

IAEA SAFETY STANDARDS

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Site Evaluation for Nuclear Installations Safety Requirements

**Regional Workshop on Volcanic, Seismic, and Tsunami Hazard
Assessment Related to NPP Siting Activities and Requirements
June 13-17, Jakarta, Indonesia**

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International Atomic Energy Agency

- **IAEA Safety Standards are structured in 3 categories:**
 - **SAFETY FUNDAMENTALS:**
, i.e. the objectives, *principles and concepts of protection*
 - **SAFETY REQUIREMENTS:**
, i.e. the requirements that must to be met to ensure the protection (*shall*)
 - **SAFETY GUIDES:**
, i.e. the recommendations and guidance on how to comply with the requirements (*should*).

IAEA Safety Standards

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Safety Standards Series hierarchy

Safety Fundamentals

Requirements

Safety Guides



8/25/2005

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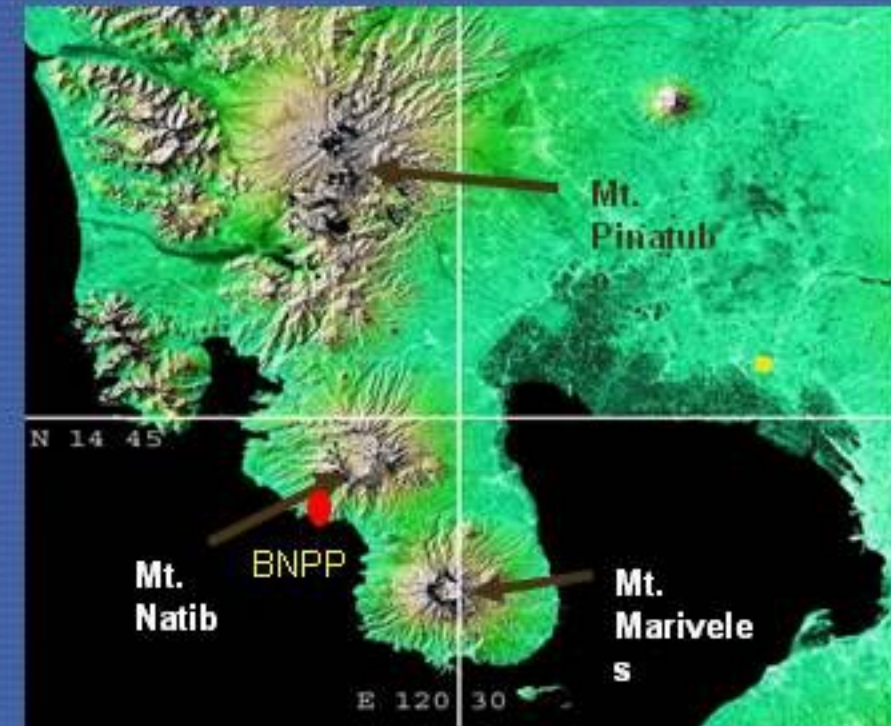
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A SITE FOR A NUCLEAR POWER PLANT

The selection and the evaluation of the site for a nuclear power plant are crucial parts of establishing a nuclear power programme and can be significantly affected by:

- *costs,*
- *public acceptance, and*
- *safety considerations.*



The “site”

Needs of clear criteria and regulatory requirements:

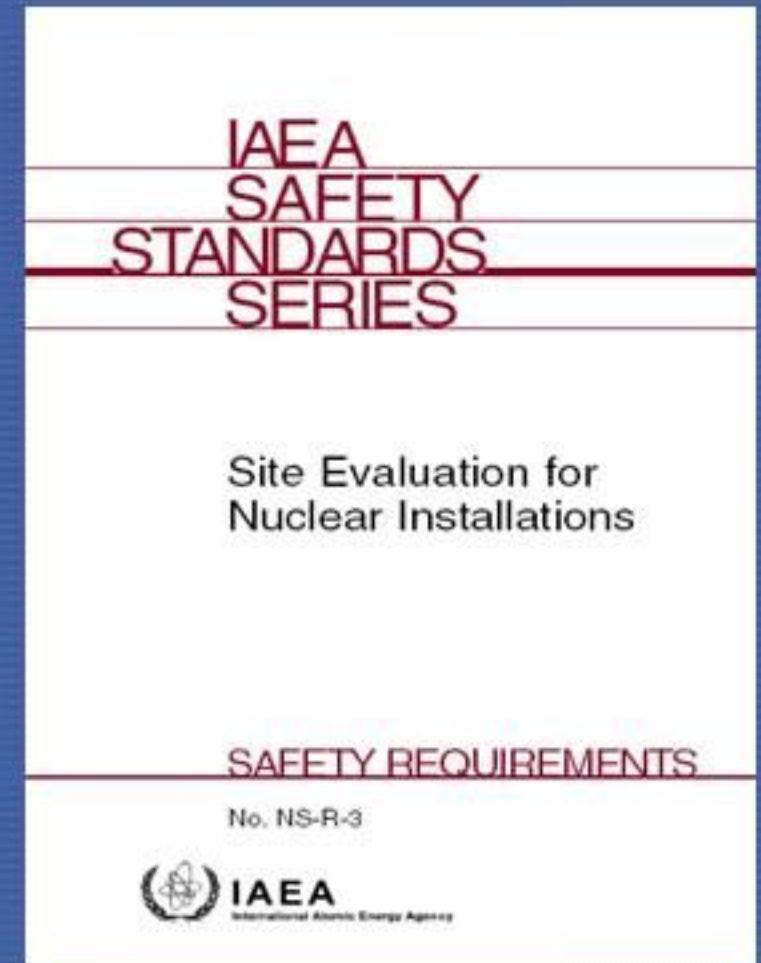
- The site selection process needs to be guided by a clearly established set of criteria or regulatory requirements.
- This is of particular importance for those aspects that can exclude sites.
- A global balance has to be established between the characteristics of a site, on the one hand, and specific design features, site protection measures and administrative procedures, on the other hand, in order to obtain an acceptable solution.
- IAEA safety standards provide a strong basis to establish such a balance.

Stages of the full process

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- **SITE SURVEY**
- **SITE EVALUATION:**
 - **SITE SELECTION**
 - **SITE ASSESSMENT**
 - **PRE-OPERATIONAL**
 - **OPERATIONAL**

covering the complete lifecycle of the nuclear installation.



To establish the requirements to be applied for:

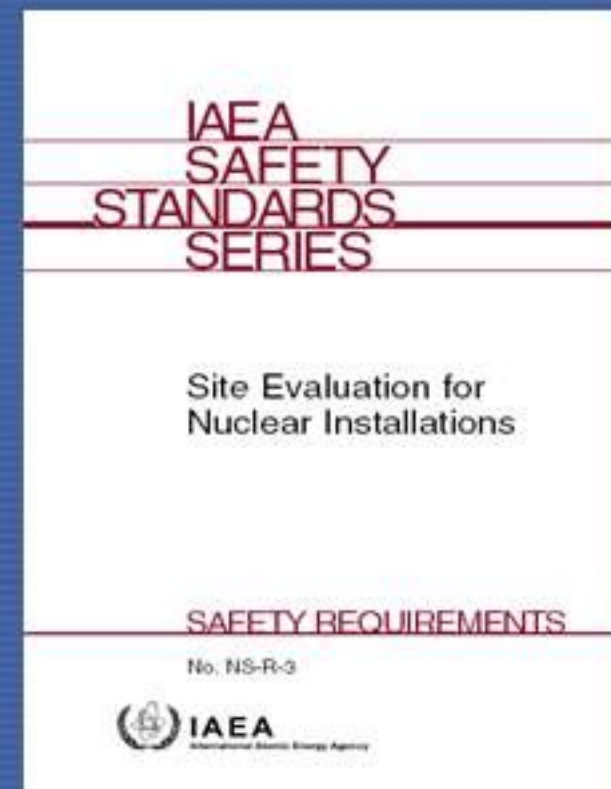
- **defining the extent of information to be presented by the applicant for a proposed site;**
- **evaluating a proposed site to ensure that the site related phenomena and characteristics are adequately taken into account;**
- **analyzing the population characteristics of the region and the capability of implementing emergency plans throughout the projected lifetime of the installation;**
- **defining site related hazards.**

NS-R-3: Contents

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Site Evaluation for Nuclear Installations - Safety Requirements:

- General requirements
- Specific requirements for evaluation of external events
- Site characteristics and the potential effects of the nuclear installation in the region
- Monitoring of hazards
- Quality assurance.



A comprehensive range of nuclear installations, including:

- **nuclear power plants,**
- **fuel cycle facilities,**
- **fuel processing plants,**
- **independent spent fuel storage installations,**
- **research reactors and**
- **reprocessing plants.**

The level of detail needed to meet the requirements of this document vary according to the type of installation being sited or evaluated.

Site related factors and site-installation interaction factors relating to:

- **plant operational states and accident conditions, including those that could lead to emergency measures; and**
- **natural and human induced events external to the installation. Human induced events are of accidental origin. It is concerned mainly with severe events of low probability.**

NS-R-3: General Requirements

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In the evaluation of the suitability of a site for a nuclear installation, the following aspects shall be considered:

- 1. Effects of external events** occurring in the region of the particular site (natural or human induced).
- 2. Characteristics of the site and its environment** which could influence the transfer of released radioactive material to persons.
- 3. Population density and distribution** and other characteristics of the external zone in relation to the possibility of implementing emergency measures and the need to evaluate the risk to individuals and the population.



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NS-R-3: General Requirements

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If the site evaluation for these three aspects indicates that the site has serious deficiencies that cannot be compensated for by means of:

- (a) design features,**
- (b) site protection measures, or**
- (c) administrative procedures,**

the site shall be deemed unsuitable.

Design features (a), and site protection measures (b), are the preferred methods of ensuring that risks are kept acceptably low.

NS-R-3: General Requirements

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In addition to providing the technical basis for the safety analysis report to be submitted to the nuclear regulatory authority, the technical information developed in compliance with this safety standard also addresses requirements associated with the environmental impact assessment for potential radiological hazard.

NS-R-3: General Criteria

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

NS-R-3: General Criteria

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- Proposed sites for nuclear installations shall be examined with respect to the frequency and the severity of natural and human induced events and phenomena that could affect the safety of the installation.
- The foreseeable evolution of natural and human made factors in the region that may have a bearing on safety shall be evaluated for a time period that encompasses the projected lifetime of the installation.

NS-R-3: General Criteria

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- The hazards associated with external events that are to be considered in the design of the nuclear installation 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 should be chosen so that they can be used easily in the design of the installation.

Example:

Earthquakes



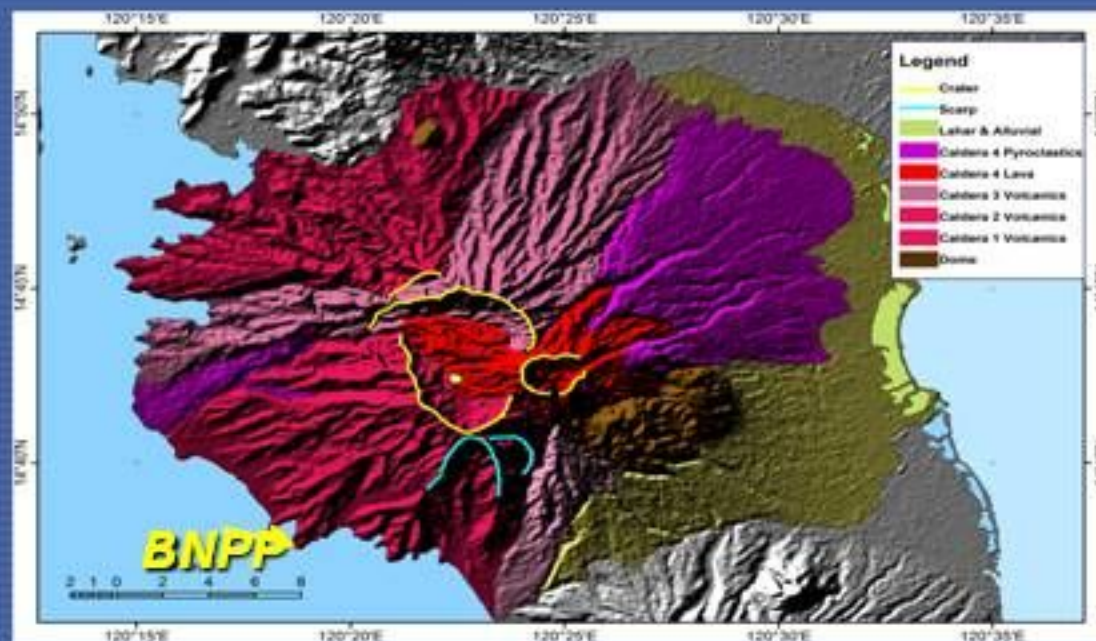
parameter: Peak Ground Acceleration (pga)

value: e.g. minimum pga = 0,10g

NS-R-3: General criteria

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In the derivation of the hazards for external events, consideration should be given to the combination of these with ambient conditions (e.g. hydrological, hydro-geological and meteorological conditions).



NS-R-3: 1 - Criteria for External Events

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- **Proposed sites shall be adequately investigated with respect to all the characteristics that could affect safety in relation to natural and human induced events.**
- **The foreseeable significant changes in land use, such as expansion of existing facilities and human activities or the construction of high risk installations, shall be considered.**



Time scales:

- **Pre-historical, historical and instrumental information and records, as applicable, of the occurrences and severity of those important natural phenomena or human induced situations/activities shall be collected for the region and carefully analyzed for reliability, accuracy and completeness.**

Time scales - Type and span of data

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TYPE OF DATA	TIME FRAME (approx.)	LOWER MAGNITUDE THRESHOLD (approx.)	TIME RESOLUTION
Local networks	10- 20 years	1	second
Modern instruments	30-40 years	2	second
Early instruments	100 years	4	second/minute
Historical	from few centuries to few millennia (*)	3(**)	from minute to year
Archaeological data	from few centuries to a few millennia (*)	5	year
Paleoseismological data	10,000 years	6	century
Neotectonics data	100,000 years		millennium

(*) depending on history of the Country

(**) depending on time period, seismic activity of region and according to cultural and socio-economic historic context.

Table 1

Type of data for the reconstruction of long term seismic history

NS-R-3: 1 - Criteria for External Events

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- **Appropriate methodologies shall be adopted for establishing the hazards from external phenomena.**
- **The methodologies shall be justified as being compatible with the characteristics of the region and the current state of the art.**
- **Preferential consideration should be given to applicable probabilistic methodologies.**
- **It should be noted that probabilistic hazard curves are needed to conduct external event PSA.**

NS-R-3: 1 - Criteria for External Events

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Size of the region: spatial scales

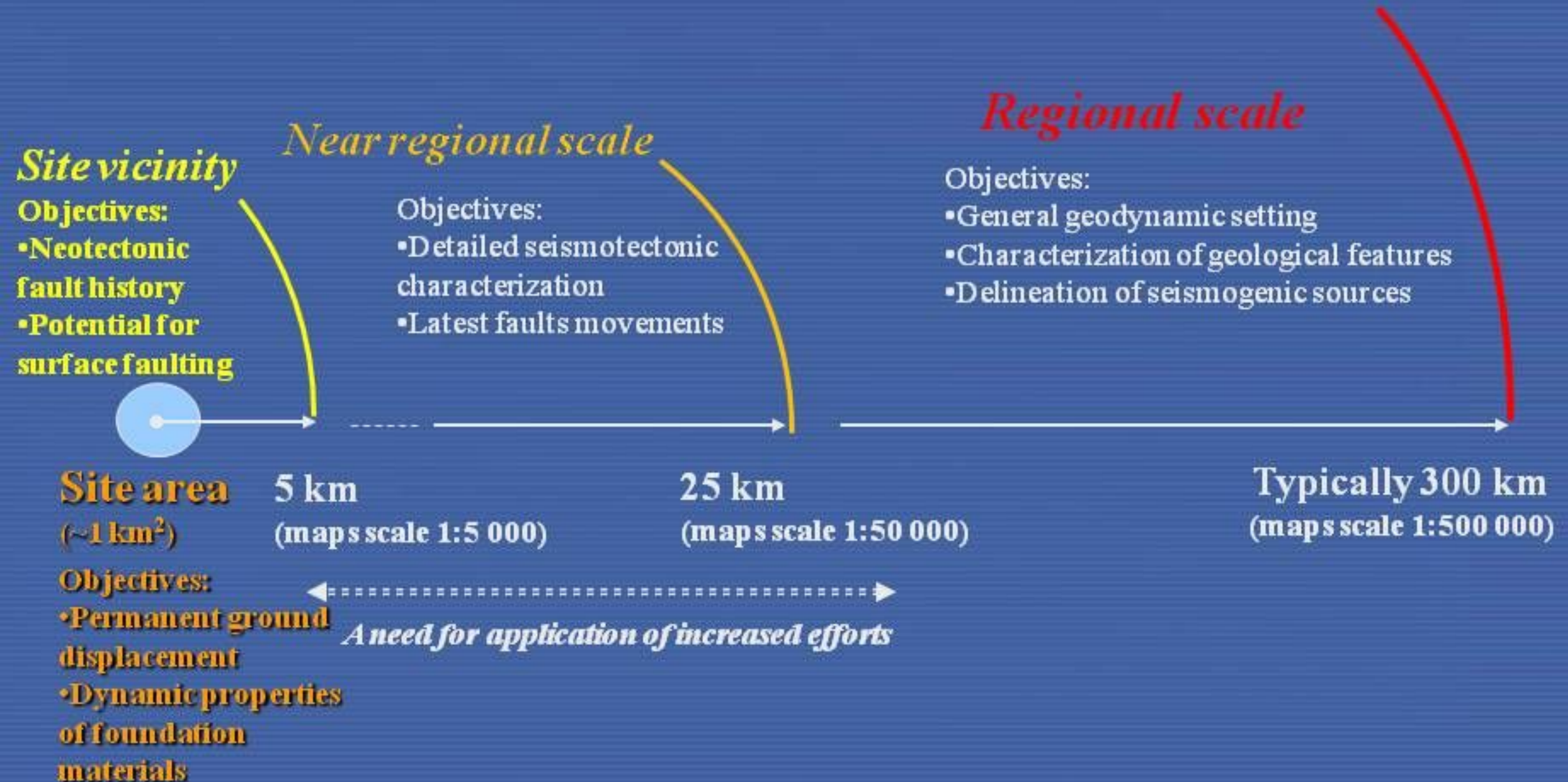
- **The size of the region to which a method for establishing the hazards associated with major external phenomena is to be applied shall be large enough to include all the features and areas that could be of significance in the determination of the natural and human induced phenomena under consideration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



Seismic Hazard Evaluation – Scales of investigations

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Geological, geophysical and geotechnical databases



NS-R-3: 1 - Criteria for External Events

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Site specific data:

- 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 .

NS-R-3: 2 - Criteria for Potential Effects of the nuclear installation in the Region

- **In the evaluation of a site to determine its potential radiological impact on the region for operational states and accident conditions which could lead to emergency measures, appropriate estimates shall be made of expected or potential releases of radioactive material, taking into account the design of the installation and its safety features.**

NS-R-3: 2 - Criteria for Potential Effects of the nuclear installation in the Region

- **The direct and indirect pathways by which radioactive material released from the 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 to the function of the biosphere in the accumulation and transport of radionuclides.**

NS-R-3: 2 - Criteria for Potential Effects of

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the nuclear installation in the Region

- **The site and the design for the nuclear installation shall be examined in conjunction to ensure that the radiological risk to the public and the environment arising from releases defined by the source terms is acceptably low.**
- **The design of the plant shall compensate for any unacceptable effects of the nuclear installation on the region, or otherwise the site shall be deemed unsuitable.**

NS-R-3: 3 - Criteria for considerations of

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Population and Emergency Planning

- **The proposed region shall be studied to evaluate the present and foreseeable future characteristics and distribution of the population,**
- **such a study shall include the evaluation of present and future used of land and water in the region, and**
- **account shall be taken of any special characteristics that may affect the potential consequences of radioactive releases for individuals and the population as a whole.**

NS-R-3: 3 - Criteria for considerations of

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Population and Emergency Planning

The combined effects of the site and the installation shall be such that:

- For operational states the radiological exposure of the population remains as low as reasonably achievable and, in any case, in compliance with national requirements with account taken of international recommendations.**
- The radiological risk to the population associated with accident conditions, including those that could lead to emergency measures being taken is acceptably low.**

NS-R-3: 3 - Criteria for considerations of

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Population and Emergency Planning

If, after thorough evaluation, it is shown that appropriate measures cannot be developed to meet the above requirements, the site shall be deemed unsuitable for the location of a nuclear installation of the type proposed.



NS-R-3: 3 - Criteria for considerations of

Population and Emergency Planning

The external zone for a proposed site shall be established with a view to the potential for radiological consequences to people and to the capability of implementing emergency plans, having due regard for any external event or phenomenon which may hinder implementation.



- The site characteristics of relevance to the nuclear installation that are considered in this safety requirements and that are pertinent to the licensing and safe operation shall be monitored over the lifetime of the facility.
- A QA 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 process, covering all activities that may influence safety or the derivation of parameters for the design basis.

NS-R-3: Specific Requirements on External Events

Specific requirements for external events are provided. Safety Guides provide detailed and specific recommendations to satisfy these requirements:

- **Earthquakes and Surface Faulting - Seismic Hazard Evaluation**
- **Extreme and Rare Meteorological Events**
- **Flood Hazards for River and Coastal Sites**
- **Hazards from Human Induced Events**
- **Geotechnical Aspects and Foundation Safety**
- **Other important considerations: volcanism, sand storms, long term heat removal from the core, etc.**

NS-R-3: Specific Requirements on External Events

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Specific requirements for Earthquakes and Surface Faulting - Seismic Hazard Evaluation:

- The seismological and geological conditions in the region and the engineering geological aspects and geotechnical aspects of the proposed site shall be evaluated.
- ...
- 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.

NS-R-3: Specific Requirements for Dispersion

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and Population

- **Specific requirements for dispersion of radioactive material in air and water, the population distribution, uses of land and water in the region and feasibility of emergency plan are covered in one new safety guide:**

“Dispersion of Radioactive material in Air and water and Considerations of Population Distribution in Site Evaluation for Nuclear Power Plants”, NS-G-3.2, IAEA, Vienna (2002).

SITE APPROVAL - LICENSING ASPECTS

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- **The Nuclear Regulatory Authority should issue a document that sets out the technical safety and security criteria against which the Site Permit Application for a new NPP will be reviewed.**
- **Typically the supporting documents for the Site Permit Application should be:**
 - ***The Site Evaluation Report***
 - ***The Environmental Impact Assessment Report***
- **The criteria for site evaluation take into account all phases of the NPP life cycle, from site selection to decommissioning.**

SITE APPROVAL - LICENSING ASPECTS

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- **Site characteristics and the effects of external events are integral considerations in the site evaluation process for the following reasons:**
 - 1. They may be used in assessing the risks to both the plant and the environment and determining the mitigation strategies required to minimize the risks and resulting consequences;**
 - 2. Site characteristics and resulting risks feed into the public consultation process;**
 - 3. Mitigation strategies feed into the NPP site preparation and design processes through various safety assessment processes;**
 - 4. Emergency preparedness and security needs can be anticipated to ensure adequate measures can be implemented at the appropriate licensing stages.**

SITE APPROVAL - LICENSING ASPECTS

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- **The final goal of the Site License is to ensure that the site characteristics which have an impact on health, safety, security and the environment have been identified and that these characteristics can, and will, be taken into consideration in the design and operation of the new nuclear power plant.**
- **The technical information arising from consideration of external events, site specific characteristics and supporting safety assessments, are used as input into the design of the new nuclear power plant, and must be included in the Site Evaluation Report (supporting document for the application for Site License).**

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Thank you for your attention



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