

# **Second Workshop on Best Practices in Physics-based Fault Rupture Models for Seismic Hazard Assessment of Nuclear Installations: issues and challenges towards full Seismic Risk Analysis**



**Cadarache-Château  
France**

**14–16 May 2018  
with optional field & nuclear facilities visits - 17<sup>th</sup> May 2018**

## **Information Sheet**

### **A. Background**

Conducting adequate assessment of seismic hazard is one of the essential issues in the external event safety for site evaluation of nuclear installations. Vibratory ground motion and surface fault displacement are the main hazards of seismic activities, and they need to be assessed in the processes of site evaluation and periodical safety reviews. However, progress of the science and technology of this subject is quite fast and the state-of-the-art practices have to be taken into account in the hazard assessment.

There is an increasing awareness that physics-based models, previously verified with observed records, provide meaningful approach to evaluate predictions on areas that go beyond the range of recorded data, specially near the source, where observed data are sparse and ground motion is dominated by the source. In particular, physics-based fault rupture modelling was highlighted and international efforts in the industry, regulatory bodies and relevant institutions from the nuclear community have been bestowed on the modelling method after the accident in Fukushima Daiichi nuclear power plant in 2011. The reason for this is because the length and width of fault rupture of “the 2011 off the Pacific Coast of Tohoku Earthquake” reached several hundred kilometres and it turned out to be necessary to consider rupture modelling of inhomogeneous crust.

The relevant IAEA Specific Safety Guide SSG-9 on “Seismic Hazards in Site Evaluation for Nuclear Installations” (2010, IAEA) has certain recommendations for physics-based fault rupture modelling. However, the descriptions about such modelling are at the high level of general recommendations, thus the Member States, who want to apply the modelling, need more detailed guideline. Therefore, with the supports and contributions of Member States, the External Events Safety Section of the IAEA has been conducting Extra-budgetary Project (EBP), one of the results of which is the publication of a Safety Report Series No. 85 “Ground Motion Simulation Based on Fault Rupture Modelling for Seismic Hazard Assessment in Site Evaluation for Nuclear Installations” (2015, IAEA).

To disseminate these practices for the seismic hazard assessment in site evaluation of nuclear installations, the IAEA held the first workshop of BestPSHANI in November 2015. About 100 participants from 30 member states participated in the workshop that included several invited keynote lectures that inspired valuable and fruitful discussions among all the participants. In this workshop, several key issues were identified and the participants concluded to encourage the international nuclear safety community to catch up the state-of-the-art practices, to assess procedures for verification and validation of numerical models, to discuss crosscutting issues with empirical schemes such as Ground Motion Prediction Equations, to assess the implications (from nuclear safety point of view) on the use of synthetic ground motion on engineering structures and to challenge the use of these models toward seismic risk analyses of nuclear installations.

The second BestPSHANI workshop is planned being fully in line with these above-mentioned developments, discussions and challenges in order to provide suggestions to the identified issues in the first workshop. The Commissariat à l'énergie atomique et aux énergies alternatives (CEA), France, donor institution of the EBP kindly will host the workshop in Cadarache, southern France. CEA has been coordinating a national project “SINAPS@” to explore seismic hazard assessment issues, as well as to challenge interface topics (e.g. non-linear soil and structure interactions, structural and components seismic vulnerability) towards full seismic risk analysis. The SINAPS@ project also addresses the uncertainties treatment and propagation in the risk approach especially through probabilistic tools enabling to better characterize the reliability of results. CEA also wishes to contribute to the EESS-EBP. Inspired resolutions in the second workshop will be a great contribution to update the Safety Guide SSG-9 to reflect the state-of-the-art practices.

## B. Objectives, Topics and Format of the Workshop

The goal of this second BestPSHANI workshop is to investigate the uses of ground motions calculated using either empirical or physics-based models in seismic hazard assessments. This workshop will also focus on the assessments of engineering issues that rely on ground motion estimates, such as soil structure interaction, structural response and fragility curve analysis for quantification of seismic vulnerability of structures and their seismic performance. Hence, this second workshop aims to broaden the discussion by incorporating some additional key technical issues that reside at the intersection of physical-empirical models and the corresponding engineering applications. The workshop will gather scientist, engineers, and practitioners with the final goal of providing practical guidance for seismic hazard analyses and engineering applications.

### Topics

The workshop aims to discuss the state of the art of ground motion prediction models for seismic hazard assessment and the engineering applications to evaluate the seismic safety of NIs, covering three main topics:

- Current practice on the use of empirical ground motion prediction models for seismic hazard assessment in nuclear installations: Ground Motion Prediction Equations (GMPEs), uncertainties evaluations, “Host to Target” methodologies for exporting GMPEs, future perspectives on GMPEs and limitations.
- Physics-based rupture models for ground motion prediction: the role of stochastic, kinematic and dynamic rupture modes; verifications and validations procedures; limitations; when, how and why to use them; data collection for source, path and site characterization to constraint models; new generation of hybrid models: empirical and physics-based ground motion prediction equations.
- Engineering interface: on the reliability of ground motion evaluation for engineering applications; procedures for ground motion selection and generation for soil structure interaction, structural response and fragility curve developments; numerical and experimental tests of structural response to validate ground motion models and evaluate structural properties through specific proxies(damping, natural frequency, etc); Guidelines for design and assessments of safety of existing NIs, with potential specificities.

This workshop will be supported by invited presentations specially dedicated to the topics mentioned above. Key speakers are

#### **Current practice on the use of ground motion prediction models**

- Norman Abrahamson (PG&E, USA)
- Gail Atkinson (UWO, Canada)
- Fabrice Cotton (GFZ, Germany)
- John Douglas (University of Strathclyde, UK)
- Hiroyuki Fujiwara (NIED, Japan)

#### **Physics-based rupture models for ground motion and fault displacement prediction**

- Hideo Aochi (BRGM, France)
- Ralph Archuleta (UCSB, USA)
- Kazuo Dan (ORI, Japan)
- Martin Mai (Thuwal, Kingdom of Saudi Arabia)
- Roberto Paolucci (Politecnico di Milano, Italy)
- Makoto Takao (Tokyo Electric Power Company, Japan)

#### **Engineering interface:**

- Muneo Hori (ERI, Tokyo, Japan)
- Boris Jeremic (ESSI software, USA)
- Pierre Labbe (EDF, France)
- Philippe Renault (swissnuclear, Switzerland)
- Pierre Sollogoub (Consultant)

In addition to the invited speakers, other contributions on the topics mentioned above are welcomed. Therefore, any participant willing to present his/her work orally or in the form of a poster should submit an abstract (max 300 words). After acceptance of the abstract and the type of presentation (oral or poster), participants are encouraged to submit a full paper with the Form for Submission of a Paper (Form B).

For interested participants, in order to enhance the importance of the discussions during the workshop, a field trip to the Cadarache facilities will be organized the day after the workshop: details on this field trip will be updated soon.

## C. Participation and Registration

The workshop is targeted at experts from regulatory bodies, utilities, technical support organizations, vendors and research and development organizations, who are working in the areas covered by the workshop. For registration please fill in the attached Participation Form (Form A).

Participants should complete the Participation Form as soon as possible and send it to the competent official authority (e.g. Ministry of Foreign Affairs or National Atomic Energy Authority of the individual Member States, where your institution is located.) for transmission to the IAEA Secretariat (see Section D), to arrive no later than **30 December 2017**. The nomination of a participant will be accepted only if forwarded by the Government of an IAEA Member State through the corresponding permanent mission for IAEA.

### **Abstract and paper submission:**

Participants willing to present their work orally or in the form of a poster must submit an abstract (max. 300 words). After acceptance of the abstract and the type of presentation (oral or poster), participants are encouraged to submit a full paper. The minimum length of the paper is 6 pages, and it is recommended to be no longer than 15 pages. This is a guideline and not an absolute limit. Please include this information when filling in Form A.

### **Important dates:**

- Abstract submission deadline: **30 December 2017**
- Full paper submission deadline: **28 February 2018**
- IAEA registration deadline: **MANDATORY - Announced soon**
- Registration deadline for the field trips: **30 April 2018**
- Workshop: **14–16 May 2018**
- Field trip (optional): **17 May 2018**

## D. Organization

### IAEA Scientific Secretary:

#### **Mr Yoshimitsu Fukushima**

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## **E. Visas**

Participants who require a visa to enter France should submit the necessary application to the nearest diplomatic or consular representative of France at least four weeks before they travel to France. Since France is a Schengen State, persons requiring a visa will have to apply for a Schengen visa. In States where France has no diplomatic mission, visas can be obtained from the consular authority of a Schengen Partner State representing France in the country in question.

## **F. Expenditure**

No registration fee is charged to participants.

## **G. Working Language**

The working language of the workshop will be English.

## **H. Workshop Web Page**

Participants will also find information on services at the CEA Cadarache Centre and general information at: <http://www.cea.fr/Pages/le-cea/les-centres-cea/cadarache.aspx>