The Abdus Salam
International Centre for Theoretical Physics

United Nations
Educational, Scientific and
Cultural Organization

IAEA
International Atomic Energy Agency

2016-5

Joint ICTP/IAEA Advanced Workshop on Earthquake Engineering for Nuclear Facilities

30 November - 4 December, 2009

Outline of the Programme

SOLLOGOUB Pierre

International Seismic Safety Centre
International Atomic Energy Agency (IAEA)
Vienna
AUSTRIA

"Outline of the Programme"

Pierre SOLLOGOUB
International Seismic Safety Centre
International Atomic Energy Agency (IAEA)
30 November – 4 December 2009
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Seismic Design of Nuclear Installations Objectives

- Specificity of Nuclear Installations: need for “high reliability”: the probability of damage or malfunction or failure to fulfil safety function is low
- Current approach:
  - Based on experience
  - Conventional engineering analyses and standards
  - Testing programs
  - Expert judgement
    - Margins
    - Defence in depth
- Performance-based approaches
  - Safety goals?
  - Final design is Deterministic: f.i. “what is the rebars section”

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Seismic Design of Nuclear Installations
General Considerations

- Different steps are to be considered:
  - Seismic sources identification
    - Faults – active/inactive, scenarios
    - Diffuse seismicity
  - Wave propagation to the site
  - Local/site effects
  - Soil behaviour
  - Soil-structure Interaction
  - Structural behaviour-design
  - Floor response spectra
  - Systems and components/equipment design
  - ***Safety analysis: what are we expecting in case of earthquakes?***

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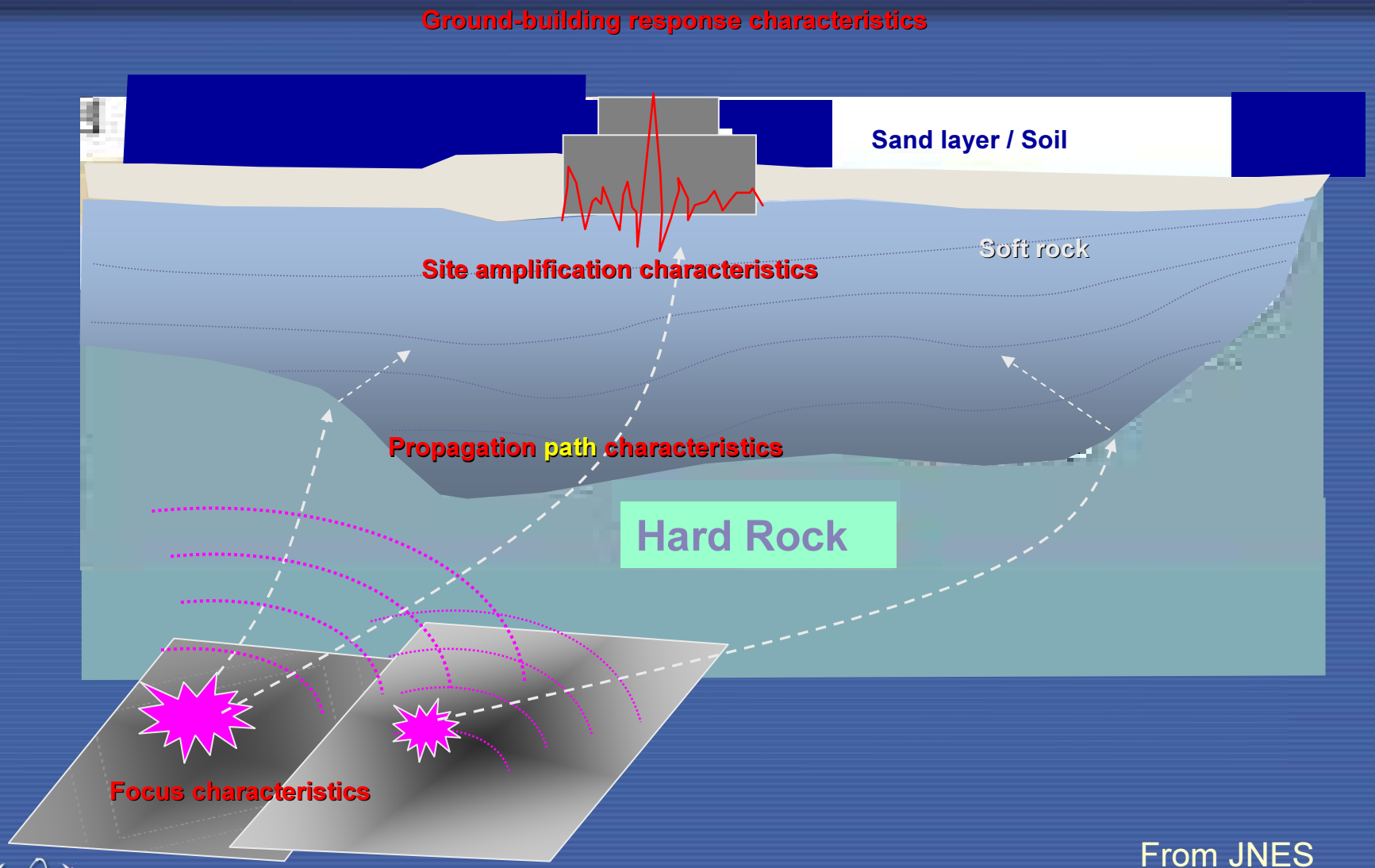
Outline of analysis of the earthquake ground motion



From JNES

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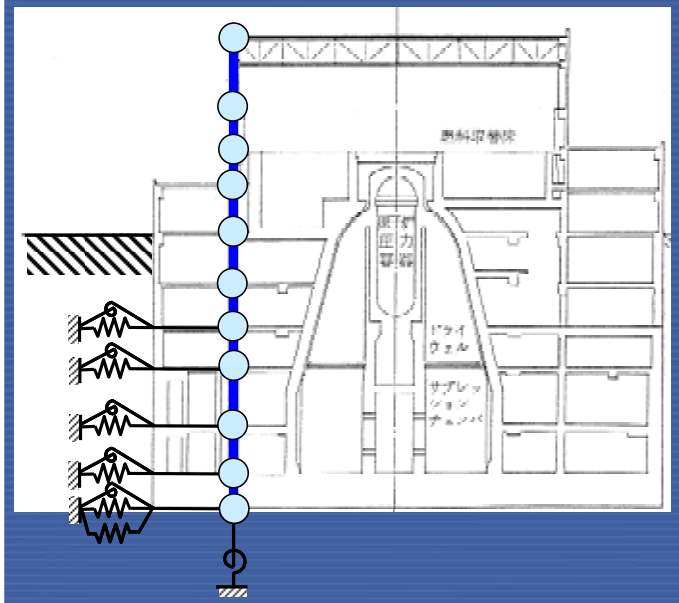
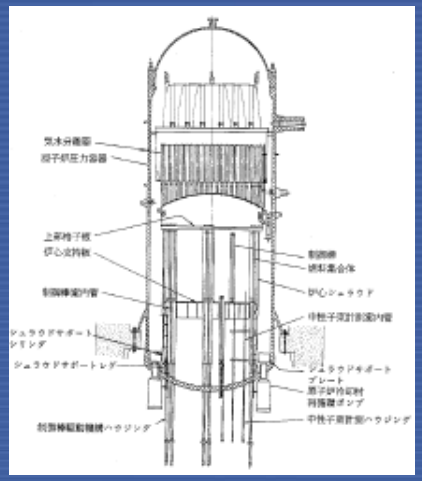
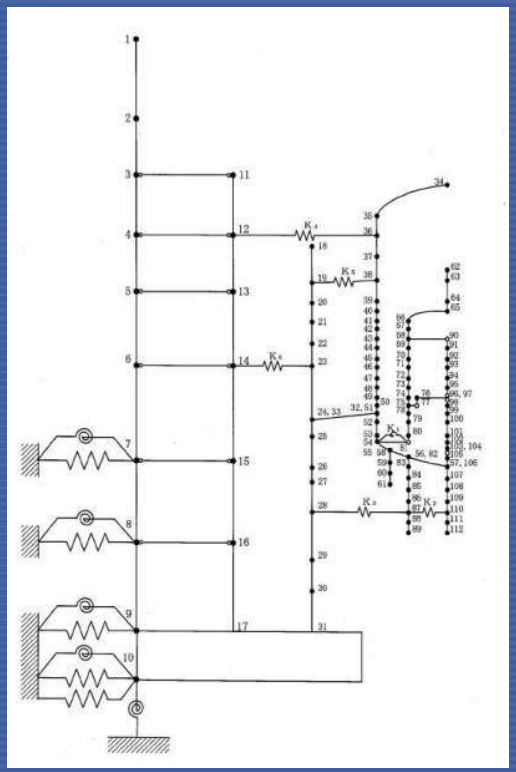
Seismic Response Analysis of Large Component





(Reactor internals analysis model)



Seismic Design of Nuclear Installations
Main tasks

- Seismic hazard assessment
  - Data collection
- Geotechnical characterisation
- Structural design and analysis
- Systems and components design and analysis
- Different approaches:
  - Safety analysis
  - Deterministic approach
  - Probabilistic approach
  - Building, construction, inspection codes
- Operation
  - Periodic re-evaluation
  - Pre- and post-earthquake procedures
- New and existing Nuclear Installations

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General

- ICTP/IAEA Advanced Worshop on Earthquake Engineering for Nuclear Facilities
- The workshop will consider previously mentioned topics:
  - Seismic Hazard
  - Probabilistic/deterministic
  - Seismic risk
  - Design
  - Safety analysis
  - Soil structure interaction
  - Fragilities
  - Operation
  - Uncertainties
  - Feedback from experience
  - ....

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Outline of the programme

- Ist Day
  - IAEA involvement in Seismic Safety
  - Introduction of the IAEA Activities
  - Seismic Hazard Assessment – comparison deterministic, probabilistic
- 2nd Day
  - PSHA and Hazard scenarios (2 presentations)
  - Seismic regulation in Japan
  - SHA in low/moderate seismicity regions

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Outline of the programme

- 3rd Day
  - Seismic Hazard and Risk analysis
  - Time dependant Seismic Risk Assessment
  - Seismic PRA for NPP
  - SISMA prototype system
- 4th Day
  - Existing facilities: SMA
  - Existing facilities: SPSA
  - Fragility evaluation and SPSA
  - Equipment fragility testing

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Outline of the programme

- 5th Day
  - Pre-earthquake Planning and post Earthquake Actions
  - Kashiwazaki-Kariwa case: Seismic Hazard Assessment and Evaluation of Plant integrity
  - Examples from participants