Protection of Nuclear Installations Against External Hazards

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IAEA’s Statute authorizes the Agency to

. . . establish 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 assistance upon request from MS for applying and using these standards
SAFETY STANDARDS FOR THE COMPLETE LIFE

SITE EVALUATION
- Site Evaluation for Nuclear Installations
  - Seismic Hazard
  - SSG-9

DESIGN
- Safety of Nuclear Power Plants: Design
- Seismic Design and Qualification for Nuclear Power Plants
  - NS-G-1.6

OPERATION
- Periodic Safety Review
- Evaluation of Seismic Safety for Existing Nuclear Installations
  - NS-G-2.13

The complete lifetime of the installation
Linking Safety Goal with Safety Requirements for Design Site Evaluation

Integrated Management System

Safety Goal

NPPs’ DESIGN REQUIREMENTS

DESIGN PROCESS

SAFETY ANALYSIS

B-DBA

BDB Internal & External Hazards,

SITEx EVALUATION SAFETY REQUIREMENTS

Plant states, PIEs, Internal and external hazards, DBAs, DEC's
Fukushima Accident

• March 11, 2011 Magnitude 9 Tohuku earthquake affected large part of Japan and generated destructive Tsunami waves.

• The combined effects of earthquake and Tsunami produced un-recoverable damages of the main safety functions of Fukushima Daicii Units 1 to 4 ending with multi-unit nuclear accident (core melt of 3 reactors followed by hydrogen explosion and fuel damage in the SFP to the forth reactor).
March 11, 2011 Tohuku Earthquake

Wave forms of seismic motion along the coast – multi segment rupture
March 11, 2011 Earthquake Generated Tsunami

Tsunami Model by Dr. Fujii (Fuji Tokoha Univ.)

Source of very high and sharp tsunami

Source of low and long period tsunami

From NHK TV on May 10
IAEA Action Plan for Strengthening Nuclear Safety

• Fact finding mission (May 2011), Ministerial Conference (June 2011)
• Strengthen nuclear safety, emergency preparedness and radiation protection of people worldwide
• IAEA Action Plan to strengthen global nuclear safety framework: Safety assessments in the light of the accident at TEPCO’s Fukushima Daiichi Nuclear Power Station
IAEA developed a “Methodology for Member States to Assess the Safety Vulnerabilities of Nuclear Power Plants against Site Specific Extreme Natural Hazards”

The methodology is based on existing IAEA Safety Standards Series documents (Requirements and Guides), and makes use of recently updated modules to existing Safety Services.
IAEA Methodology for Assessment of NPPs Vulnerability against External Hazards

- Selection of the methodology (deterministic and/or probabilistic)
- Selection of the Review Level Hazard (Consistent with the performance and safety goals - NS-G-2.13)
- Design Review, and Data Collection relevant for the external hazards considered (NS-G-2.13, NS-G-1.5, NS-G-1.6, SSR-2/1).
- Deterministic safety margin analysis (NS-G-2.13, GS-R-4)
- Probabilistic external events safety analysis (NS-G-2.13, GS-R-4)
Objectives

• The Objectives of the Safety Margin Evaluation may include:
  • To demonstrate the Safety Margin beyond the original design basis
  • To identify vulnerabilities and the week links
  • To identify and prioritize the possible upgrades and compensatory measure
  • To provide input for Risk Informed Decision Making
  • To assess the risk (expressed in CDF, LERF) and/or plant capacity against regulatory requirements
  • To evaluate a group of Nuclear Installation to determine their relative seismic capacity and/or their risk ranking
Field Data Collection During Structures and Systems Walkdowns

- Reactor Control Rods
- Drive Mechanism
- Reactor Core Isolation Cooling System (RCIC)
- Connection between Containment Vessel and Torus (Pressure Suppression Vessel)
- Base of the Ventilation Stack (Tower)
- Control Room
- Entrance to Containment Area
- Reactor Control Rods Drive Mechanism
Field Activities during Safety Review Missions
Field Activities during Safety Review Missions
Working under Press’ Pressure
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Final Remarks

1. There are no gaps in IAEA safety requirements in relation to protection against external events of nuclear installations.

2. Periodic Safety Re-evaluation including site safety and external hazards should be conducted.

3. The Fukushima accident has also shown that defence-in-depth should be strengthened by taking into account severe accidents resulting from extreme natural hazards exceeding the levels taken into account by the design basis.

4. Adequate defence in depth capability (for Did 4 and 5) should be maintained for beyond design base accidents considering impact of external hazards.
4. The high consequences low probability events shall be properly considered in siting, site characterization, design and safety assessment.

5. The credited emergency measures should be assessed against external hazards for their feasibility with appropriate consideration of the human errors.

6. Validated methodologies for safety assessment against external hazards should be used to assess and maintain adequate safety margin (consistent with the safety goal and safety objectives).