

IAEA SAFETY STANDARDS SERIES

Meteorological Events in Site Evaluation for Nuclear Power Plants

SAFETY GUIDE

No. NS-G-3.4



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METEOROLOGICAL EVENTS IN SITE EVALUATION FOR NUCLEAR POWER PLANTS

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FOREWORD

by Mohamed ElBaradei
Director General

One of the statutory functions of the IAEA is to establish or adopt standards of safety for the protection of health, life and property in the development and application of nuclear energy for peaceful purposes, and to provide for the application of these standards to its own operations as well as to assisted operations and, at the request of the parties, to operations under any bilateral or multilateral arrangement, or, at the request of a State, to any of that State's activities in the field of nuclear energy.

The following bodies oversee the development of safety standards: the Commission on Safety Standards (CSS); the Nuclear Safety Standards Committee (NUSSC); the Radiation Safety Standards Committee (RASSC); the Transport Safety Standards Committee (TRANSSC); and the Waste Safety Standards Committee (WASSC). Member States are widely represented on these committees.

In order to ensure the broadest international consensus, safety standards are also submitted to all Member States for comment before approval by the IAEA Board of Governors (for Safety Fundamentals and Safety Requirements) or, on behalf of the Director General, by the Publications Committee (for Safety Guides).

The IAEA's safety standards are not legally binding on Member States but may be adopted by them, at their own discretion, for use in national regulations in respect of their own activities. The standards are binding on the IAEA in relation to its own operations and on States in relation to operations assisted by the IAEA. Any State wishing to enter into an agreement with the IAEA for its assistance in connection with the siting, design, construction, commissioning, operation or decommissioning of a nuclear facility or any other activities will be required to follow those parts of the safety standards that pertain to the activities to be covered by the agreement. However, it should be recalled that the final decisions and legal responsibilities in any licensing procedures rest with the States.

Although the safety standards establish an essential basis for safety, the incorporation of more detailed requirements, in accordance with national practice, may also be necessary. Moreover, there will generally be special aspects that need to be assessed on a case by case basis.

The physical protection of fissile and radioactive materials and of nuclear power plants as a whole is mentioned where appropriate but is not treated in detail; obligations of States in this respect should be addressed on the basis of the relevant instruments and publications developed under the auspices of the IAEA. Non-radiological aspects of industrial safety and environmental protection are also not explicitly considered; it is recognized that States should fulfil their international undertakings and obligations in relation to these.

The requirements and recommendations set forth in the IAEA safety standards might not be fully satisfied by some facilities built to earlier standards. Decisions on the way in which the safety standards are applied to such facilities will be taken by individual States.

The attention of States is drawn to the fact that the safety standards of the IAEA, while not legally binding, are developed with the aim of ensuring that the peaceful uses of nuclear energy and of radioactive materials are undertaken in a manner that enables States to meet their obligations under generally accepted principles of international law and rules such as those relating to environmental protection. According to one such general principle, the territory of a State must not be used in such a way as to cause damage in another State. States thus have an obligation of diligence and standard of care.

Civil nuclear activities conducted within the jurisdiction of States are, as any other activities, subject to obligations to which States may subscribe under international conventions, in addition to generally accepted principles of international law. States are expected to adopt within their national legal systems such legislation (including regulations) and other standards and measures as may be necessary to fulfil all of their international obligations effectively.

EDITORIAL NOTE

An appendix, when included, is considered to form an integral part of the standard and to have the same status as the main text. Annexes, footnotes and bibliographies, if included, are used to provide additional information or practical examples that might be helpful to the user.

The safety standards use the form 'shall' in making statements about requirements, responsibilities and obligations. Use of the form 'should' denotes recommendations of a desired option.

The English version of the text is the authoritative version.

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1. INTRODUCTION

BACKGROUND

1.1. This Safety Guide was prepared under the IAEA programme for safety standards for nuclear power plants. It supplements the IAEA Safety Requirements publication on Site Evaluation for Nuclear Facilities¹ which is to supersede the Code on the Safety of Nuclear Power Plants: Siting, Safety Series No. 50-C-S (Rev. 1), IAEA, Vienna (1988).

1.2. The present Safety Guide supersedes two earlier Safety Guides: Safety Series No. 50-SG-S11A (1981) on Extreme Meteorological Events in Nuclear Power Plant Siting, Excluding Tropical Cyclones and Safety Series No. 50-SG-S11B (1984) on Design Basis Tropical Cyclone for Nuclear Power Plants.

OBJECTIVE

1.3. The purpose of this Safety Guide is to provide recommendations and guidance on conducting hazard assessments of extreme and rare meteorological phenomena. This Safety Guide provides interpretation of the Safety Requirements publication on Site Evaluation for Nuclear Facilities and guidance on how to fulfil these requirements. It is aimed at safety assessors or regulators involved in the licensing process as well as designers of nuclear power plants, and provides them with guidance on the methods and procedures for analyses that support the assessment of the hazards associated with extreme and rare meteorological events.

SCOPE

1.4. This Safety Guide discusses the extreme values of meteorological variables and rare meteorological phenomena, as well as their rates of occurrence, according to the following definitions:

¹ Site Evaluation for Nuclear Facilities, Safety Standards Series No. NS-R-3, IAEA, Vienna (in preparation).

- (a) Extreme values of meteorological variables such as air temperature and wind speed characterize the meteorological or climatological environment. These variables are measured routinely over a network of fixed stations by international, national, local or private meteorological services. These measurements are usually normalized (such as data collected on wind speed, which are normalized to a given height). The extreme values, associated with the annual probabilities of being exceeded, are derived from the measurements.
- (b) Rare meteorological phenomena. These are phenomena that occur infrequently. Thus at any particular station, the instruments used for routine measurements would rarely register characteristics of these phenomena. Rare meteorological phenomena, which are highly complex, are usually scaled in terms of their intensity. These intensity values may be expressed in terms of either a qualitative characteristic such as damage or a quantitative physical parameter such as wind speed.

1.5. The meteorological variables considered in this Safety Guide whose extreme values are to be evaluated are those associated with wind, precipitation, snow pack, temperature and seawater level.

1.6. The rare meteorological phenomena considered in this Safety Guide are tornadoes, tropical cyclones and lightning. Lightning is not a rare event; however, data on parameters relevant to lightning are not routinely recorded, and it is therefore not possible to derive any corresponding extreme values. For this reason, lightning appears under 'rare events' in the present Safety Guide. Other meteorological phenomena that should be considered owing to their possible impact on plant safety, but which are not explicitly discussed in this Safety Guide, are blizzards, dust and sand storms, drought, icing and hail.

1.7. The meteorological phenomena that should be taken into account for the assessment of atmospheric dispersion of radioactive releases are discussed in the IAEA Safety Guide on Dispersion of Radioactive Material in Air and Water and Consideration of Population Distribution in Site Evaluation for Nuclear Power Plants [1].

1.8. A major possible consequence of the meteorological phenomena addressed in the present Safety Guide is flooding, which is addressed in another IAEA Safety Guide [2].

1.9. The results of the site evaluation should be used for the design of a plant as described in the Safety Requirements publication on the Safety of Nuclear Power Plants: Design [3] and its related Safety Guides. In particular, guidance for a design

safe against the consequences of meteorological phenomena is given in a related IAEA Safety Guide [4].

STRUCTURE

1.10. The general approach in terms of the scope and detail of the information to be collected, the investigations to be performed and quality assurance are presented in Section 2. Section 3 provides information on the development of a database for both determining extreme values of meteorological variables and characterizing rare meteorological phenomena. Hazard determination on the basis of extreme values is discussed in Section 4, while determination of the hazard for rare meteorological phenomena is dealt with in Section 5.

2. GENERAL APPROACH TO HAZARD ASSESSMENT

2.1. The extreme values of the meteorological variables and the rare meteorological phenomena listed below should be investigated for every nuclear power plant site:

- wind, precipitation, snow pack, temperature and seawater level;
- tornadoes, tropical cyclones and lightning.

2.2. The meteorological and climatological characteristics of the region around the site should be investigated as described in this Safety Guide. The size of the region to be investigated, the type of information to be collected and the scope and detail of the investigations should be determined on the basis of the nature and complexity of the meteorological and geographical environment of the area in which the site is located. In practice, the time extension for data collection is limited by the availability of the data.

2.3. Since climate change is increasingly topical, due attention should be paid to global warming and its possible consequences in relation to the meteorological hazards considered in this Safety Guide; their possible effects during the lifetime of the plant should accordingly be described.

2.4. In all cases, the scope and detail of the information to be collected and the investigations to be undertaken should be sufficient to determine the design bases for protection against meteorological hazards at or near the site. In order to combine the