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Joint ICTP-IAEA School of Nuclear Energy Management

5 - 23 November 2012

NPP SITING

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NPP SITING

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Annual ICTP/IAEA Nuclear Energy Management School

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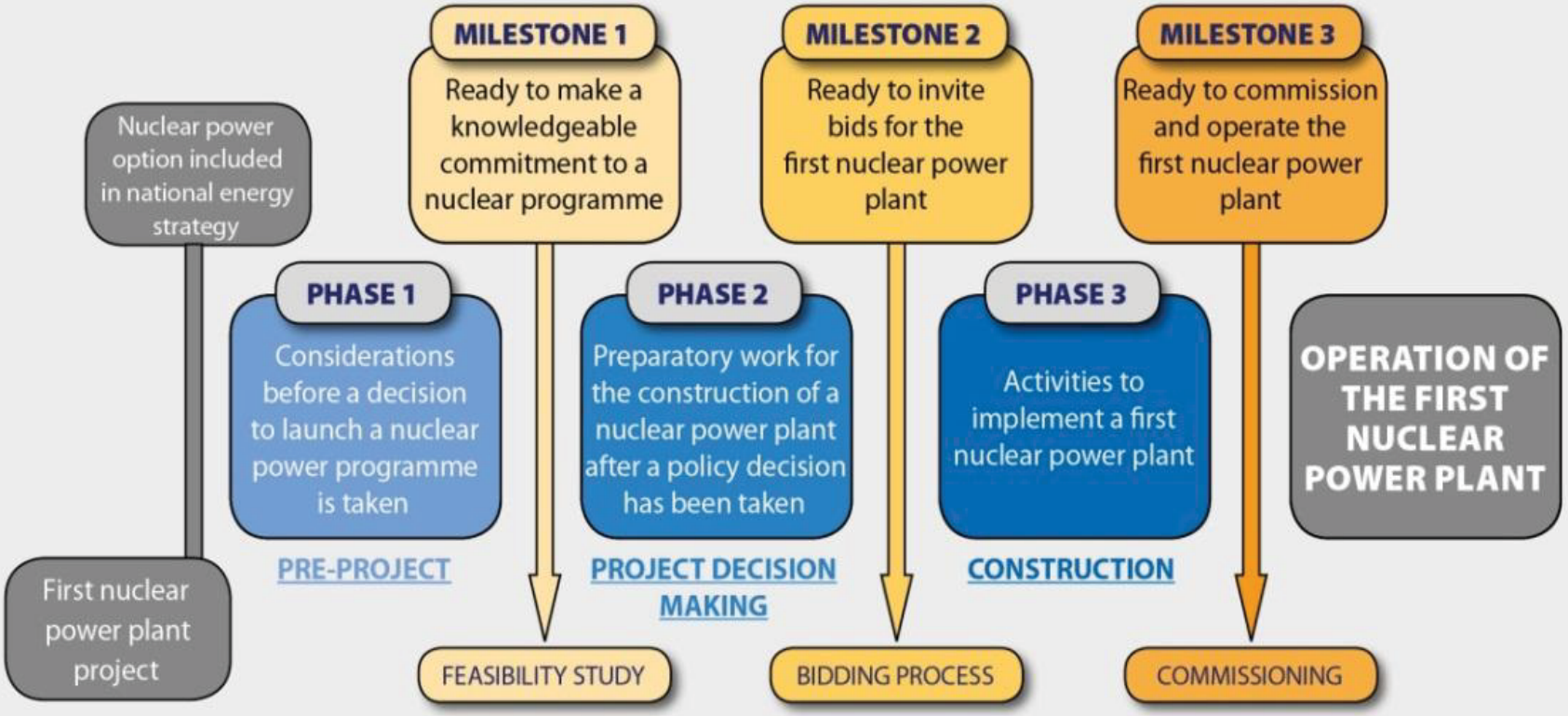
IAEA MILESTONES APPROACH

NUCLEAR INFRASTRUCTURE DEVELOPMENT PROGRAMME



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INFRASTRUCTURE DEVELOPMENT PROGRAM

Infrastructure program

1st. NPP Project

PHASE 1

- ✓ Energy Planning
- ✓ Collection of information on NPP
- ✓ Awareness raising
- ✓ Plan for the phases 2/3

PHASE 2

- ✓ Key organizations established (or designated)
- ✓ Legislation and regulations in place
- ✓ National Policy defined for NPP (HRD, RW management) and implemented as required

PHASE 3

- ✓ Consolidation of the NPP Owner/Operator organization
- ✓ Development of the Regulatory Body as knowledgeable organization

Maintenance and continuous infrastructure improvement

Pre project | **Project decision making** | **Construction** | Operation / decommissioning

Siting (initial study, site selection, site characterization)

Operator/ Owner established

Feasibility Study

BIS prepared

Contract concluded

Necessary licence for NPP

Construction

Commissioning

Operation

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DEFINITIONS

- **SITE:** The area containing the Nuclear Power Plant, defined by a boundary and under effective control of the Plant Management.
- **SITING:** The process of selecting a suitable site for a nuclear facility, including appropriate assessment and definition of the related design bases.
- **EXTERNAL EVENTS:** The events unconnected with the operation of a nuclear facility or activity which could have an effect on the safety of the facility or activity.

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IAEA MILESTONES AND NPP SITE

IAEA Milestone document (NG-G-3.1 Section 3.12):

NPP Site selection and evaluation are a crucial part of establishing a nuclear power program and can be significantly affected by costs and public acceptance.

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IAEA MILESTONES AND NPP SITE

Milestone 1:

- General survey of potential sites
- Identification of possible sites

Milestone 2:

- Detailed site characterization
- A suitable site (s) for BIS is (are) selected

Milestone 3:

- All site services and provisions in place and functional

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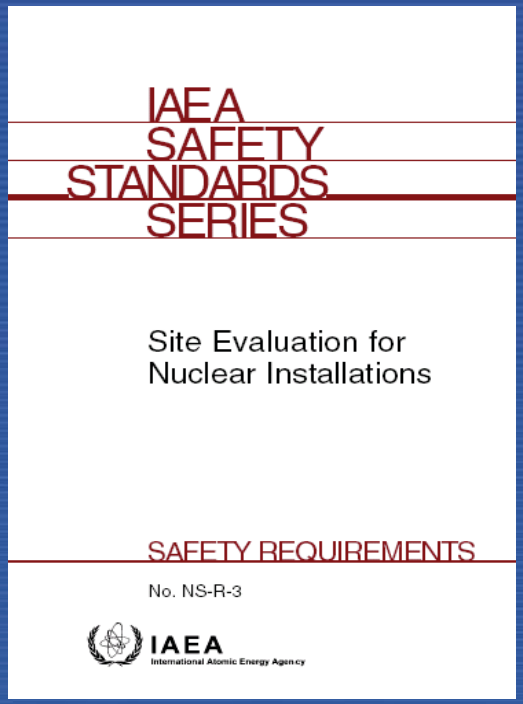
PHASES OF THE FULL NPP SITING PROCESS

NPP siting process has the following phases:

- **Site survey**
- **Site evaluation:**
  - ✓ **Site selection**
  - ✓ **Site assessment**
  - ✓ **Pre-operational**
  - ✓ **Operational**



covering the complete lifecycle of the nuclear installation.

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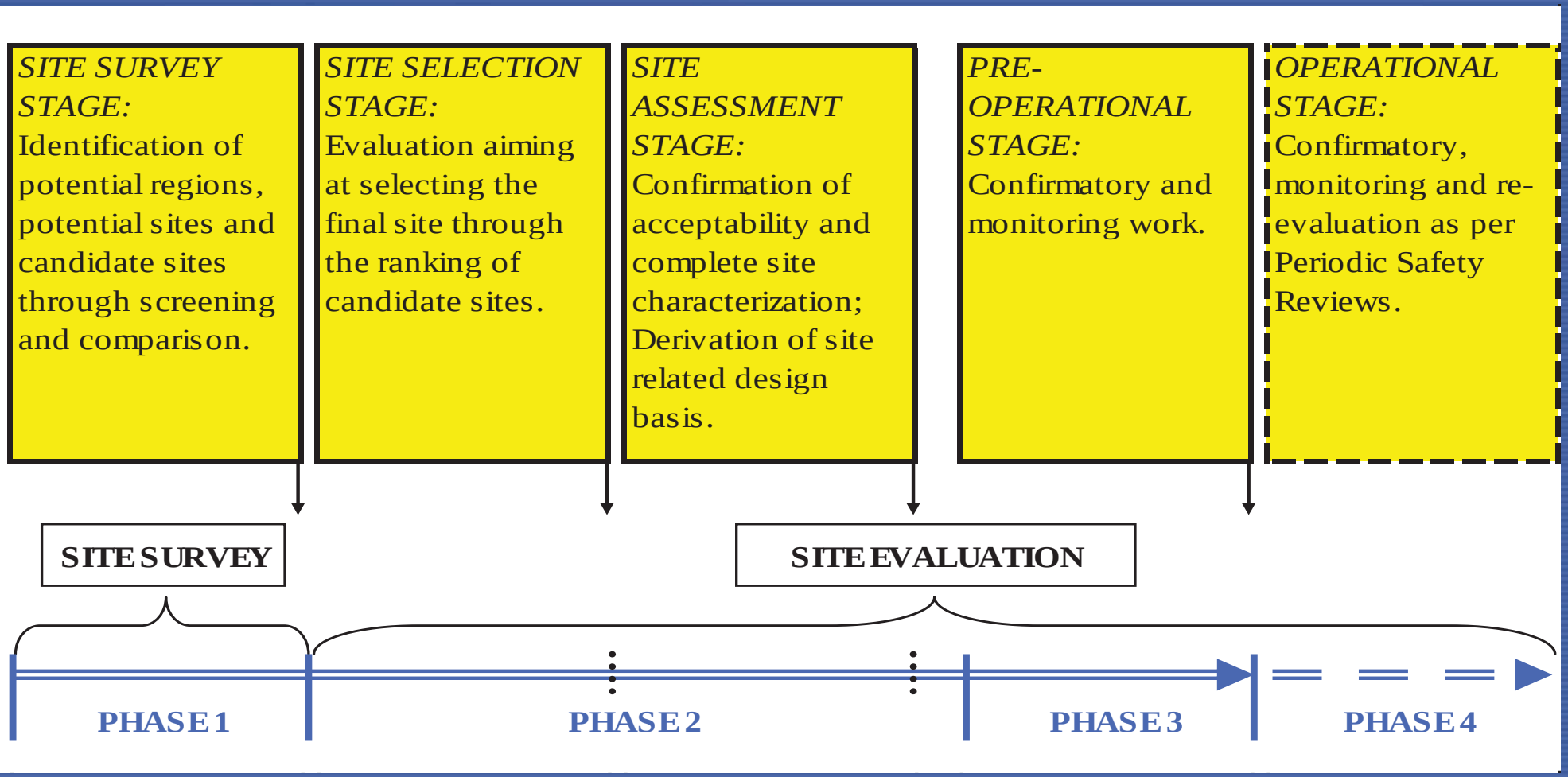
SITE SELECTION AND EVALUATION PHASES



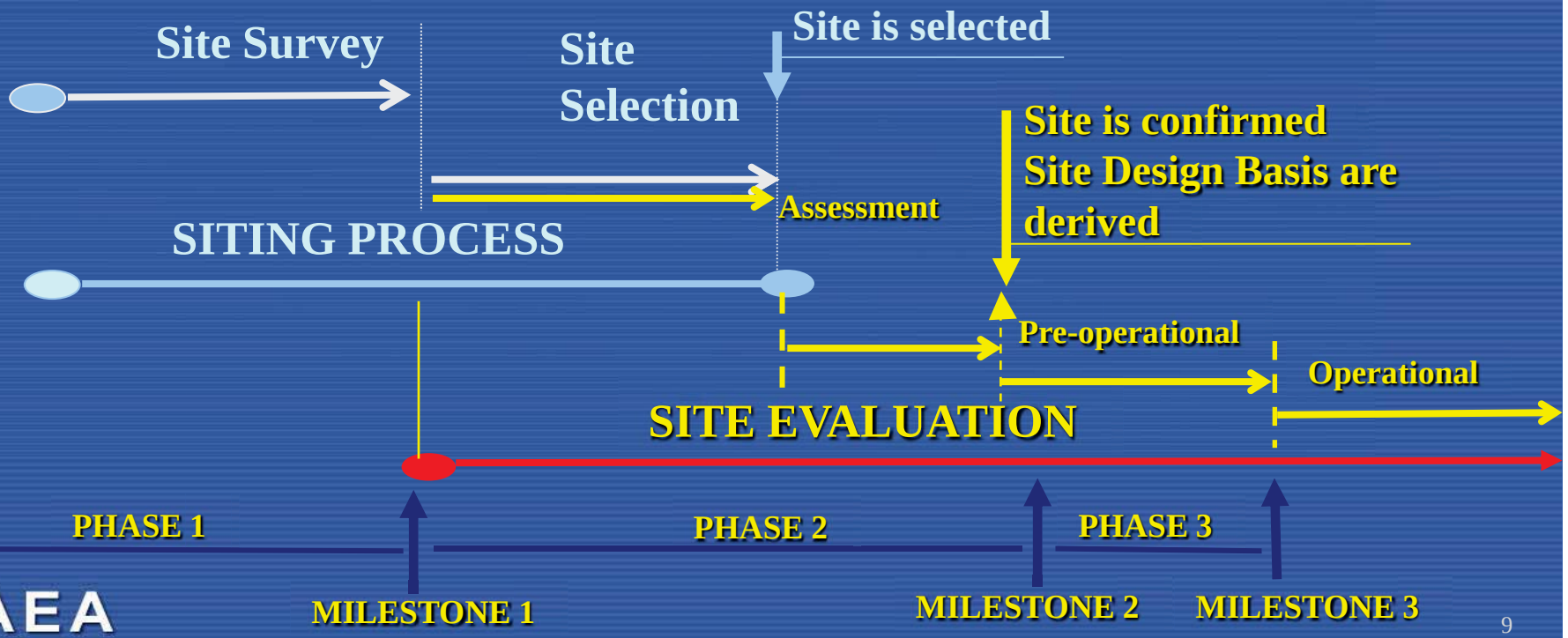
SITE SELECTION AND SITE EVALUATION

SITING:

1. Site Survey
2. Site Selection

SITE EVALUATION:

1. Site Selection
2. Assessment (Characterization)
3. Pre-operational
4. Operational



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SITE SURVEY AND EVALUATION

A multidisciplinary effort is required:

- power engineering,
- nuclear engineering,
- radiological protection,
- ecology-radioecology,
- demography,
- emergency planning,
- civil engineering,
- soil mechanics,
- geology, geophysics
- seismology,
- hydrology, hydrogeology
- meteorology
- oceanography.

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SITE SURVEY AND EVALUATION

Generally, the site survey for a NPP is performed in the following three steps:

1. **Regional analysis to identify potential sites**
2. **Screening of potential sites to select candidate sites**
3. **Comparison and ranking of candidate sites to obtain the preferred candidate site(s)**

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1. REGIONAL ANALYSIS (1)

- It is important to consider all potential sites and not to discard any site that may eventually be selected.
- Objective is to retain a relatively large number of sites at the end of this step.
- Brief site visits may be made to ascertain the results of the desk studies.
- Data that is available either from previous studies or that can be gathered from public sources are used. No site specific investigations need to be made.
- Data involve topics such as: population density, proximity to towns and cities, land use, access and transportation, proximity to hazardous activities, meteorology, topography and bathymetry, availability of cooling and industrial water, grid connection, geotechnical conditions, proximity to natural hazards, environmental impact considerations and others as required.

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1. REGIONAL ANALYSIS (2)

Deliverable:

- A report describing the work performed should be prepared.
- Data, criteria and the methodology used should be described.
- **List of the potential sites** with their positive and negative aspects.
- A brief description of the sites that have been considered in the process but eventually discarded should also be given substantiating reasons for rejection.

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2. SCREENING OF POTENTIAL SITES (1)

- Purpose of this phase is to narrow down the sites to a manageable number so that a detailed comparison and ranking can be made.
- Boundaries of the selected sites are better defined.
- Selected criteria should be able to discriminate between the potential sites without eliminating all the sites.
- It is important that the candidate sites are not all located within the same region or sub-region. This is to avoid the possibility that an unexpected factor to be discovered in a later investigation will have a negative affect on all the candidate sites and cause all of them to be rejected.

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2. SCREENING OF POTENTIAL SITES (2)

Tasks to be performed during Screening stage:

- **Task 1. Identification of criteria for the selection of candidate sites**
  - ✓ Revise the criteria used in Phase 1, to eliminate less attractive sites
  - ✓ Iterate the criteria levels to check their effectiveness
  - ✓ Identify other criteria that have discriminatory qualities
- **Task 2. Data collection and verification**
  - ✓ Collect additional available data on topics not considered
  - ✓ Verify data that have been collected in Phase 1
  - ✓ Visit each site, collect data through site investigations
  - ✓ Prepare a systematic, consistent and uniform database for each potential site and regarding each considered topic

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2. SCREENING OF POTENTIAL SITES (3)

Tasks to be performed during Screening stage:

- **Task 3. Identification of candidate sites**
  - ✓ Using the established criteria and the collected data, identify a reasonable number of candidate sites (for example, 3 – 6)
  - ✓ Visit each candidate site once again to confirm the results.

2. SCREENING OF POTENTIAL SITES (4)

- **Data Requirements:**
  - ✓ Data used in Phase 1 need to be enhanced in two ways. Firstly, data related to topics not covered in Phase 1 should be collected. Secondly, the data need to be uniform for all sites if a reasonably comparative basis is to be established. For this reason further collection of data may be needed for sites where such information is lacking.
- Data to be collected should be the following categories:
  - ✓ Magnitude and frequency of external events of natural and/or man induced origin
  - ✓ Impact of the NPP to the population and the environment, including aspects related to emergency planning
  - ✓ Legal aspects
  - ✓ Socioeconomic and cultural aspects
  - ✓ Economical aspects (access, availability issues)
  - ✓ Public acceptance aspects

2. SCREENING OF POTENTIAL SITES (5)

Deliverable:

- ✓ A report describing the work performed should be prepared.
- ✓ Data, criteria and the methodology used should be described.
- ✓ **List of candidate sites** including maps and photographs.
- ✓ Topographic maps of 1:50000 scale for a distance of 10 km from each candidate site should be prepared.
- ✓ These maps include information on transportation infrastructure, population centers and sources of human induced hazards.

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3. COMPARISON AND RANKING OF CANDIDATE SITES (1)

- Purpose:
  - ✓to confirm that there are no features at the sites that would preclude the construction and operation of a NPP,
  - ✓to compare the candidate sites and rank them in the order of their attractiveness as a NPP site.
- Safety and economic aspects will play the major role in this comparison process.
- Confirmation of the suitability of the site may require limited site specific work such as geophysical profiles or boreholes (for example to demonstrate that there are no capable faults in the site area).

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3. COMPARISON AND RANKING OF CANDIDATE SITES (2)

- **Task1. Confirmation of the suitability of the sites (i.e. no exclusion factors)**
  - ✓Identify the potential weakness of each site that may be the basis for excluding it from further consideration.
  - ✓Conduct appropriate site specific investigations and analyses to decide whether or not the site is confirmed that it does not possess any negative features to be considered as an NPP site.
- **Task2. Establish criteria for comparison and ranking**
  - ✓Criteria related to the design basis of the NPP with respect to external events.
  - ✓Criteria related to the design of the NPP with respect to its environmental impact.
  - ✓Criteria related to the efficiency of the NPP.

3. COMPARISON AND RANKING OF CANDIDATE SITES (3)

- **Task3. Identify the preferred candidate site(s)**
  - ✓ Using the established criteria quantify the selected attributes of each site.
  - ✓ Select the site(s) that ranks highest as the preferred candidate site(s).
- **Data Requirements:**
  - ✓ For Task 1 of this phase, it is possible that detailed data is required for some sites through site investigations.
  - ✓ For the comparison and ranking task, economic data is needed. It is not required to know the design details of any particular plant because the differentials are relative.
  - ✓ Data needed for the simplified calculations of external hazard and other design parameters related to the site should be collected.

3. COMPARISON AND RANKING OF CANDIDATE SITES (4)

Deliverable:

- ✓ A report describing the work performed should be prepared.
- ✓ Data, criteria and the methodology used should be described.
- ✓ **List of preferred candidate sites** including maps and photographs.
- ✓ Documentation regarding the confirmatory studies regarding site acceptability should be included.
- ✓ Basis for the comparison and eventual ranking should be clearly explained.

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SITE SELECTION – DECISION MAKING

- Based on ranking in the **List of preferred candidate sites,** the site for the NPP should be selected **(selected site).**
- Acceptability of the **"selected site"** should be confirm and after the site is accepted the final **Site Evaluation Report** shall be finalized, which will include inputs for the definition of the **design bases for the future NPP**.
- Information included in the Site Evaluation Report should be used for the Bid Invitation Specification process.

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LICENSING ASPECTS OF NPP SITE (1)

Site selection is a process where safety considerations largely dominate and provides two distinct levels of **defence in depth**:

- ✓ First level is preventive and aims at **decreasing the exposure to external hazards.** It involves a comprehensive process of screening out sites where hazards are too high.
- ✓ Second level is connected with mitigation and aims at **decreasing the impact on public and environment**. Selected site should have appropriate characteristics and also favourable conditions for the implementation of a site emergency plan.

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LICENSING ASPECTS OF NPP SITE (2)

- NPP site selection process needs to be guided by Regulatory Body using a clearly established **set of criteria** or **regulatory requirements.**
- Typically the supporting documents for the Site Permit Application prepared by the NPP Owner/Operator should be:
  1. **The Site Evaluation Report**
  2. **The Environmental Assessment Report**
- 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.

LICENSING ASPECTS OF NPP SITE (3)

- Technical information included in the Site Evaluation Report and 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**.**
- For the selected site, detailed and specific investigations and studies, with all results included in the Site Evaluation Report, shall be transferred into the **site related design bases** for the new NPP.

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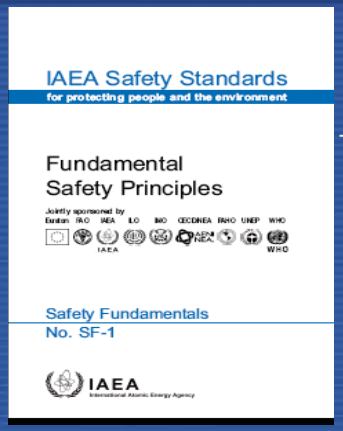
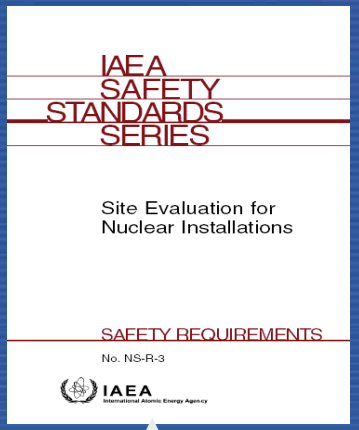
IAEA SAFETY STANDARDS ON NPP SITING (1)

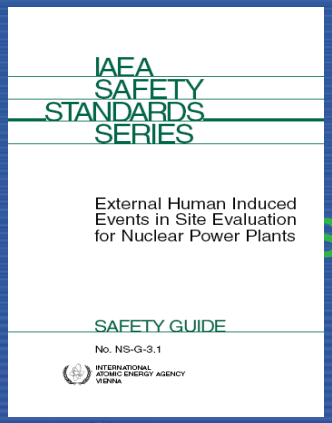


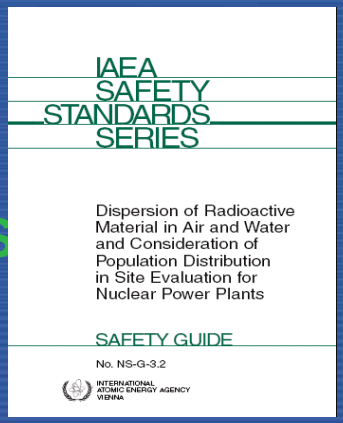
SITE EVALUATION

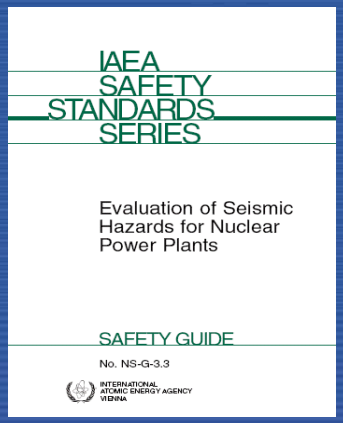


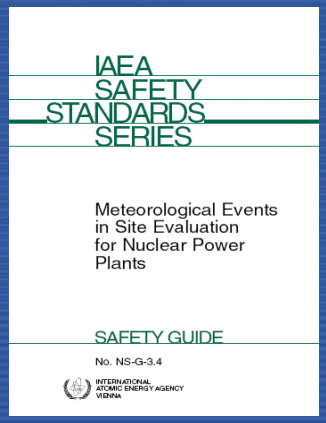
REQUIREMENTS

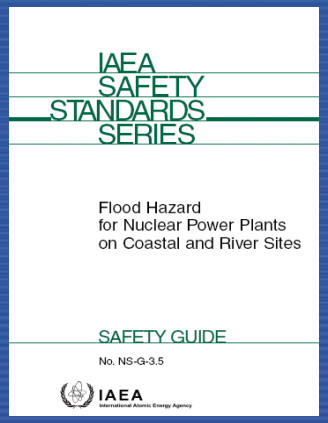
SAFETY GUIDES

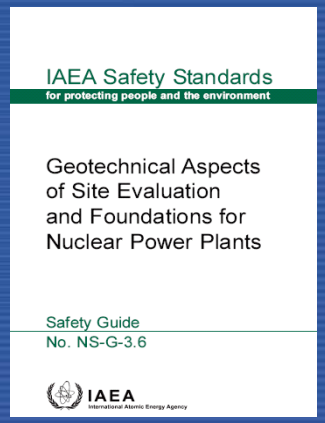












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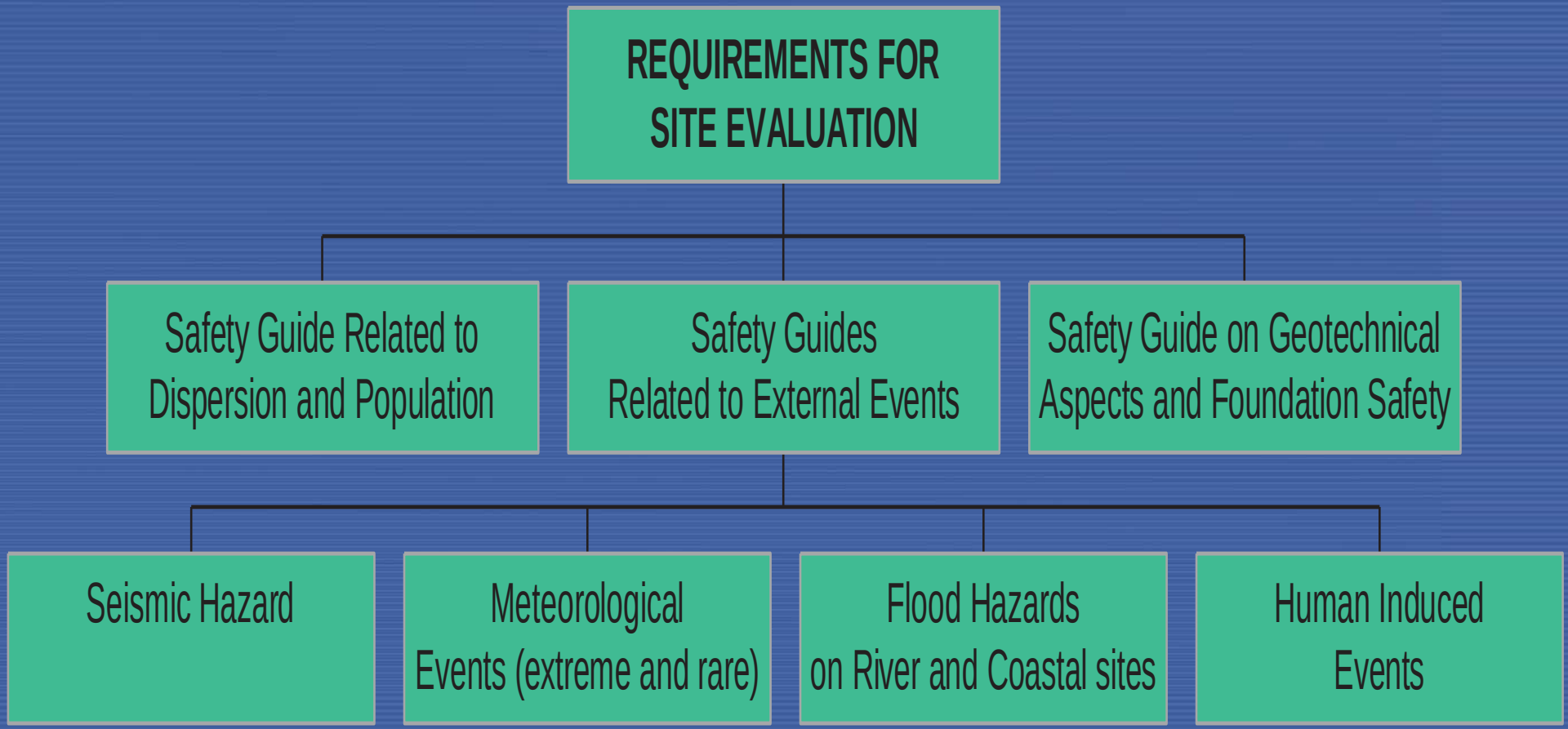
IAEA SAFETY STANDARDS ON NPP SITING (2)



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IAEA ASSISTANCE - WORKSHOPS (1)

Suggested sequence	When is recommended	Subject of WS
1	Earlier Phase 2	Nuclear Power Program Management, including NPP Owner/Operator interfaces
2	Earlier Phase 2	Establishment of the NPP Owner/Operator organization, including Capacity Building
3	Earlier Phase 2	New Nuclear Power Programs: How to Become a Knowledgeable Customer
4	Beginning of Phase 2	Integrated Management System, Leadership and Safety Culture for the NPP Owner/Operator organization
5	Beginning of Phase 2	NPP Feasibility Study(FS) preparation
6	Beginning of Phase 2	**NPP site selection**

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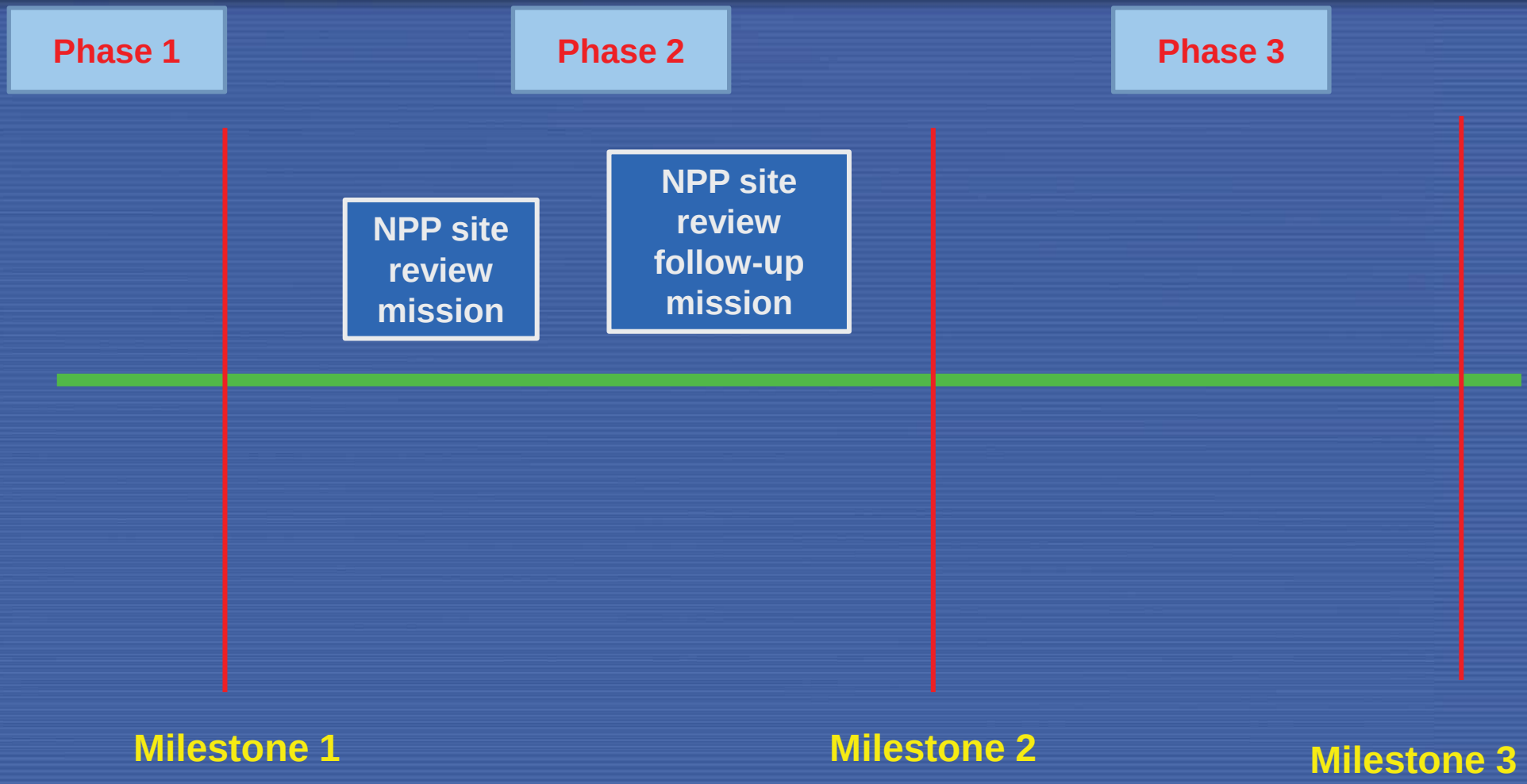
IAEA ASSISTANCE - SITE REVIEW SERVICES



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CONCLUSIONS

- ✓ IAEA Safety Standard NS-R-3 provides requirements for NPP site evaluation process.
- ✓ There is a complete set of IAEA Safety Guides covering all NPP siting topics.
- ✓ Siting activities are part of a NPP project and implementing appropriate integrated management system (including Quality Management) is strongly recommended.
- ✓ Development of Regulatory Requirements for NPP Siting activities in agreement with IAEA Safety Standards is strongly recommended in the newcomer countries.

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Thank you!

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