Standards Committees at their meetings in June and July 2014, and were endorsed by the CSS at its meeting in November 2014.

This publication has been superseded by SSR-1.

The revisions to NS-R-3 relate to the following main areas:

— The potential occurrence of events in combination;
— Establishing levels of hazard for the design basis for the installation and their associated uncertainties;
— Multiple facilities at a single site;
— Monitoring of hazards and periodic review of site specific hazards.

Amendments have been made to specific paragraphs, as outlined below. New paragraphs have been added; these are indicated by means of an uppercase letter (A, B, …). In addition, where a paragraph has been deleted, this is indicated in the text.

The following requirements and paragraphs have been amended or added in this revised edition: 1.9, 2.2, 2.5, 2.5A, 2.7, 2.13A, 3.6, 3.21, 3.51 and 5.1A. Some modifications of an editorial nature have also been made.

A table of changes made is available upon request to the IAEA (Safety.Standards@iaea.org).

The Board, at its meeting starting on 2 March 2015, established as an IAEA safety standard — in accordance with Article III.A.6 of the Statute of the IAEA — the draft of this revised Safety Requirements publication, and authorized the Director General to promulgate these revised safety requirements and to issue them as a Safety Requirements publication in the IAEA Safety Standards Series.

The 59th IAEA General Conference, in September 2015, encouraged Member States to implement measures nationally, regionally and internationally to ensure nuclear, radiation, transport and waste safety, as well as emergency preparedness, taking full account of IAEA safety standards; requested the IAEA to continuously review, strengthen and implement as broadly and effectively as possible the IAEA safety standards; and supported the CSS and the Safety Standards Committees in their review of the relevant safety standards in the light of the Fukushima Daiichi accident, as well as the lessons identified in the IAEA report on the Fukushima Daiichi accident[1].

The General Conference requested the Secretariat:

> "to continue its close cooperation with the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), the International Commission on Radiological Protection (ICRP) and other relevant organizations in the development of safety standards, including, but not limited to, the protection of the environment".

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The 59th IAEA General Conference also encouraged Member States to use the IAEA safety standards in their national regulatory programmes, as appropriate, and noted the need to consider the periodic review of national regulations and guidance against internationally established standards and guidance, and to report on progress in appropriate international forums such as review meetings under the terms of the relevant safety conventions.

The General Conference further encouraged Member States to ensure regular self-assessments of their domestic nuclear, radiation, transport and waste safety, as well as emergency preparedness, using the IAEA self-assessment tools and taking into account relevant IAEA safety standards.

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THE IAEA SAFETY STANDARDS

BACKGROUND

Radioactivity is a natural phenomenon and natural sources of radiation are features of the environment. Radiation and radioactive substances have many beneficial applications, ranging from power generation to uses in medicine, industry and agriculture. The radiation risks to workers and the public and to the environment that may arise from these applications have to be assessed and, if necessary, controlled.

Activities such as the medical uses of radiation, the operation of nuclear installations, the production, transport and use of radioactive material, and the management of radioactive waste must therefore be subject to standards of safety.

Regulating safety is a national responsibility. However, radiation risks may transcend national borders, and international cooperation serves to promote and enhance safety globally by exchanging experience and by improving capabilities to control hazards, to prevent accidents, to respond to emergencies and to mitigate any harmful consequences.

States have an obligation of diligence and duty of care, and are expected to fulfil their national and international undertakings and obligations.

International safety standards provide support for States in meeting their obligations under general principles of international law, such as those relating to environmental protection. International safety standards also promote and assure confidence in safety and facilitate international commerce and trade.

A global nuclear safety regime is in place and is being continuously improved. IAEA safety standards, which support the implementation of binding international instruments and national safety infrastructures, are a cornerstone of this global regime. The IAEA safety standards constitute a useful tool for contracting parties to assess their performance under these international conventions.

THE IAEA SAFETY STANDARDS

The status of the IAEA safety standards derives from the IAEA's Statute, which authorizes the IAEA to establish or adopt, in consultation and, where appropriate, in collaboration with the competent organs of the United Nations and with the specialized agencies concerned, standards of safety for protection of health and minimization of danger to life and property, and to provide for their application.

This publication has been superseded by SSR-1.

With a view to ensuring the protection of people and the environment from harmful effects of ionizing radiation, the IAEA safety standards establish fundamental safety principles, requirements and measures to control the radiation exposure of people and the release of radioactive material to the environment, to restrict the likelihood of events that might lead to a loss of control over a nuclear reactor core, nuclear chain reaction, radioactive source or any other source of radiation, and to mitigate the consequences of such events if they were to occur. The standards apply to facilities and activities that give rise to radiation risks, including nuclear installations, the use of radiation and radioactive sources, the transport of radioactive material and the management of radioactive waste.

Safety measures and security measures[1] have in common the aim of protecting human life and health and the environment. Safety measures and security measures must be designed and implemented in an integrated manner so that security measures do not compromise safety and safety measures do not compromise security.

The IAEA safety standards reflect an international consensus on what constitutes a high level of safety for protecting people and the environment from harmful effects of ionizing radiation. They are issued in the IAEA Safety Standards Series, which has three categories (see Fig. 1).

Safety Fundamentals

Safety Fundamentals present the fundamental safety objective and principles of protection and safety, and provide the basis for the safety requirements.

Safety Requirements

An integrated and consistent set of Safety Requirements establishes the requirements that must be met to ensure the protection of people and the environment, both now and in the future. The requirements are governed by the objective and principles of the Safety Fundamentals. If the requirements are not met, measures must be taken to reach or restore the required level of safety. The format and style of the requirements facilitate their use for the establishment, in a harmonized manner, of a national regulatory framework. Requirements, including numbered 'overarching' requirements, are expressed as 'shall' statements. Many requirements are not addressed to a specific party, the implication being that the appropriate parties are responsible for fulfilling them.

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[1] See also publications issued in the IAEA Nuclear Security Series.

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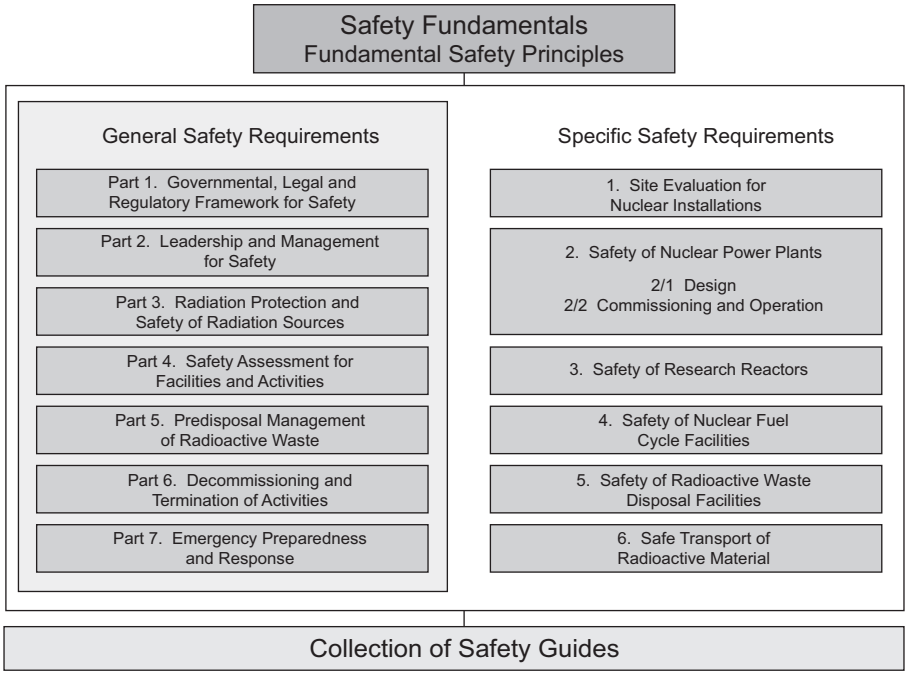

FIG. 1. The long term structure of the IAEA Safety Standards Series.

Safety Guides

Safety Guides provide recommendations and guidance on how to comply with the safety requirements, indicating an international consensus that it is necessary to take the measures recommended (or equivalent alternative measures). The Safety Guides present international good practices, and increasingly they reflect best practices, to help users striving to achieve high levels of safety. The recommendations provided in Safety Guides are expressed as 'should' statements.

APPLICATION OF THE IAEA SAFETY STANDARDS

The principal users of safety standards in IAEA Member States are regulatory bodies and other relevant national authorities. The IAEA safety standards are also used by co-sponsoring organizations and by many organizations that design, construct and operate nuclear facilities, as well as organizations involved in the use of radiation and radioactive sources.

This publication has been superseded by SSR-1.

The IAEA safety standards are applicable, as relevant, throughout the entire lifetime of all facilities and activities — existing and new — utilized for peaceful purposes and to protective actions to reduce existing radiation risks. They can be used by States as a reference for their national regulations in respect of facilities and activities.

The IAEA's Statute makes the safety standards binding on the IAEA in relation to its own operations and also on States in relation to IAEA assisted operations.

The IAEA safety standards also form the basis for the IAEA's safety review services, and they are used by the IAEA in support of competence building, including the development of educational curricula and training courses.

International conventions contain requirements similar to those in the IAEA safety standards and make them binding on contracting parties. The IAEA safety standards, supplemented by international conventions, industry standards and detailed national requirements, establish a consistent basis for protecting people and the environment. There will also be some special aspects of safety that need to be assessed at the national level. For example, many of the IAEA safety standards, in particular those addressing aspects of safety in planning or design, are intended to apply primarily to new facilities and activities. The requirements established in the IAEA safety standards might not be fully met at some existing facilities that were built to earlier standards. The way in which IAEA safety standards are to be applied to such facilities is a decision for individual States.

The scientific considerations underlying the IAEA safety standards provide an objective basis for decisions concerning safety; however, decision makers must also make informed judgements and must determine how best to balance the benefits of an action or an activity against the associated radiation risks and any other detrimental impacts to which it gives rise.

DEVELOPMENT PROCESS FOR THE IAEA SAFETY STANDARDS

The preparation and review of the safety standards involves the IAEA Secretariat and four safety standards committees, for nuclear safety (NUSSC), radiation safety (RASSC), the safety of radioactive waste (WASSC) and the safe transport of radioactive material (TRANSSC), and a Commission on Safety Standards (CSS) which oversees the IAEA safety standards programme (see Fig. 2).

All IAEA Member States may nominate experts for the safety standards committees and may provide comments on draft standards. The membership of the Commission on Safety Standards is appointed by the Director General and

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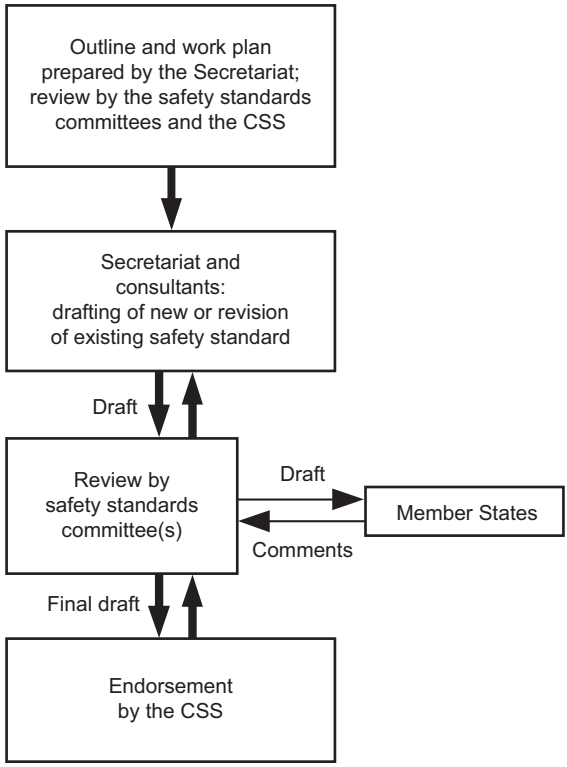

FIG. 2. The process for developing a new safety standard or revising an existing standard.

the Commission on Safety Standards is appointed by the Director General and includes senior governmental officials having responsibility for establishing national standards.

A management system has been established for the processes of planning, developing, reviewing, revising and establishing the IAEA safety standards. It articulates the mandate of the IAEA, the vision for the future application of the safety standards, policies and strategies, and corresponding functions and responsibilities.

INTERACTION WITH OTHER INTERNATIONAL ORGANIZATIONS

The findings of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and the recommendations of international expert bodies, notably the International Commission on Radiological Protection

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(ICRP), are taken into account in developing the IAEA safety standards. Some safety standards are developed in cooperation with other bodies in the United Nations system or other specialized agencies, including the Food and Agriculture Organization of the United Nations, the United Nations Environment Programme, the International Labour Organization, the OECD Nuclear Energy Agency, the Pan American Health Organization and the World Health Organization.

INTERPRETATION OF THE TEXT

Safety related terms are to be understood as defined in the IAEA Safety Glossary (see http://www-ns.iaea.org/standards/safety-glossary.htm). Otherwise, words are used with the spellings and meanings assigned to them in the latest edition of The Concise Oxford Dictionary. For Safety Guides, the English version of the text is the authoritative version.

The background and context of each standard in the IAEA Safety Standards Series and its objective, scope and structure are explained in Section 1, Introduction, of each publication.

Material for which there is no appropriate place in the body text (e.g. material that is subsidiary to or separate from the body text, is included in support of statements in the body text, or describes methods of calculation, procedures or limits and conditions) may be presented in appendices or annexes.

An appendix, if included, is considered to form an integral part of the safety standard. Material in an appendix has the same status as the body text, and the IAEA assumes authorship of it. Annexes and footnotes to the main text, if included, are used to provide practical examples or additional information or explanation. Annexes and footnotes are not integral parts of the main text. Annex material published by the IAEA is not necessarily issued under its authorship; material under other authorship may be presented in annexes to the safety standards. Extraneous material presented in annexes is excerpted and adapted as necessary to be generally useful.

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CONTENTS

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1. INTRODUCTION

BACKGROUND

1.1. This Safety Requirements publication supersedes the edition of Site Evaluation for Nuclear Installations that was issued in 2003 as IAEA Safety Standards Series No. NS-R-3[1]. NS-R-3 took account of developments relating to site evaluations for nuclear installations since the Code on Siting was issued in 1988 as Safety Series No. 50-C-S (Rev. 1)[2]. It applies the Safety Fundamentals publication SF-1 on Fundamental Safety Principles [1]. Requirements for site evaluation are intended to ensure adequate protection of site personnel and the public and protection of the environment from harmful effects of ionizing radiation that could arise from nuclear installations. It is recognized that there are steady advances in technology and scientific knowledge in the area of nuclear safety and in what is considered adequate protection. Safety requirements change with these advances and this publication reflects the present consensus among States.

1.2. This Safety Requirements publication establishes requirements and provides criteria for ensuring safety in site evaluation for nuclear installations. The Safety Guides on site evaluation listed in the references provide recommendations on how to meet the requirements established in this Safety Requirements publication.

OBJECTIVE

1.3. The objective of this publication is to establish the requirements for the elements of a site evaluation for a nuclear installation so as to characterize fully the site specific conditions pertinent to the safety of the nuclear installation.

1.4. The purpose is to establish requirements for criteria, to be applied as appropriate to site and site–installation interactions in operational states and

[1] INTERNATIONAL ATOMIC ENERGY AGENCY, Site Evaluation for Nuclear Installations, IAEA Safety Standards Series No. NS-R-3, IAEA, Vienna (2003).

[2] INTERNATIONAL ATOMIC ENERGY AGENCY, Code on the Safety of Nuclear Power Plants: Siting, Safety Series No. 50-C-S (Rev. 1), IAEA, Vienna (1988).

This publication has been superseded by SSR-1.

accident conditions, including those interactions that could lead to conditions that warrant emergency response actions, for:

(a) Defining the extent of information on a proposed site to be presented by the applicant;
(b) Evaluating a proposed site to ensure that the site related phenomena and characteristics are adequately taken into account;
(c) Analysing the characteristics of the population of the region and the capability of implementing emergency plans over the projected lifetime of the installation;
(d) Defining site related hazards.

1.5. This publication does not specifically address underground or offshore installations.

SCOPE

1.6. The scope of this publication encompasses site related factors and site–installation interaction factors relating to operational states and accident conditions, including those that could warrant emergency response actions, and natural and human induced events external to the installation that are important to safety. The external human induced events considered in this Safety Requirements publication are all of accidental origin. Considerations relating to the physical protection of the installation against wilful actions by third parties are outside its scope.

1.7. The phrase 'external to the installation' is intended to include more than the external zone [2]. In addition to the area immediately surrounding the site, the site area itself could contain objects that pose a hazard to the installation, such as an oil storage tank for diesel generators or another reactor on a multiunit site.

1.8. The siting process for a nuclear installation generally consists of an investigation of a large region to select one or more candidate sites (site survey)[3], followed by a detailed evaluation of those candidate sites. This publication is primarily concerned with the latter stage.

[3] Site survey is the process that is used to identify preferred candidate sites for nuclear installations on the basis of safety and other considerations.

This publication has been superseded by SSR-1.

1.9. Previous safety standards on this subject related to land based, stationary thermal neutron power plants. This Safety Requirements publication covers a more comprehensive range of nuclear installations, with the use of a graded approach on the basis of the radiation risks that they pose to people and the environment. In some instances in this publication a requirement is stated to apply to nuclear power plants. In these cases, the requirements are most appropriate for nuclear power plants, but they may also apply to other nuclear installations.

1.10. The level of detail needed in an evaluation to meet the requirements established in this publication will vary according to the type of installation being sited. Nuclear power plants will generally require the highest level of detail. Depending on the level of risks posed by the installation, less detail and smaller areas of coverage may be sufficient to comply with the requirements established in this publication.

1.11. This publication is concerned with the evaluation of those site related factors that have to be taken into account to ensure that the site–installation combination does not constitute an unacceptable risk to individuals, the population or the environment over the lifetime of the installation. Evaluation of the non-radiological impacts of a nuclear installation is not considered here.

1.12. As used in this publication, the term ‘risk’ refers to the product derived from the multiplication of the probability of a particular event that results in the release of radioactive material by a parameter corresponding to the radiological consequences of this event. In concept, a comprehensive risk analysis includes all the sequential steps of analysing all the initiating events, following for each initiating event all the possible sequences of subsequent events, associating a probability value with each of these sequences and finally assessing the consequences for individuals, the population and the environment. In some States, it is an established practice to utilize parts of such a risk analysis and to define probabilistic requirements to supplement traditional deterministic analysis and engineering judgement.

1.13. This publication is concerned mainly with severe events of low probability that relate to the siting of nuclear installations and that have to be considered in designing a particular nuclear installation. If events of lesser severity but with higher probabilities of occurrence make a significant contribution to the overall risk, they are also to be considered in the design of the nuclear installation.

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1.14. The scope of the investigation for the site of a nuclear installation covers the entire process of the site evaluation — the selection, assessment, pre-operational and operational stages. The requirements established in this publication do not apply to the site selection stage, for which a different series of criteria may be used. These may include criteria that have little direct relevance to safety, such as the distance to the planned consumers of the power to be generated.

STRUCTURE

1.15. This Safety Requirements publication follows the relationship between safety principles and the safety objective [1], and establishes safety requirements and criteria. Section 2 provides the general safety criteria for site related evaluation of external natural and human induced hazards to the nuclear installation. It also establishes requirements relating to the effects of the installation on the region and matters relating to population and emergency planning. Section 3 establishes specific requirements for the characterization of hazards for natural and human induced events. Section 4 establishes specific requirements for site related evaluation of the effects of the installation on the regional environment — the atmosphere, the hydrosphere and the biosphere — and on the population. Section 5 establishes requirements for continuous monitoring of natural and human induced hazards throughout the lifetime of the installation. Section 6 establishes requirements for a quality assurance programme for site evaluation.

2. GENERAL REQUIREMENTS

OBJECTIVE

2.1. The main objective in site evaluation for nuclear installations in terms of nuclear safety is to protect the public and the environment from radiological consequences of radioactive releases due to accidents. Radioactive releases due to normal operation (i.e. discharges) shall also be considered. In the evaluation of the suitability of a site for a nuclear installation, the following aspects shall be considered:

(a) The effects of external events occurring in the region of the particular site (the external events could be of natural origin or human induced);

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(b) The characteristics of the site and its environment that could influence the transfer to persons and to the environment of radioactive material that has been released;
(c) The population density and population distribution and other characteristics of the external zone in so far as they could affect the possibility of implementing emergency response actions and the need to evaluate the risks to individuals and to the population.

2.2. If the site evaluation for the three aspects cited indicates or if subsequent reviews indicate that the site is unacceptable and the deficiencies cannot be compensated for by design features, measures for site protection or administrative procedures, the site shall be deemed unsuitable.

USES FOR SITE EVALUATION

2.3. In addition to providing the technical basis for the safety analysis report to be submitted to the regulatory body, the technical information obtained for use in complying with these safety requirements will also be useful in fulfilling the requirements for the environmental impact assessment for radiological hazards.

GENERAL CRITERIA

2.4. Site characteristics that could affect the safety of the nuclear installation shall be investigated and assessed. Characteristics of the natural environment in the region that might be affected by potential radiological impacts in operational states and in accident conditions shall be investigated. All these characteristics shall be observed and monitored throughout the lifetime of the installation.

2.5. Proposed sites for a nuclear installation shall be evaluated with regard to the frequency and severity of external natural and human induced events, and potential combinations of such events, that could affect the safety of the installation.

2.5A. Information on frequency and severity derived from the characterization of the hazards resulting from external events shall be used in establishing the design basis hazard level for the nuclear installation. Account shall be taken of uncertainties in the design basis hazard level.

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2.6. The foreseeable evolution of natural and human-made factors in the region that could have a bearing on safety shall be evaluated for a time period that encompasses the projected lifetime of the nuclear installation. These factors, and in particular population growth and population distribution, shall be monitored over the lifetime of the nuclear installation. If necessary, appropriate measures shall be taken to ensure that the overall risk remains acceptably low. There are three means available to ensure that risks are acceptably low: design features, measures for site protection (e.g. dykes for flood control) and administrative procedures. Design features and protective measures are the preferred means of ensuring that risks are kept acceptably low.

2.7. The hazards associated with external events that are to be considered in the design of the nuclear installation and in its safety assessment shall be determined. For an external event (or a combination of events) the parameters and the values of those parameters that are used to characterize the hazards shall be chosen so that they can be used easily in the design of the installation and in its safety assessment.

2.8. In the derivation of the hazards associated with external events, consideration shall be given to the effects of the combination of these hazards with the ambient conditions (e.g. hydrological, hydrogeological and meteorological conditions).

2.9. In the analysis to determine the suitability of the site, consideration shall be given to additional matters relating to safety, such as the storage and transport of input and output materials (uranium ore, UF_6, UO_2, etc.), fresh fuel and spent fuel and radioactive waste.

2.10. The possible non-radiological impact of the installation, due to chemical or thermal releases, and the potential for explosion and the dispersion of chemical products shall be taken into account in the site evaluation process.

2.11. The potential for interactions between radioactive and non-radioactive effluents, such as interactions due to the combination of heat or chemicals with radioactive material in liquid effluents, shall be considered.

2.12. For each proposed site the potential radiological impacts in operational states and in accident conditions on people in the region, including impacts that could warrant emergency response actions, shall be evaluated with due consideration of relevant factors, including population distribution, dietary habits, uses of land and water, and the radiological impacts of any other releases of radioactive material in the region.

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2.13. For nuclear power plants, the total nuclear capacity to be installed on the site shall be determined as far as possible at the first stages of the siting process. If it is proposed that the installed nuclear capacity be significantly increased to a level greater than that previously determined to be acceptable, the suitability of the site shall be re-evaluated.

2.13A. An assessment shall be made of the feasibility of implementation of emergency plans. All on-site and collocated installations shall be considered in the assessment, with special emphasis on nuclear installations that could concurrently experience accidents.

CRITERIA FOR HAZARDS ASSOCIATED WITH EXTERNAL NATURAL AND HUMAN INDUCED EVENTS

2.14. Proposed sites shall be adequately investigated with regard to all the site characteristics that could be significant to safety in external natural and human induced events.

2.15. Possible natural phenomena and human induced situations and activities in the region of a proposed site shall be identified and evaluated according to their significance for the safe operation of the nuclear installation. This evaluation shall be used to identify the important natural phenomena or human induced situations and activities in association with which potential hazards are to be investigated.

2.16. Foreseeable significant changes in land use shall be considered, such as the expansion of existing installations and human activities or the construction of high risk installations.

2.17. Prehistoric, historical and instrumentally recorded information and records, as applicable, of the occurrences and severity of important natural phenomena or of human induced situations and activities shall be collected for the region and shall be carefully analysed for reliability, accuracy and completeness.

2.18. Appropriate methods shall be adopted for establishing the hazards associated with major external phenomena. The methods shall be justified in terms of being up to date and compatible with the characteristics of the region. Special consideration shall be given to applicable probabilistic methodologies. It should be noted that probabilistic hazard curves are generally needed to conduct probabilistic safety assessments for external events.

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2.19. The size of the region to which a method for establishing the hazards associated with major external phenomena is to be applied shall be large enough to include all the features and areas that could be of significance for the determination of the natural and human induced phenomena under consideration and for the characteristics of the event.

2.20. Major natural and human induced phenomena shall be expressed in terms that can be used as input for deriving the hazards associated with the nuclear installation; that is, appropriate parameters for describing the hazard shall be selected or developed.

2.21. In the determination of hazards, site specific data shall be used, unless such data are unobtainable. In this case, data from other regions that are sufficiently relevant to the region of interest may be used in the determination of hazards. Appropriate and acceptable simulation techniques may also be used. In general, data obtained for similar regions and simulation techniques could be used to augment the site specific data.

CRITERIA FOR DETERMINING THE POTENTIAL EFFECTS OF THE NUCLEAR INSTALLATION IN THE REGION

2.22. In the evaluation of a site to determine its potential radiological impacts on the region for operational states and accident conditions that could warrant emergency response actions, appropriate estimates shall be made of expected or potential releases of radioactive material, with account taken of the design of the installation and its safety features. These estimates shall be confirmed when the design and its safety features have been confirmed.

2.23. The direct and indirect pathways by which radioactive material released from the nuclear installation could potentially reach and affect people and the environment shall be identified and evaluated. In such an evaluation, specific regional and site characteristics shall be taken into account, with special attention paid to the function of the biosphere in the accumulation and transport of radionuclides.

2.24. The site and the design for the nuclear installation shall be examined in conjunction to ensure that the radiation risks to the public and to the environment associated with radioactive releases are acceptably low.

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2.25. The design of the installation shall be such as to compensate for any unacceptable potential effects of the nuclear installation in the region, or otherwise the site shall be deemed unsuitable.

CRITERIA DERIVED FROM CONSIDERATIONS OF POPULATION AND EMERGENCY PLANNING

2.26. The proposed region shall be studied to evaluate the present and foreseeable future characteristics and the distribution of the population of the region. Such a study shall include an evaluation of present and future uses of land and water in the region and account shall be taken of any special characteristics that could affect the potential consequences of radioactive releases for individuals and the population as a whole.

2.27. In relation to the characteristics and distribution of the population, the combined effects of the site and the installation shall be such that:

(a) For operational states of the installation the exposure of the population remains as low as reasonably achievable and in any case is in compliance with national requirements, with account taken of international recommendations;
(b) The radiation risks to the population associated with accident conditions, including those that could warrant emergency response actions being taken, are acceptably low.

2.28. If, after thorough evaluation, it is shown that no appropriate measures can be developed to meet the above mentioned requirements, the site shall be deemed unsuitable for the location of a nuclear installation of the type proposed.

2.29. The external zone for a proposed site shall be established with account taken of the potential for radiological consequences for people and the feasibility of implementing emergency plans, and of any external events or phenomena that might hinder their implementation. Before construction of the nuclear installation is started, it shall be confirmed that there will be no insurmountable difficulties in establishing an emergency plan for the external zone before the start of operation of the installation.

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3. SPECIFIC REQUIREMENTS FOR EVALUATION OF EXTERNAL EVENTS

EARTHQUAKES AND SURFACE FAULTING

Earthquakes

3.1. The seismological and geological conditions in the region and the engineering geological aspects and geotechnical aspects of the proposed site area shall be evaluated (see Refs [3, 4]).

3.2. Information on prehistoric, historical and instrumentally recorded earthquakes in the region shall be collected and documented.

3.3. The hazards associated with earthquakes shall be determined by means of a seismotectonic evaluation of the region with the greatest possible use of the information collected.

3.4. Hazards due to earthquake induced ground motion shall be assessed for the site with account taken of the seismotectonic characteristics of the region and specific site conditions. A thorough uncertainty analysis shall be performed as part of the evaluation of seismic hazards.

Surface faulting

3.5. The potential for surface faulting (i.e. the fault capability) shall be assessed for the site. The methods to be used and the investigations to be undertaken shall be sufficiently detailed that a reasonable decision can be reached using the definition of fault capability given in para. 3.6.

3.6. A fault shall be considered capable if, on the basis of geological, geophysical, geodetic or seismological data (including palaeoseismological and geomorphological data), one or more of the following conditions applies:

(a) It shows evidence of past movement or movements (significant deformations and/or dislocations) of a recurring nature within such a period that it is reasonable to infer that further movements at or near the surface could occur. In highly active areas, where both earthquake data and geological data consistently reveal short earthquake recurrence intervals, periods of the order of tens of thousands of years may be appropriate for the assessment

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of capable faults. In less active areas, it is likely that much longer periods will be required.

(b) A structural relationship with a known capable fault has been demonstrated such that movement of one could cause movement of the other at or near the surface.

(c) The maximum potential earthquake associated with a seismogenic structure is sufficiently large and at such a depth that it is reasonable to infer that, in the geodynamic setting of the site, movement at or near the surface could occur.

3.7. Where reliable evidence shows the existence of a capable fault that has the potential to affect the safety of the nuclear installation, an alternative site shall be considered.

METEOROLOGICAL EVENTS

3.8. The extreme values of meteorological variables and rare meteorological phenomena listed below shall be investigated for the site of any installation. The meteorological and climatological characteristics for the region around the site shall be investigated (see Ref. [5]).

Extreme values of meteorological phenomena

3.9. In order to evaluate their possible extreme values, the following meteorological phenomena shall be documented for an appropriate period of time: wind, precipitation, snow, temperature and storm surges.

3.10. The output of the site evaluation shall be described in a way that is suitable for design purposes for the nuclear installation, such as the probability of exceedance values relevant to design parameters. Uncertainties in the data shall be taken into account in this evaluation.

Rare meteorological events

Lightning

3.11. The potential for the occurrence and the frequency and severity of lightning shall be evaluated for the site.

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Tornadoes

3.12. The potential for the occurrence of tornadoes in the region of interest shall be assessed on the basis of detailed historical and instrumentally recorded data for the region.

3.13. The hazards associated with tornadoes shall be derived and expressed in terms of parameters such as rotational wind speed, translational wind speed, radius of maximum rotational wind speed, pressure differentials and rate of change of pressure.

3.14. In the assessment of the hazards, missiles that could be associated with tornadoes shall be considered.

Tropical cyclones

3.15. The potential for tropical cyclones in the region of the site shall be evaluated. If this evaluation shows that there is evidence of tropical cyclones or a potential for tropical cyclones, related data shall be collected.

3.16. On the basis of the available data and the appropriate physical models, the hazards associated with tropical cyclones shall be determined in relation to the site. Hazards for tropical cyclones include factors such as extreme wind speed, pressure and precipitation.

3.17. In the assessment of the hazards, missiles that could be associated with tropical cyclones shall be considered.

FLOODING

Floods due to precipitation and other causes

3.18. The region shall be assessed to determine the potential for flooding due to one or more natural causes, such as runoff resulting from precipitation or snowmelt, high tide, storm surge, seiche and wind waves, that could affect the safety of the nuclear installation (see Ref. [5]). If there is a potential for flooding, then all pertinent data, including historical data, both meteorological and hydrological, shall be collected and critically examined.

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3.19. A suitable meteorological and hydrological model shall be developed with account taken of the limits on the accuracy and quantity of the data, the length of the historical period over which the data were accumulated, and all known past changes in relevant characteristics of the region.

3.20. The possible combinations of the effects of several causes shall be examined. For example, for coastal sites and sites on estuaries, the potential for flooding by a combination of high tide, wind effects on bodies of water and wave actions, such as those due to cyclones, shall be assessed and taken into account in the hazard model.

3.21. The hazards for the site due to flooding shall be derived by the use of appropriate models.

3.22. The parameters used to characterize the hazards due to flooding shall include the height of the water, the height and period of the waves (if relevant), the warning time for the flood, the duration of the flood and the flow conditions.

3.23. The potential for instability of the coastal area or river channel due to erosion or sedimentation shall be investigated.

Water waves induced by earthquakes or other geological phenomena

3.24. The region shall be evaluated to determine the potential for tsunamis or seiches that could affect the safety of a nuclear installation on the site.

3.25. If there is found to be such a potential, prehistoric and historical data relating to tsunamis or seiches affecting the shore region around the site shall be collected and critically evaluated for their relevance to the evaluation of the site and their reliability.

3.26. On the basis of the available prehistoric and historical data for the region and comparisons with similar regions that have been well studied with regard to these phenomena, the frequency of occurrence, magnitude and height of regional tsunamis or seiches shall be estimated and shall be used in determining the hazards associated with tsunamis or seiches, with account taken of any amplification due to the coastal configuration at the site.

3.27. The potential for tsunamis or seiches to be generated by regional offshore seismic events shall be evaluated on the basis of known seismic records and seismotectonic characteristics.

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3.28. The hazards associated with tsunamis or seiches shall be derived from known seismic records and seismotectonic characteristics as well as from physical and/or analytical modelling. These include potential draw-down and run-up[4] that could result in physical effects on the site.

Floods and waves caused by failure of water control structures

3.29. Information relating to upstream water control structures shall be analysed to determine whether the nuclear installation would be able to withstand the effects resulting from the failure of one or more of the upstream structures.

3.30. If the nuclear installation could safely withstand all the effects of the massive failure of one or more of the upstream structures, then the structures need be examined no further in this regard.

3.31. If a preliminary examination of the nuclear installation indicates that it might not be able to withstand safely all the effects of the massive failure of one or more of the upstream structures, then the hazards associated with the nuclear installation shall be assessed with the inclusion of all such effects; otherwise such upstream structures shall be analysed by methods equivalent to those used in determining the hazards associated with the nuclear installation to show that the upstream structures could survive the event concerned.

3.32. The possibility of storage of water as a result of a temporary blockage of rivers upstream or downstream (e.g. caused by landslides or ice) so as to cause flooding and associated phenomena at the proposed site shall be examined.

GEOTECHNICAL HAZARDS

Slope instability

3.33. The site and its vicinity shall be evaluated to determine the potential for slope instability (such as landslides, rockslides and snow avalanches) that could affect the safety of the nuclear installation (see Ref. [3]).

[4] Draw-down is a falling of the water level at a coastal site. Run-up is a sudden surge of water up a beach or a structure.

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3.34. If there is found to be a potential for slope instability that could affect the safety of the nuclear installation, the hazard shall be evaluated by using parameters and values for the site specific ground motion.

Collapse, subsidence or uplift of the site surface

3.35. Geological maps and other appropriate information for the region shall be examined for the existence of natural features such as caverns and karstic formations and human-made features such as mines, water wells and oil wells. The potential for collapse, subsidence or uplift of the site surface shall be evaluated.

3.36. If the evaluation shows that there is a potential for collapse, subsidence or uplift of the surface that could affect the safety of the nuclear installation, practicable engineering solutions shall be provided or otherwise the site shall be deemed unsuitable.

3.37. If there do seem to be practicable engineering solutions available, a detailed description of sub-surface conditions obtained by reliable methods of investigation shall be developed for the purposes of determination of the hazards.

Soil liquefaction

3.38. The potential for liquefaction of the sub-surface materials of the proposed site shall be evaluated by using parameters and values for the site specific ground motion.

3.39. The evaluation shall include the use of accepted methods of soil investigation and analytical methods to determine the hazards.

3.40. If the potential for soil liquefaction is found to be unacceptable, the site shall be deemed unsuitable unless practicable engineering solutions are demonstrated to be available.

Behaviour of foundation materials

3.41. The geotechnical characteristics of the sub-surface materials, including the uncertainties in them, shall be investigated and a soil profile for the site in a form suitable for design purposes shall be determined.

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3.42. The stability of the foundation material under static and seismic loading shall be assessed.

3.43. The groundwater regime and the chemical properties of the groundwater shall be studied.

EXTERNAL HUMAN INDUCED EVENTS

Aircraft crashes

3.44. The potential for aircraft crashes on the site shall be assessed with account taken, to the extent practicable, of characteristics of future air traffic and aircraft (see Ref. [6]).[5]

3.45. If the assessment shows that there is a potential for an aircraft crash on the site that could affect the safety of the installation, then an assessment of the hazards shall be made.

3.46. The hazards associated with an aircraft crash that are to be considered shall include impact, fire and explosions.

3.47. If the assessment indicates that the hazards are unacceptable and if no practicable solutions are available, then the site shall be deemed unsuitable.

Chemical explosions

3.48. Activities in the region that involve the handling, processing, transport and storage of chemicals having a potential for explosions or for the production of gas clouds capable of deflagration or detonation shall be identified.

3.49. Hazards associated with chemical explosions shall be expressed in terms of overpressure and toxicity (if applicable), with account taken of the effect of distance.

3.50. A site shall be considered unsuitable if such activities take place in its vicinity and there are no practicable solutions available.

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[5] Wilful actions that could potentially affect the site area are excluded from consideration here.

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Other important human induced events

3.51. The region shall be investigated for installations (including collocated units of nuclear power plants and installations within the site boundary) in which flammable, explosive, asphyxiant, toxic, corrosive or radioactive materials are stored, processed, transported and otherwise dealt with that, if released under normal conditions or accident conditions, could jeopardize the safety of the nuclear installation. This investigation shall also include installations that could give rise to missiles of any type that could affect the safety of the nuclear installation. The potential effects of electromagnetic interference, eddy currents in the ground and the clogging of air or water inlets by debris shall also be evaluated. If the effects of such phenomena and occurrences would produce an unacceptable hazard and if no practicable solution is available, the site shall be deemed unsuitable.

OTHER IMPORTANT CONSIDERATIONS

3.52. Historical data concerning phenomena that have the potential to give rise to adverse effects on the safety of the nuclear installation, such as volcanism, sand storms, severe precipitation, snow, ice, hail, and sub-surface freezing of subcooled water (frazil), shall be collected and assessed (see Refs [7, 8]). If the potential is confirmed, the hazard shall be assessed and design bases for these events shall be derived.

3.53. In the design of systems for long term heat removal from the core, site related parameters such as the following shall be considered:

(a) Air temperatures and humidity;
(b) Water temperatures;
(c) Available flow of water, minimum water level and the period of time for which safety related sources of cooling water are at a minimum level, with account taken of the potential for failure of water control structures.

3.54. Potential natural and human induced events that could cause a loss of function of systems required for the long term removal of heat from the core shall be identified, such as the blockage or diversion of a river, the depletion of a reservoir, an excessive amount of marine organisms, the blockage of a reservoir or cooling tower by freezing or the formation of ice, ship collisions, oil spills and fires. If the probabilities and consequences of such events cannot be reduced to acceptable levels, then the hazards for the nuclear installation that are associated with such events shall be established.

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3.55. If the hazards for the nuclear installation are unacceptable and no practicable solution is available, the site shall be deemed unsuitable.

4. SITE CHARACTERISTICS AND THE POTENTIAL EFFECTS OF THE NUCLEAR INSTALLATION IN THE REGION

ATMOSPHERIC DISPERSION OF RADIOACTIVE MATERIAL

4.1. A meteorological description of the region shall be developed, including descriptions of the basic meteorological parameters, regional orography and phenomena such as wind speed and direction, air temperature, precipitation, humidity, atmospheric stability parameters, and prolonged inversions (see Ref. [9]).

4.2. A programme for meteorological measurements shall be prepared and carried out at or near the site with the use of instrumentation capable of measuring and recording the main meteorological parameters at appropriate elevations and locations. Data from at least one full year shall be collected, together with any other relevant data that might be available from other sources.

4.3. On the basis of the data obtained from the investigation of the region, the atmospheric dispersion of radioactive material released shall be assessed with the use of appropriate models. These models shall include all significant site specific and regional topographic features and characteristics of the installation that could affect atmospheric dispersion.

DISPERSION OF RADIOACTIVE MATERIAL THROUGH SURFACE WATER

4.4. A description of the surface hydrological characteristics of the region shall be developed, including descriptions of the main characteristics of water bodies, both natural and artificial, the major structures for water control, the locations of water intake structures and information on water use in the region.

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4.5. A programme of investigation and measurement of the surface hydrology shall be carried out to determine to the extent necessary the dilution and dispersion characteristics for water bodies, the reconcentration ability of sediments and biota, transfer mechanisms of radionuclides in the hydrosphere and exposure pathways.

4.6. An assessment of the potential impact of the contamination of surface water on the population shall be performed by using the collected data and information in a suitable model.

DISPERSION OF RADIOACTIVE MATERIAL THROUGH GROUNDWATER

4.7. A description of the groundwater hydrology of the region shall be developed, including descriptions of the main characteristics of the water bearing formations and their interaction with surface waters, and data on the uses of groundwater in the region.

4.8. A programme of hydrogeological investigations shall be carried out to permit the assessment of radionuclide movement in hydrogeological units. This programme shall include investigations of the migration and retention characteristics of the soils, the dilution and dispersion characteristics of the aquifers, and the physical and physicochemical properties of underground materials, mainly in relation to transfer mechanisms of radionuclides in groundwater and their exposure pathways.

4.9. An assessment of the potential impact of the contamination of groundwater on the population shall be performed by using the data and information collected in a suitable model.

POPULATION DISTRIBUTION

4.10. The distribution of the population within the region shall be determined.

4.11. In particular, information on existing and projected population distributions in the region, including resident populations and to the extent possible transient populations, shall be collected and kept up to date over the lifetime of the nuclear installation. The radius within which data are to be collected shall be chosen on the basis of national practices, with account taken of special situations. Special

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attention shall be paid to the population living in the immediate vicinity of the installation, to densely populated areas and population centres in the region, and to residential institutions such as schools, hospitals and prisons.

4.12. The most recent census data for the region, or information obtained by extrapolation of the most recent census data, shall be used in obtaining the population distribution. In the absence of reliable data, a special study shall be carried out.

4.13. The data shall be analysed to give the population distribution in terms of the direction and distance from the nuclear installation. An evaluation shall be performed of the potential radiological impacts of discharges and accidental releases of radioactive material, including reasonable consideration of releases due to severe accidents, with the use of site specific parameters as appropriate.

USES OF LAND AND WATER IN THE REGION

4.14. The uses of land and water shall be characterized in order to assess the potential effects of the nuclear installation in the region and in particular for the purposes of preparing emergency plans. The investigation shall cover land and water bodies that may be used by the population or that could serve as a habitat for organisms in the food chain.

AMBIENT RADIOACTIVITY

4.15. Before commissioning of the nuclear installation the ambient radioactivity of the atmosphere, hydrosphere, lithosphere and biota in the region shall be assessed so as to be able to determine the effects of the nuclear installation. The data thus obtained are intended for use as baseline data in future investigations.

5. MONITORING OF HAZARDS

5.1. The characteristics of natural hazards and human induced hazards as well as the demographic, meteorological and hydrological conditions of relevance to the nuclear installation shall be monitored over the lifetime of the nuclear installation. This monitoring shall be commenced no later than the start of construction and

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shall be continued up until decommissioning. All the hazards and conditions that are considered in this Safety Requirements publication and that are pertinent to the licensing and safe operation of the installation shall be monitored.

5.1A. Site specific hazards shall be periodically reviewed using updated knowledge, typically every ten years, and shall be re-evaluated when necessary. A review after a shorter interval shall be considered in the event of evidence of potentially significant changes in hazards (for example, in the light of the feedback of operating experience, a major accident or the occurrence of extreme events). The implications of such a review of site specific hazards for the safe operation of the nuclear installation shall be evaluated.

6. QUALITY ASSURANCE

6.1. An adequate quality assurance programme shall be established to control the effectiveness of the execution of the site investigations and assessments and engineering activities performed in the different stages of the site evaluation for the nuclear installation (see Refs [10–12]).

6.2. The quality assurance programme shall cover the organization, planning, work control, personnel qualification and training, verification and documentation for the activities to ensure that the required quality of the work is achieved.

6.3. The quality assurance programme is a part of the overall quality assurance programme for the nuclear installation. However, since activities for site investigation are normally initiated long before the establishment of a nuclear project, the quality assurance programme shall be established at the earliest possible time consistent with its application in the conduct of site evaluation activities for the nuclear installation.

6.4. The results of the activities for site investigation shall be compiled in a report that documents the results of all in situ work, laboratory tests and geotechnical analyses and evaluations.

6.5. The results of studies and investigations shall be documented in sufficient detail to permit an independent review.

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6.6. A quality assurance programme shall be implemented for all activities that could influence safety or the derivation of parameters for the design basis for the site. The quality assurance programme may be graded in accordance with the importance to safety of the individual siting activity under consideration.

6.7. The process of establishing site related parameters and evaluations involves technical and engineering analyses and judgements that require extensive experience and knowledge. In many cases the parameters and analyses might not lend themselves to direct verification by inspections, tests or other techniques that can be precisely defined and controlled. These evaluations shall be reviewed and verified by individuals or groups (e.g. by peer review) who are separate from those who did the work.

6.8. In accordance with the importance of engineering judgement and expertise in geotechnical engineering, the feedback of experience is an important aspect. For the assessment of matters such as the liquefaction potential, the stability of slopes and the safety in general of earth and of buried structures, information from the feedback of experience of failures in comparable situations shall be documented and analysed in order to be able to provide evidence that similar failures will not occur.

6.9. Records shall be kept of the work carried out in the activities for site evaluation for the nuclear installation.

This publication has been superseded by SSR-1.

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Yukiya Amano
Director General

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