

# International Technical Meeting on Seismic Safety of Nuclear Power Plants

25-26 March 2010

Tivoli, Italy.

## ***“ISSC and IAEA role and services”***

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Acting Head

***Pierre SOLLOGOUB***

INTERNATIONAL SEISMIC SAFETY CENTRE, NSNI/IAEA



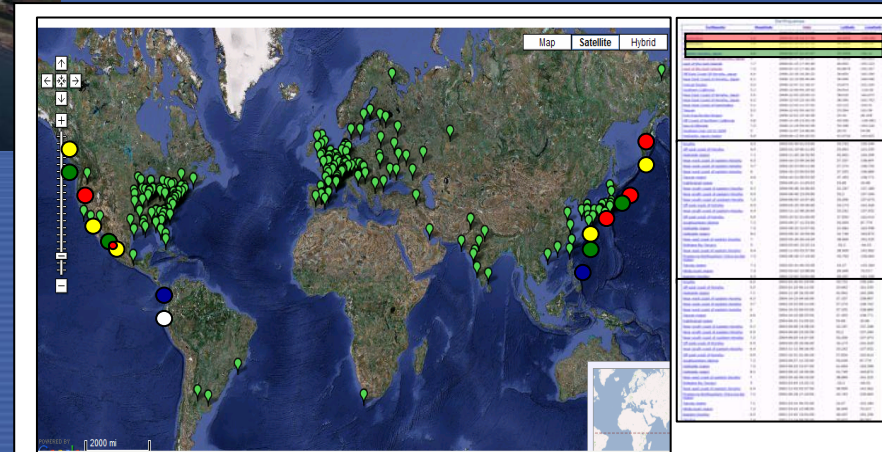
**IAEA**

International Atomic Energy Agency

1<sup>st</sup> session

# NUCLEAR INSTALLATION SAFETY DIVISION

## THE IAEA-INTERNATIONAL SEISMIC SAFETY CENTRE (ISSC)



# **IAEA – INTERNATIONAL SEISMIC SAFETY CENTRE (ISSC)**

## **Enhancing the Seismic Safety of Nuclear Installations**

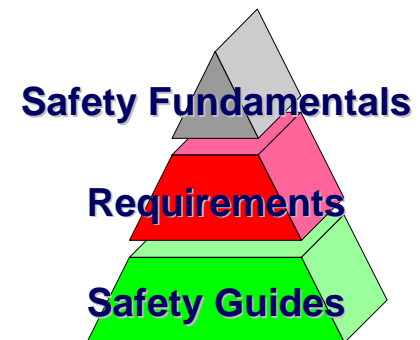
**The ISSC was established (Sept 2008) within the IAEA-Department of Nuclear Safety and Security as a global focal point on seismic safety for nuclear installations worldwide.**

**Currently (since July 2009), ISSC is part of the organizational structure of IAEA.**

# ISSC – BACKGROUND

- **Seismic safety –as well as the safety and protection aspects against of all kinds of external hazards- of nuclear installations is a subject that has received substantial attention at the IAEA within the frame of its *statutory functions*, and of the corresponding programmatic projects, for establishing safety standards and for assisting Member States for its application.**

Safety Standards Series hierarchy



# ISSC – BACKGROUND

- Recently seismic matters are paid more attention owing to the occurrence of strong earthquakes that have affected nuclear power plants beyond their original design levels, impacting on the operation, economics and public acceptance and credibility of these installations.
- Worldwide occurrence of natural disasters : tsunamis, volcanic eruptions, landslides, hurricanes.

# July 2007 Earthquake Effects at the K-K Plant: *Fire at in-house (non-safety) electrical transformer*



The fire was extinguished after 2 hours.  
Root cause: soil subsidence of the base of the secondary connection bus bar with respect to the transformer foundation.





# Upgrading example: piping supports K-K NPP





# Upgrading example: refuelling machine K-K NPP



# ISSC – BACKGROUND

- **Owing to the complexity of these multidisciplinary problems they should be resolved using the experience and contribution of the whole related international scientific community as well as sharing the lessons learned in order to avoid or mitigate the consequences of such extreme natural events.**

# ISSC - SCOPE

- 1. Site Selection (Siting) and Site Evaluation**
  - 2. Safety against external hazards to nuclear installations: earthquakes, flooding, tsunamis, volcanic and meteorological hazards, human induced events including those of malevolent origin (e.g. aircraft crash, explosions, toxic releases, etc.)**
  - 3. Site related aspects of environmental impact assessment, e.g. dispersion in air and surface and ground water**
  - 4. Design related aspects - Chapters 2 and 3 of Safety Analysis Report.**
- . . . geosciences, earthquake and structural engineering aspects, design and layout engineering . . .

# IAEA NS – NSNI - ISSC

**DIRECTOR GENERAL**

**Department  
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Cooperatio  
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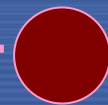
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(NS)**

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**NSNI**



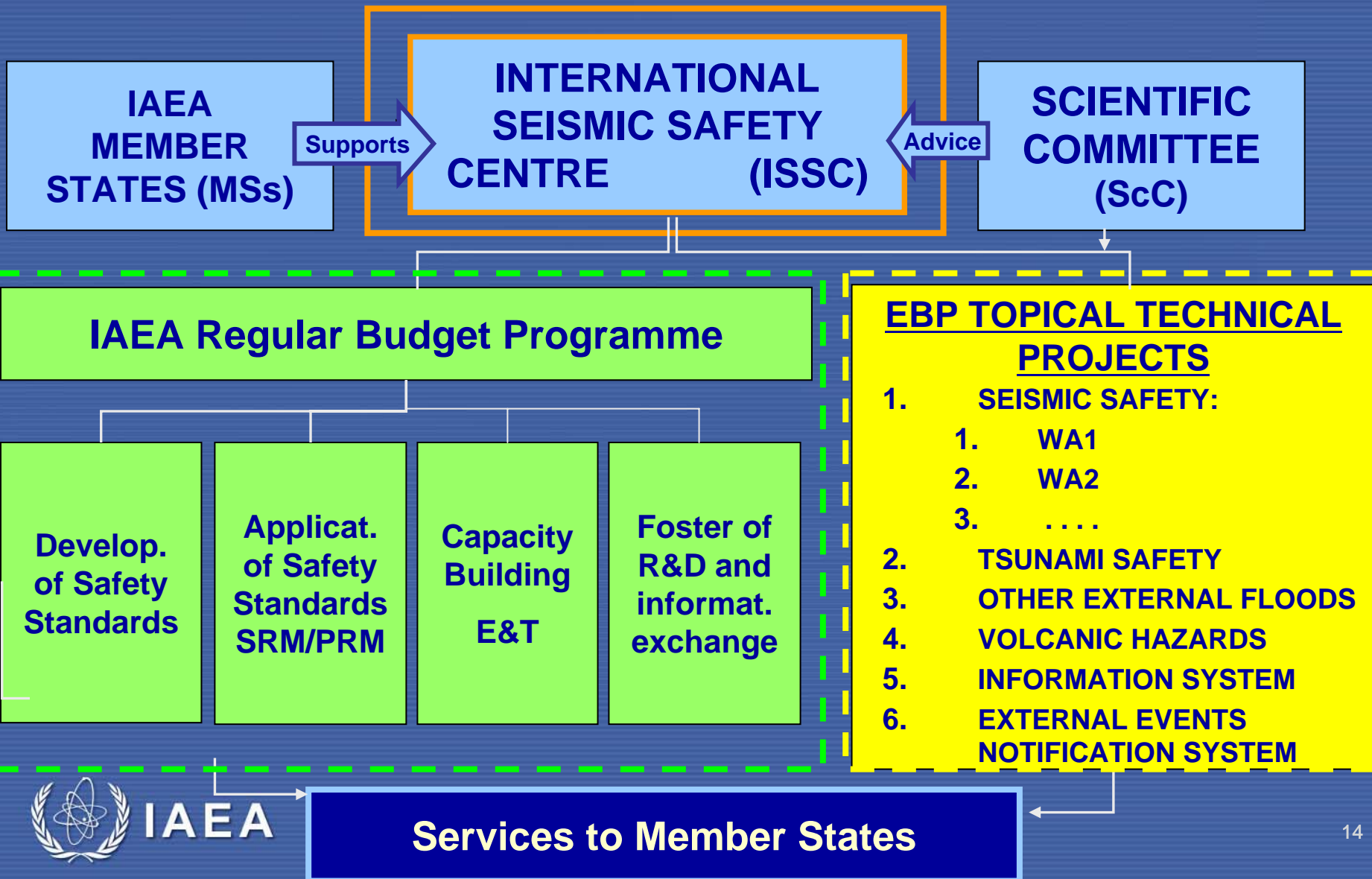
**ISSC**

# NS – NUCLEAR SAFETY INSTALLATION DIVISION

Current status since 1<sup>st</sup> July 2009, IAEA DG Sec/Dir/73:



# STRUCTURE OF ISSC-INTEGRATION OF REGULAR AND EXTRABUDGETARY ACTIVITIES

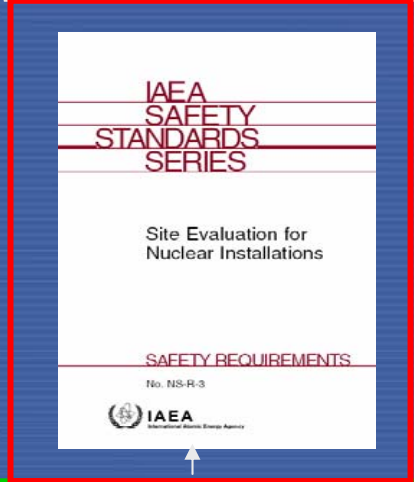
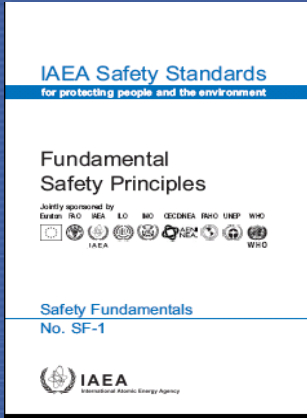


# ISSC ACTIVITIES

- **Regular budget activities: “core” activities**
  - Development of safety standards.
  - Assistance to Member States for application of safety standards: training, advisory and review safety services (mainly, Site Safety Review Missions).
- **Activities with extrabudgetary resources:**
  - Capacity building: workshops, training courses.
  - Development of topical technical projects and support to research studies.
  - Knowledge management: collection and dissemination of information, Information System (database).
  - External Events Notification System.

# IAEA SAFETY STANDARDS ON SITE EVALUATION

## SITE EVALUATION



## REQUIREMENTS

## SAFETY GUIDES



IAEA SAFETY STANDARDS SERIES

External Human Induced Events in Site Evaluation for Nuclear Power Plants

SAFETY GUIDE  
No. NS-G-3.1

IAEA SAFETY STANDARDS SERIES

Dispersion of Radioactive Material in Air and Water and Consideration of Population Distribution in Site Evaluation for Nuclear Power Plants

SAFETY GUIDE  
No. NS-G-3.2

IAEA SAFETY STANDARDS SERIES

Evaluation of Seismic Hazards for Nuclear Power Plants

SAFETY GUIDE  
No. NS-G-3.3

IAEA SAFETY STANDARDS SERIES

Meteorological Events in Site Evaluation for Nuclear Power Plants

SAFETY GUIDE  
No. NS-G-3.4

IAEA SAFETY STANDARDS SERIES

Flood Hazard for Nuclear Power Plants on Coastal and River Sites

SAFETY GUIDE  
No. NS-G-3.5

IAEA Safety Standards  
for protecting people and the environment

Geotechnical Aspects of Site Evaluation and Foundations for Nuclear Power Plants

Safety Guide  
No. NS-G-3.6

IAEA SAFETY STANDARDS  
for protecting people and the environment

Volcanic Hazards in Site Evaluation for Nuclear Installations

DRAFT SAFETY GUIDE  
DS 405

IAEA SAFETY STANDARDS  
for protecting people and the environment

safety series  
No. 50-SG-S9  
IAEA SAFETY GUIDES

Site Survey for Nuclear Power Plants  
A Safety Guide

DS422

New SG-DS417

DS405

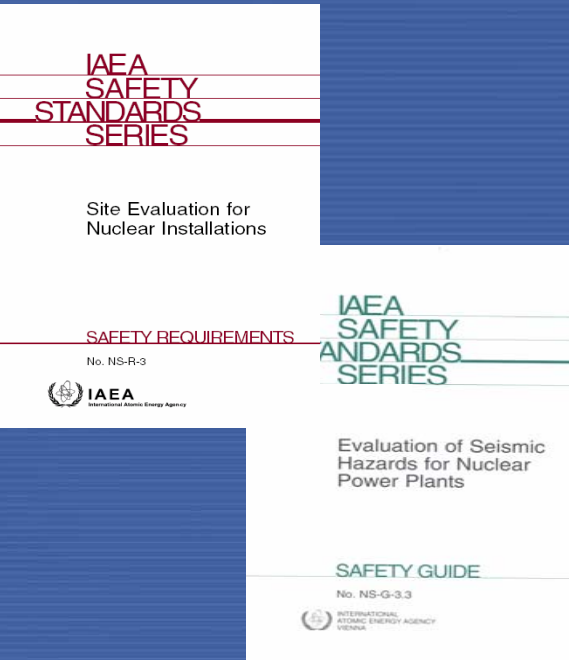
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# IAEA SAFETY STANDARDS - SEISMIC SAFETY

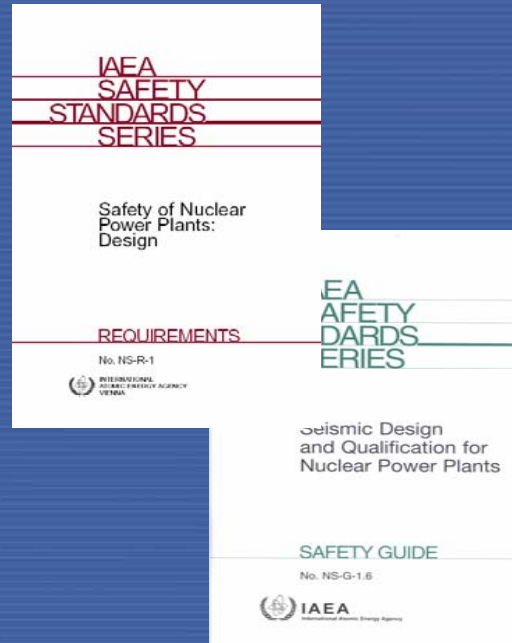
## SITE EVALUATION



**Seismic Hazard  
NS-G-3.3**

## DESIGN

new installations



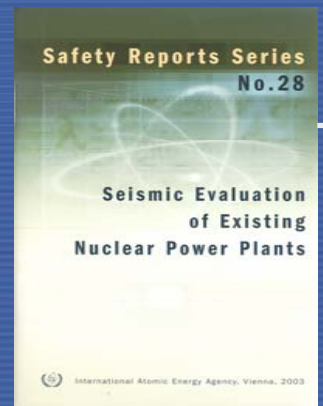
**Seismic Design and Qualification  
NS-G-1.6**

## OPERATION

operating/existing installations



**Periodic Safety Review**



The complete lifetime of the installation ( $t$ )

# NS-G-1.6 Seismic Design and Qualification for NPPs

- General Safety Concepts
  - Design basis earthquake
  - Seismic categorisation for SSCs
  - Combination of earthquake loads
  - Seismic capacity
  - Beyond design earthquake
- Seismic design and Seismic Qualification

SG issued in 2003

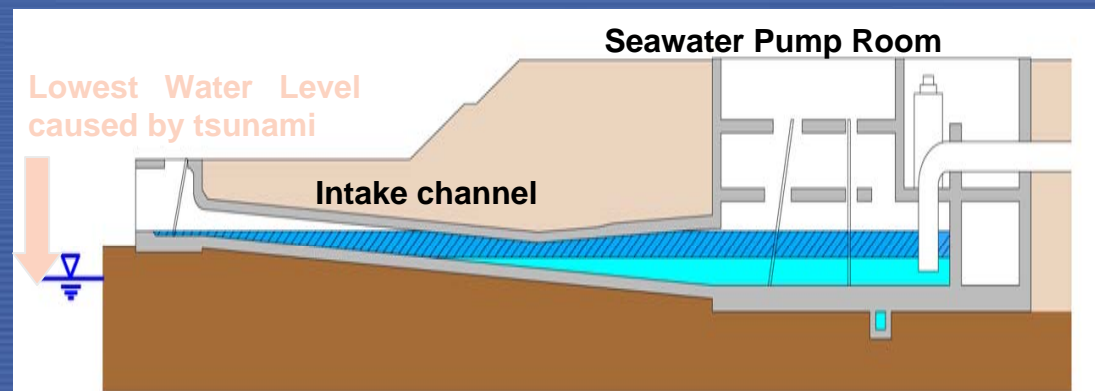
# DEVELOPMENT OF SAFETY STANDARDS

## SAFETY GUIDES - Activities during 2009:

1. **Seismic evaluation of Existing Nuclear Installations (NS-G-2.13)**, published.
2. **Seismic Hazard Assessment for Nuclear Installations (NS-G-3.3, DS422)**, approved for publication
3. **Volcanic Hazards Assessment for Nuclear Installations (DS405)**, to MSs for comments.
4. **Meteorological and Hydrological Hazards for Nuclear Installations (DS417)** to MSs for comments.
5. **Dispersion in Air and Water and Environmental Impact Assessment (DS427)**, draft in preparation.
6. **Site Survey and Site Selection (50-SG-S9)**, draft in preparation.

# DS417 – SCOPE

- For the site selection and site evaluation processes
- For *nuclear installations*
- For *new and existing installations*
- Hazards “*external to the installation*”



# SITE AND SEISMIC SAFETY REVIEW SERVICES

**Purpose:** To assist Member States, upon request, in the application of IAEA safety standards.

More than 240 site and seismic safety review missions were conducted since 1980, to ~50 MSs.

**Site Safety Review Missions in 2009 :**

- **To MSs embarking in NPP site selection:** Egypt, Jordan, Vietnam, Nigeria, Tunisia, Belarus, Turkey.
- **To others:** Iran, Armenia.



# Seismic Safety Review Missions: IAEA INVOLVEMENT in K-K NPP, Japan, 2007-2008

1. “*Seismic Safety Expert Mission - Preliminary Findings and Lessons Learned*”, August 2007.
2. “*1<sup>st</sup> Follow up Mission in relation to the Findings and Lessons Learned*”, January/February 2008.
3. “*Experts Meeting in relation to the Geological and Geophysical investigations*”, May 2008.
4. “*Experts Meeting in relation to the New Revised Seismic Hazard Assessment for the K-K NPP site*”, June 2008.
5. “*IAEA International Workshop on Lessons Learned from Recent Strong Earthquakes*”, Kashiwazaki, Japan, June 2008.
6. “*Experts Meeting in relation to the Geological and Geophysical investigations*”, September 2008.
7. Presentations in international meetings and tasks related to ongoing EBP projects.
8. “*2<sup>nd</sup> Follow up Mission in relation to the Findings and Lessons Learned*”, 1-5 December 2008.

# ACTIVITIES WITH EXTRABUDGETARY CONTRIBUTIONS

**EBPs: they have grown substantially during  
last 3 years**

# CURRENT EBPs

## 1. Tsunami EBP - TIPEEZ:

- Started in 2007. Finalize in March 2010.
- The concept of integration into other ISSC extrabudgetary activities, after March 2010, was agreed at March 2009 StC.

## 2. Seismic EBP:

- Started in 2007. Finalize in September 2010
- At September 2009 StC Meeting, it was agreed that Seismic EBP is a part of ISSC and the participating organisations are considered as ISSC participants.

## 3. ISSC EBP:

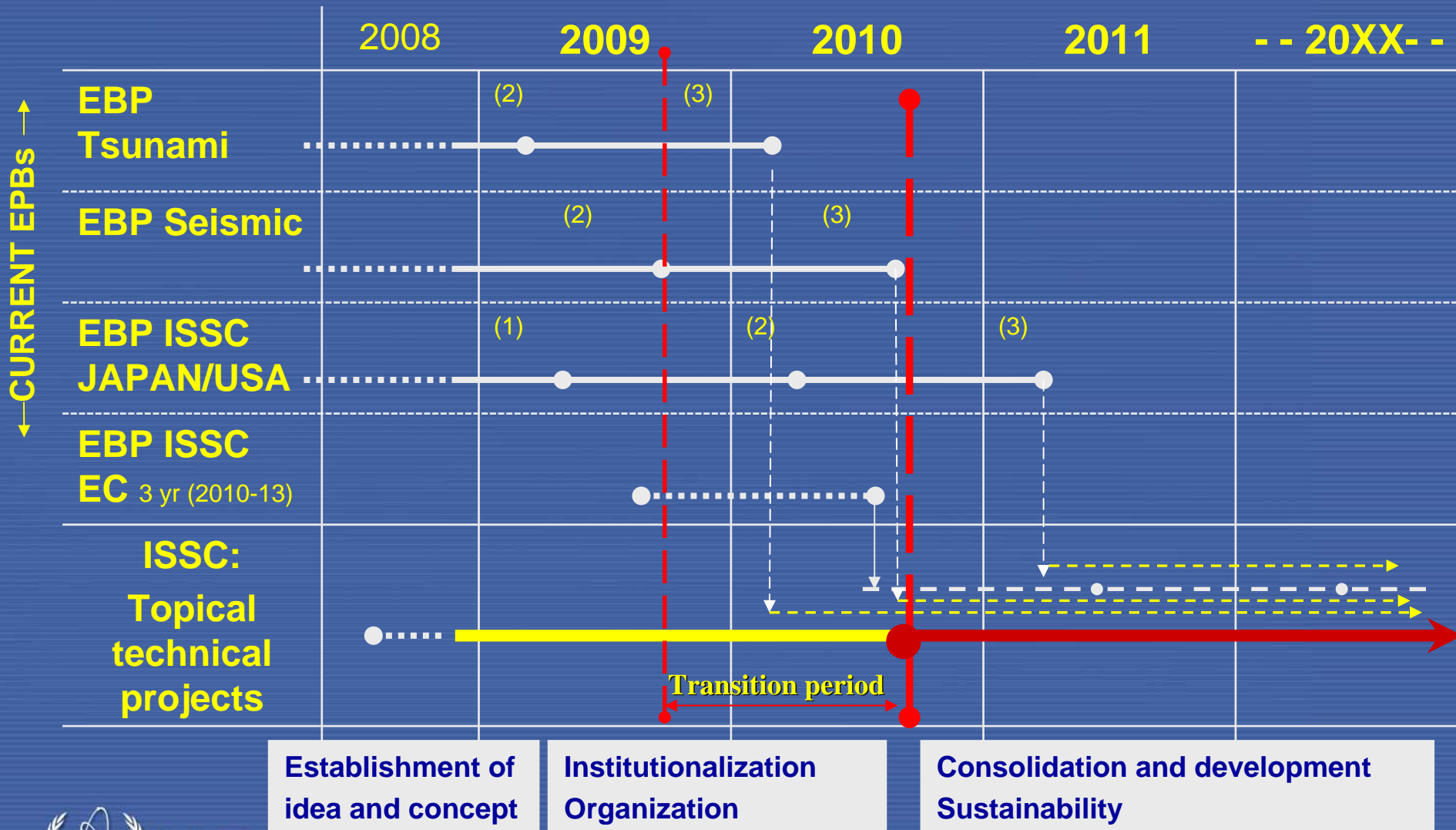
- Started in 2008, supported by NISA/JAPAN, US/NRC and Argentina.

## 4. ISSC EC:

- In final stage of contract negotiation with EC-3 years-2 MEuros.



# ISSC DEVELOPMENT – A LONG TERM VISION



# TOPICAL PROJECTS AND R&D

- **Topical researches and studies to be conducted within scope of the “EBP Seismic” project in relation to the earthquake and its effect on NPPs**
  - Seismic Hazard Evaluation, CAV/JMA Research/GM Simulat,
  - **KARISMA (International analyses benchmark Unit 7 of KK NPP)**
  - Post earthquake plant response actions
  - Seismic Instrumentation and Exceedance Criteria
  - Detailed guidelines for Seismic safety Re-evaluation of Existing Installations
  - **DATABASE: Seismic and Tsunami**
    - OECD/NEA-IAEA Survey on NPPs that have experienced earthquakes
    - On line monitoring system
  - Probabilistic fault displacement assessment and other NISA/TEPCO activities
  - PSHA project by NISA, Japan.
- **Tsunamis and Volcanic Hazards Assessment projects**

# Benchmark name

KARISMA

KAshiwazaki-Kariwa Research Initiative for  
Seismic Margin Assessment

# Main objectives of the Benchmark

- Understanding what happened to the soil and structures during the July 2007 earthquake: are we able to capture the main characteristics of the response?
- Understanding of margins: quantifying what will happen both in soil and in structure, when the input is increased.
- Calibration of different simulation methodologies
- Identification of main parameters influencing the response, by collecting and analysing the results from different teams.
- Understanding of equipment behaviour for some selected equipment. Approaches to margins evaluation

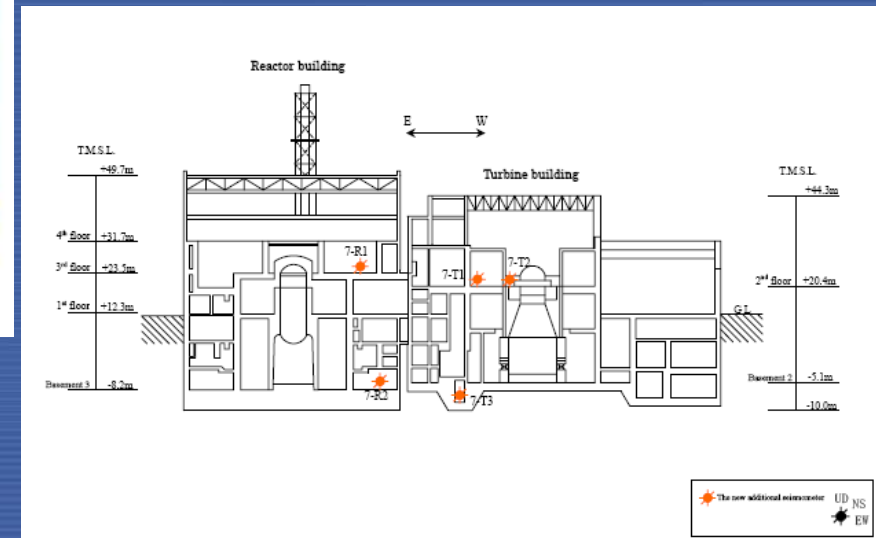
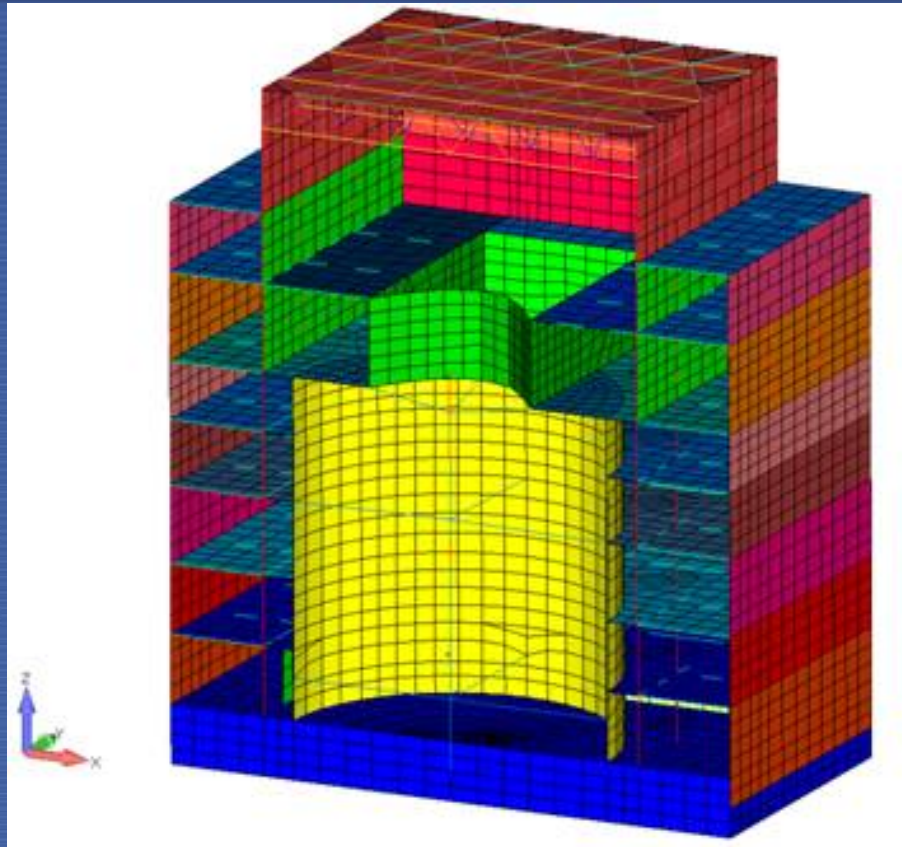
# KARISMA Benchmark

- 25 participating institutions
- 15 countries
- 3 tasks
  - Construction of models
  - Analysis of NCO earthquake
  - Evaluation of margins
- Schedule: Task 1 will be reviewed in May.

# *Non linear structures behaviour during the main shock?*

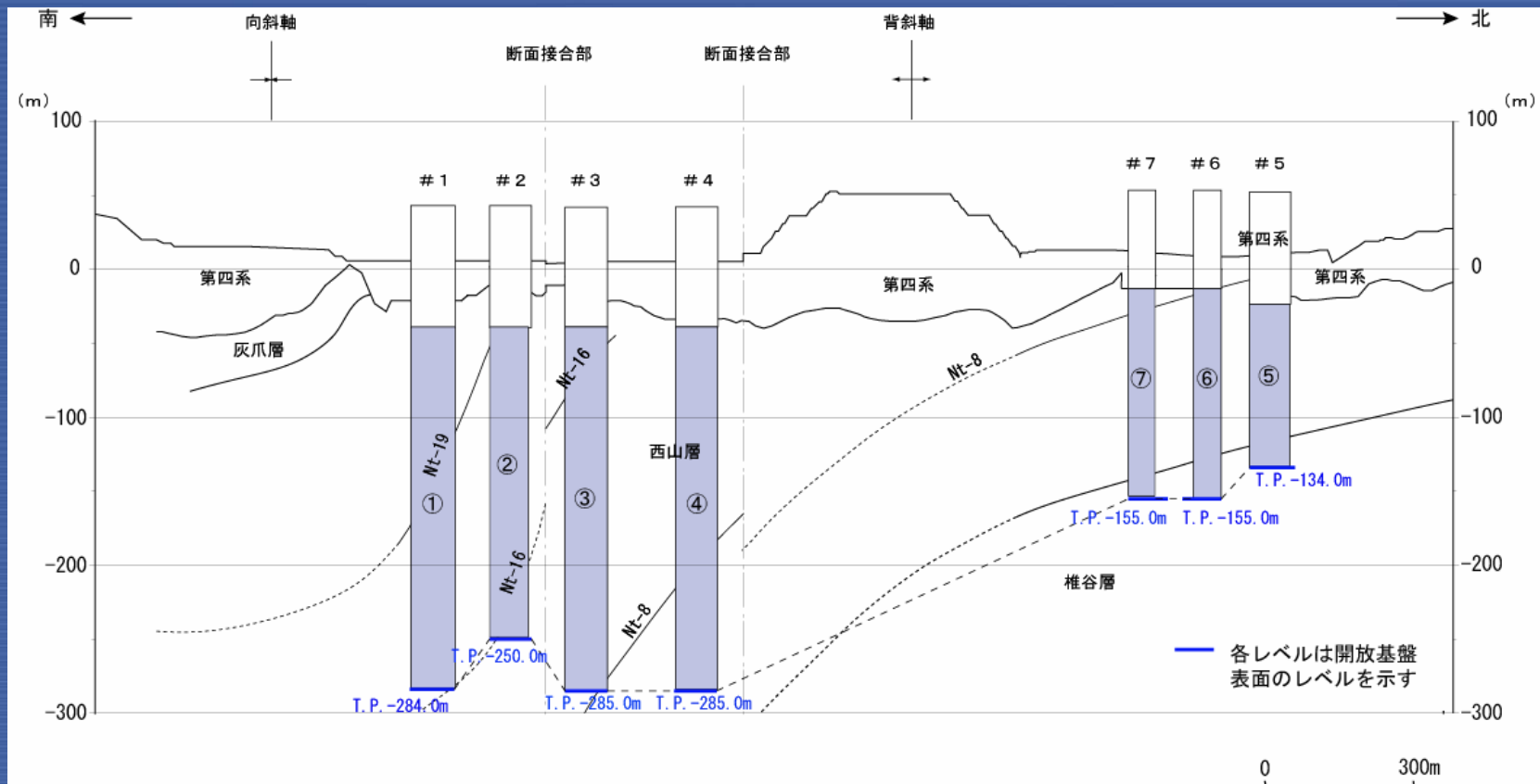


# Layout of main buildings and seismometer positions



## Unit 7

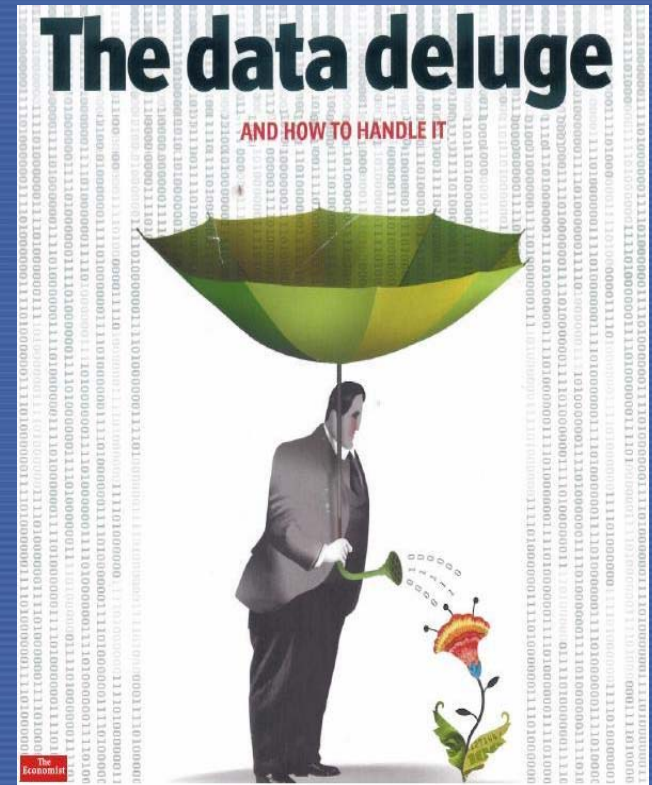
# Depth of the base stratum for each unit





# IAEA - ISSC

## INFORMATION SYSTEM (Database) - EXTERNAL EVENTS NOTIFICATION SYSTEM (EENS)



# IAEA/ISSC EXTERNAL EVENTS NOTIFICATION SYSTEM

The main objective of the “*External Event Notification System*” is to receive at real time at the IAEA-ISSC, information on the occurrence of external events at the world which could affect operating nuclear installation sites, through a web based online monitoring system.

This information may be used as appropriate for communicating with the IAEA staff, the Member States, the public and the media through an adequate product such as an “*External Events Notification Report*”.

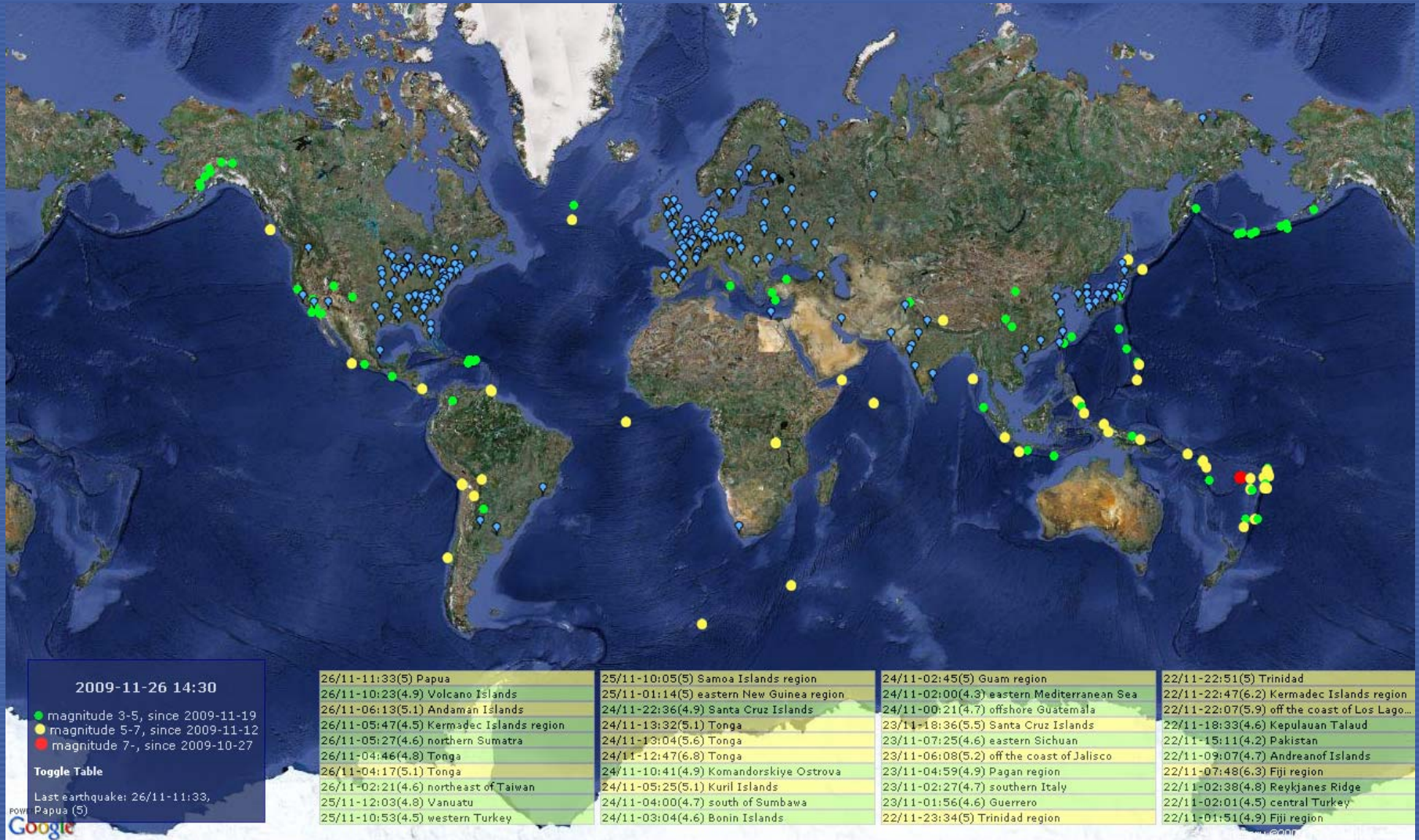
# IAEA/ISSC EXTERNAL EVENTS NOTIFICATION SYSTEM

**A very well known and recognized worldwide network is the one being operated by the United States Geological Survey (USGS), which is the one currently being used.**

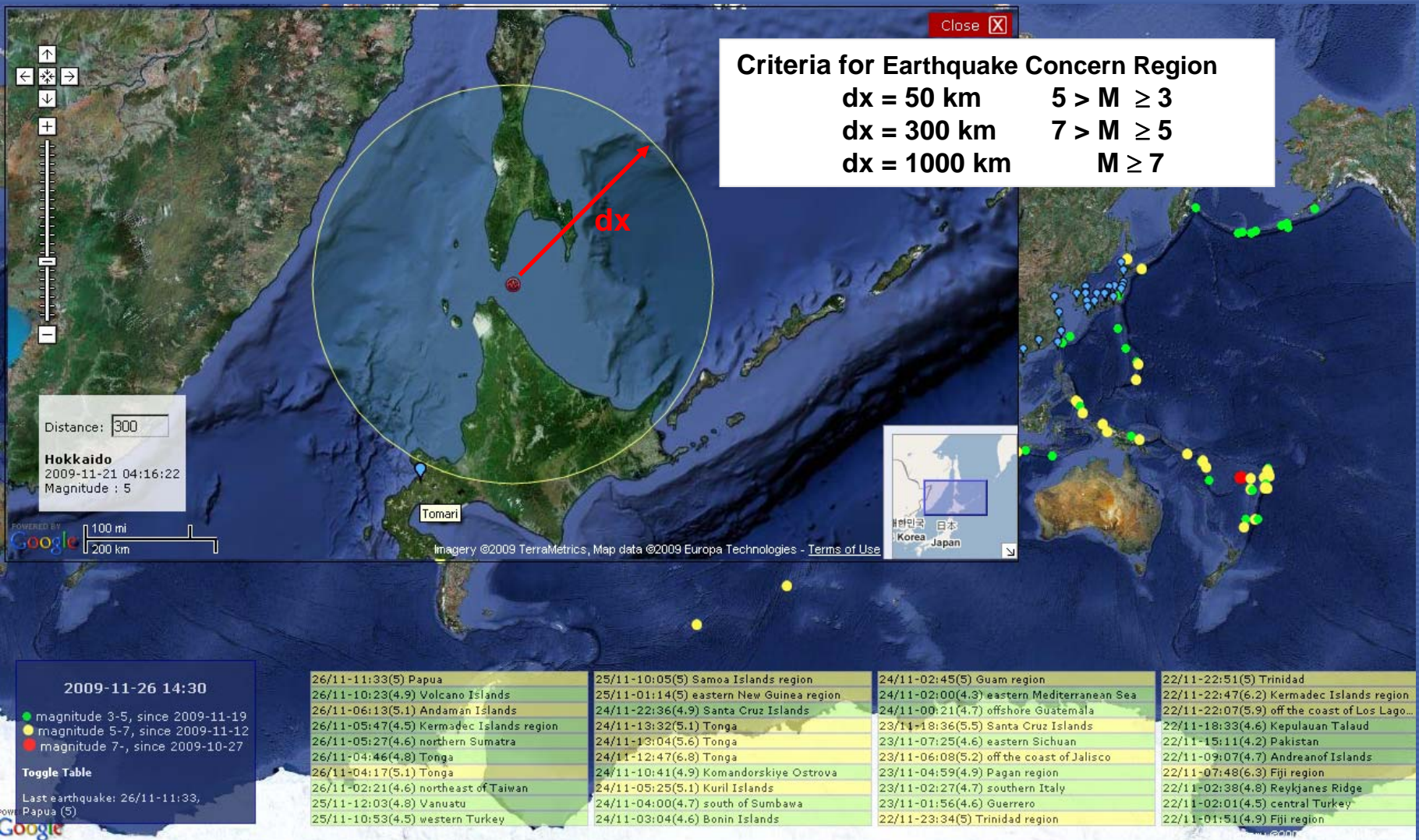
**A common programme with US NRC was initially developed based on collaboration agreements with the USGS and the US National Oceanographic and Atmospheric Administration (NOAA).**

**Other networks are currently being contacted to participate in the system: JNES (JMA, NIED, AIST).**

# IAEA/ISSC EXTERNAL EVENTS NOTIFICATION SYSTEM – current status



# Hokkaido earthquake (M=5.0) in Japan in 21.11.2009 and NPP sites



# IAEA/ISSC EXTERNAL EVENTS NOTIFICATION SYSTEM – current status



- Full synergy between participating Institutions: ISSC/US-NRC/USGS/USNOA
- Working at different 'layers': international, regional, national, local (NPPsite)
- A part of our Incident Emergency Centre
- A notification formal tool
- Criteria defined for installation fragility



**IAEA ShakeCast 2**

Home Earthquakes Search FAQ Profile Administration Panel Log out [ scadmin ]

Jump to: Select an earthquake from the last 7 days [Go]

Map Satellite Hybrid

Port-au-Prince

**ShakeCast Summary**

Number of facilities evaluated: 0

Peak Ground Acceleration (%g): 1.4034 - 48.6911

Peak Ground Velocity (cm/sec): 0.1604 - 204.7904

Instrumental Intensity: III - X

Peak Spectral Acc. at 0.3 sec (%g): 3.2794 - 105.3239

Peak Spectral Acc. at 1.0 sec (%g): 1.9141 - 80.1307

Peak Spectral Acc. at 3.0 sec (%g): 1.137 - 32.7427

PGA Uncertainty in Std Deviation: 0.4512 - 1

Estimated Vs30 in m/s: 210 - 740

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**M 7 - HAITI REGION**

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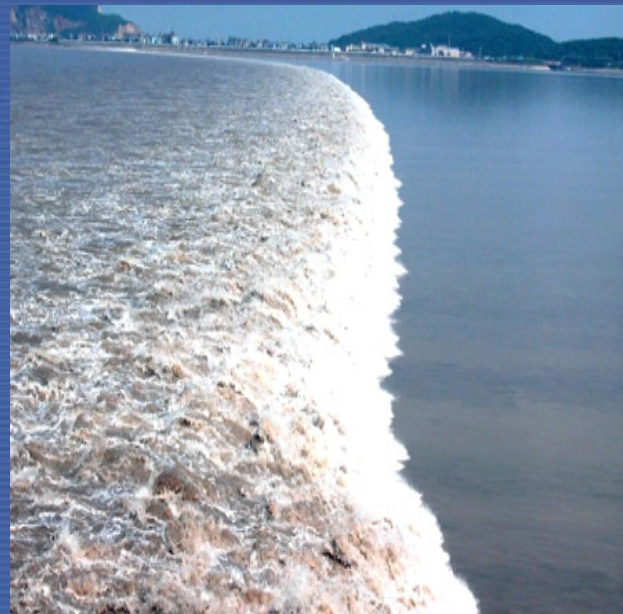
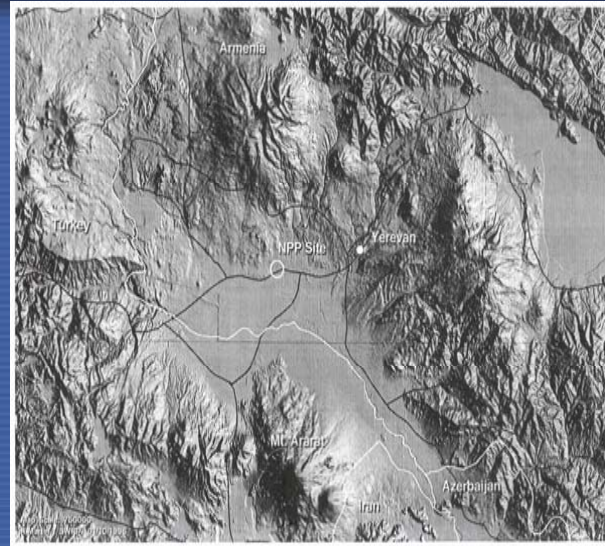
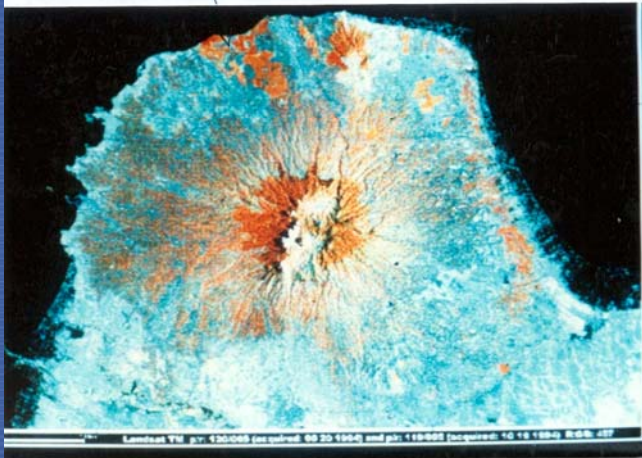
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Go to Administration Panel

# 7 - SUMMARY

An aerial view of Muria Peninsula at Central Java, Indonesia, with the Muria volcano at the centre of the picture, the Genuk volcano directly straight to the north, and showing the location of Ujung Lemahabang site.

*Ujung Lemahabang site*



# CONCLUDING REMARKS

- **Nuclear installations –complex systems- should be sited, designed, constructed and operated taken into account the potential occurrence of extreme rare events and its impact on the public and environment.**
- **Earthquake has significant impact on plant design: general layout, common cause effects...**
- **Nuclear renaissance is an opportunity and a challenge to avoid cases where sites were selected with no explicit safety considerations.**
- **No complacency, continuous improvement process.**



# CONCLUDING REMARKS

- **The sharing of “Lessons learned” from the occurrence of strong natural events (tsunamis, earthquakes, hurricanes, etc.) showed that unresolved issues still exist: margins, hazard assessment, beyond design basis...**
- **Public acceptance and communication**
- **A need for international cooperation, openness and transparency – Sharing of experience.**
- **The INTERNATIONAL SEISMIC SAFETY CENTRE is now a global focal point for the nuclear engineering community in those fields and the extrabudgetary contributions from Member States institutions have proved to be a proper, efficient and effective tool for its development.**

# International Atomic Energy Agency



*Thank you for your attention*