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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

Hosted by the Government of
France

through the
French Alternative Energies and Atomic Energy Commission (CEA)

within the framework of the project
'Earthquakes and Nuclear Facilities: Ensuring and Sustaining Safety'
('Séisme et Installations Nucléaires – Améliorer et Pérenniser la Sûreté')
(SINAPS@)

Cadarache Château (Castle), France

14–16 May 2018

Ref. No.: J20-TM-54780; EVT1700587

Information Sheet

A. Background

Conducting adequate assessment of seismic hazards is one of the essential issues in the external hazard aspect of site evaluation of nuclear installations. Vibratory ground motion and surface fault displacement are the key issues associated with seismic activities, and they need to be assessed during the siting and site evaluation processes. However, scientific and technological knowledge in this area is advancing quite rapidly, 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 a meaningful approach to evaluate predictions on areas that go beyond the range of recorded data, especially near the source, where observed data are sparse and ground motion is dominated by the source. In particular, the value of physics-based fault rupture modelling has been recognized, and international efforts by the industry, regulatory bodies and relevant institutions from the nuclear community have focused on modelling methods after the accident at the Fukushima Daiichi nuclear power plant caused by the Great East Japan Earthquake in March 2011. This is because the length and width of the fault rupture that dislocated off the Pacific Coast of the Tōhoku region (north-east Japan) reached several hundred kilometres, and it proved necessary to consider rupture modelling of inhomogeneous crust.

The relevant International Atomic Energy Agency (IAEA) Specific Safety Guide entitled *Seismic Hazards in Site Evaluation for Nuclear Installations* (IAEA Safety Standards Series No. SSG-9, Vienna, 2010) gives certain recommendations for physics-based fault rupture modelling. The descriptions given there for such modelling are, however, at the high level of general recommendations. For the Member States that would like to apply such modelling more detailed guidance is necessary. The IAEA, with the support and contributions provided by various Member States, has been conducting an extrabudgetary project on this subject, one of the results of which is the publication of the Safety Report entitled *Ground Motion Simulation Based on Fault Rupture Modelling for Seismic Hazard Assessment in Site Evaluation for Nuclear Installations* (IAEA Safety Reports Series No. 85, Vienna, 2015).

In order to encourage the use of such modelling for seismic hazard assessment in the sitting and site evaluation of nuclear installations, the IAEA held the first Workshop on Best Practices in Physics-Based Fault Rupture Models for Seismic Hazard Assessment of Nuclear Installations (BestPSHANI) in November 2015. About 100 participants from 30 Member States participated in the workshop, which 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 by encouraging the international nuclear safety community to catch up on the state-of-the-art practices in this area, 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 the nuclear safety point of view) for the use of synthetic ground motion on engineering structures, and to consider the use of these models for seismic risk analyses of nuclear installations.

The second BestPSHANI workshop will take into account the above-mentioned developments, discussions and challenges, and it is expected that it will result in suggestions to resolve the issues identified at the first workshop. The French Alternative Energies and Atomic Energy Commission (CEA), which is one of the donor institutions for the IAEA extrabudgetary project, will kindly host the workshop in Cadarache, southern France. The CEA has itself been coordinating a national project entitled ‘Earthquake and Nuclear Facilities: Ensuring and Sustaining Safety’, Séisme et Installations

Nucléaires – Améliorer et Pérenniser la Sûreté (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 treatment and propagation of uncertainties in the risk approach, especially through probabilistic scheme which may enhance the reliability of results. The discussions at this workshop are expected to contribute significantly to the IAEA's work on updating the Safety Guide SSG-9 in order 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 use of ground motions calculated using either empirical or physics-based models in seismic hazard assessments. This workshop will also focus on the assessment 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. The 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. It will bring together scientists, engineers and practitioners with the ultimate goal of providing practical guidance on seismic hazard analyses and to discuss the efforts that are necessary to support the hazard assessment up to the full seismic risk assessment of nuclear installations.

Topics

The workshop aims to discuss the state-of-the-art practice of ground motion prediction models for seismic hazard assessment and the engineering applications of such models, as well as the efforts that are necessary to support the hazard assessment up to the full seismic risk assessment of nuclear installations. It will cover three main topics:

- Current practices in the use of empirical ground motion prediction models for seismic hazard assessment in nuclear installations: ground motion prediction equations (GMPEs), evaluation of uncertainties, 'host to target' methodologies for exporting GMPEs, future perspectives of GMPEs and limitations.
- Physics-based rupture models for ground motion and fault displacement prediction: the role of stochastic, kinematic and dynamic rupture modes; procedures for verifications and validations; limitations of the models; 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 selection and generation of ground motion 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.); as well as seismic risk analyses. Guidelines for seismic design and safety assessments of existing nuclear installations, with potential specificities.

This workshop will be supported by invited presentations especially dedicated to the topics mentioned above. Expected keynote speakers are:

Current practices in the use of ground motion prediction models

1) Mr Norman Abrahamson (Pacific Gas and Electric Company, USA)
2) Ms Gail Atkinson (Western University (UWO), Canada)
3) Mr Fabrice Cotton (Helmholtz Centre Potsdam for Geosciences, Germany)
4) Mr John Douglas (University of Strathclyde, UK)
5) Mr Hiroyuki Fujiwara (National Research Institute for Earth Science and Disaster Prevention, Japan)

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

1) Mr Hideo Aochi (Office of Geological and Mining Research, France)
2) Mr Ralph Archuleta (University of California, Santa Barbara, USA)
3) Mr Kazuo Dan (Ohsaki Research Institute, Japan)
4) Mr Roberto Paolucci (Polytechnic University of Milan, Italy)
5) Mr Makoto Takao (Tokyo Electric Power Company, Japan)
6) Mr Luis A. Dalguer (swissnuclear, Switzerland)

Engineering interface:

1) Mr Muneo Hori (Earthquake Research Institute, University of Tokyo, Japan)
2) Mr Boris Jeremic (Real ESSI ('Realistic Earthquake–Soil–Structure Interaction') software, USA)
3) Mr Pierre Labbe (Special School for Public Works, Building and Industry (ESTP), France)
4) Mr Pierre Sollogoub (Consultant)
5) Mr Philippe Renault (swissnuclear, Switzerland)

In addition to the invited speakers, other contributions on the topics mentioned above are welcome. 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 together with the attached Form for Submission of a Paper (Form B), in which the author(s) will need to agree with one of assignments of the rights.

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.

Participants should complete the attached Participation Form (Form A) and send it to the competent official authority (e.g. Ministry of Foreign Affairs or National Atomic Energy Authority) for transmission to the IAEA Secretariat (see Section D), to arrive no later than **28 February 2018**. The designation of a participant will be accepted only if forwarded by the Government of an IAEA Member State through the corresponding Permanent Mission to the IAEA.

Submission of abstracts and papers:

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 proposed 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. The paper should be prepared in IAEA format and must be submitted together with Form B following instructions to be sent by the IAEA after notification of the acceptance of the abstract.

Important dates:

- Abstract submission deadline: **30 December 2017**
- Registration and full paper submission deadline: **28 February 2018**
- Workshop: **14–16 May 2018**

D. Organization

Scientific Secretary:

Mr Yoshimitsu Fukushima

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Subsequent correspondence on scientific matters should be sent to the Scientific Secretary and correspondence on other matters related to the workshop to the Administrative Secretaries.

Scientific Organizing Committee:

Mr Luis A. Dalguer (Chair)
swissnuclear, Switzerland

Ms Catherine Berge-Thierry (Co-chair)
CEA/SINAPS@ project, France

Mr Philippe Renault
swissnuclear, Switzerland

Mr Fabrice Hollender
CEA, Cadarache, France

Mr Kojiro Irikura
Aichi Institute of Technology, Japan

Mr Dogan Seber
Nuclear Regulatory Commission, USA

Mr Changjiang Wu
Nuclear Regulation Authority, Japan

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. The IAEA is generally not in a position to bear the travel and other costs of participants in the workshop.

G. Working Language

The working language of the workshop will be English.

H. Workshop Web Page

Participants will find further information on the workshop at: https://www.institut-seism.fr/en/2nd-workshop-best-psha-ni-may-2018-cadarache-chateau-france/

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Form A
J20-TM-54780; EVT1700587

Participation Form

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Cadarache-Château, France

14–16 May 2018

To be completed by the participant and sent to the competent official authority (e.g. Ministry of Foreign Affairs, Permanent Mission to the IAEA, or National Atomic Energy Authority) of his/her country for subsequent transmission to the International Atomic Energy Agency (IAEA), Vienna International Centre, PO Box 100, 1400 Vienna, Austria, either electronically by email to: Official.Mail@iaea.org or by fax to: +43 1 26007 (no hard copies needed).

Participants who are members of an invited organization can submit this form to their organization for subsequent transmission to the IAEA.

Deadline for receipt by IAEA through official channels: 28 February 2018

<table>
<tr><td>Family name: (e.g. Smith)</td><td>First name(s): (e.g. John)</td><td>Mr/Ms</td></tr>
<tr><td colspan="3">Institution:</td></tr>
<tr><td colspan="3">Full address:</td></tr>
<tr><td>For urgent communications please indicate:</td><td colspan="2">Tel.:
Fax:
Email:</td></tr>
<tr><td>Nationality:</td><td colspan="2">Designating Government or organization:</td></tr>
<tr><td colspan="3">Mailing address (if different from address indicated above):</td></tr>
<tr><td colspan="3">Do you intend to submit a paper? Yes ☐ No ☐
Would you prefer to present your paper as a poster? Yes ☐ No ☐
Title:</td></tr>
</table>

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Form for Submission of a Paper

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<table>
<tr><td colspan="3">Title of the paper:</td></tr>
<tr><td colspan="3">Abstract id (INDICO):</td></tr>
<tr><td>Family name(s) and first name(s) of all author(s):
e.g. Smith, John</td><td>Scientific establishment(s) in which the work has been carried out</td><td>City/Country</td></tr>
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<tr><td colspan="2">Family name and first name(s) of author presenting the paper: e.g. Smith, John</td><td rowspan="3">Mailing address:</td></tr>
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Date: **Signature of main author:**