# Feedback from IAEA Activities on Safety Reassessments of Research Reactors following the Fukushima-Daiichi NPP Accident

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# Introduction

- The experience available from the Fukushima accident is crucial for defining and implementing measures to prevent the occurrence of accidents involving a large release of radioactive material at nuclear installations, including at a research reactor.

- Involved areas include: Regulatory effectiveness, safety requirements of the design, site specific hazard assessment, total loss of electrical power supply, hydrogen control, loss of ultimate heat sink, accident management, safety of spent fuel, emergency preparedness and communication of information, and safety culture.

- Most of these topics are relevant for research reactors, when subjected to extreme external events.

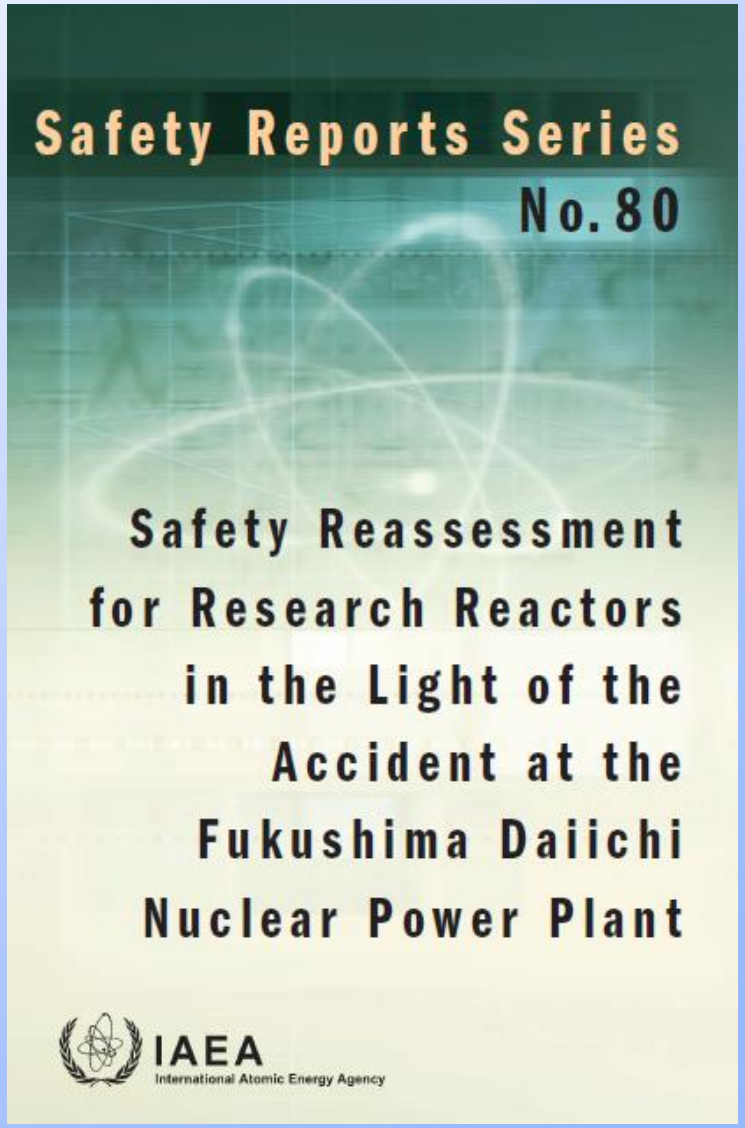
# Introduction

- Safety reassessment (stress-test) is needed in light of the feedback from the accident taking into account that:
  - *The majority of research reactors were constructed decades ago (ageing) and not fully in conformance with the up-to-date safety standards;*
  - *Most of research reactors are located near populated areas, and for some of these the leak-tightness of their confinements are inadequate;*
  - *In many cases, the reactor site and the site vicinity characteristics have changed since the construction of the facility and these changes have not been considered;*

*The elements mentioned above are not reflected in the safety analysis of many of the existing research reactor facilities.*

# Recent IAEA activities on the implications of Fukushima on research reactor safety - Publications

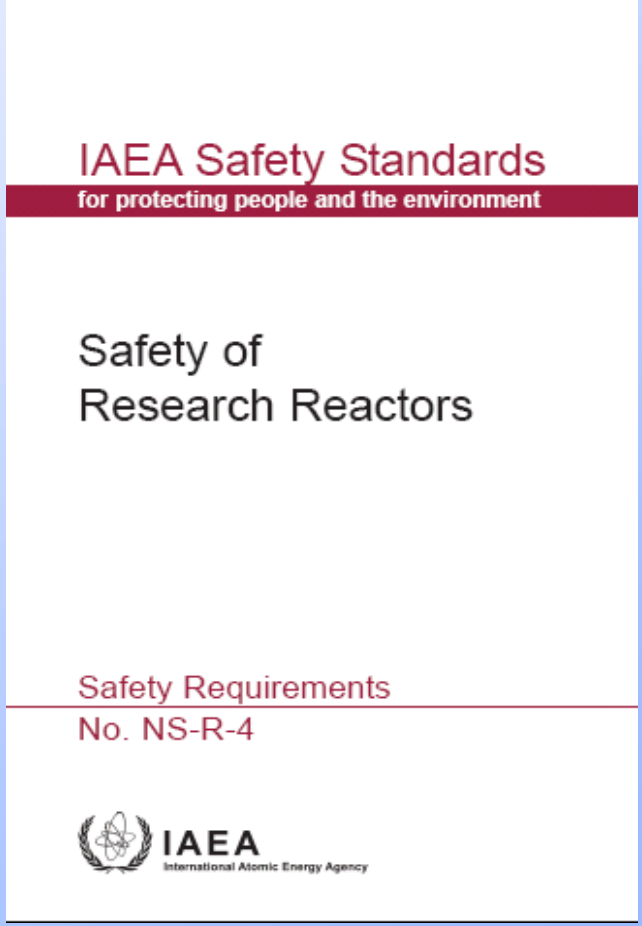
- Publication of Safety Report Series No 80. The document:
  - *Provides a set of suggestions and methods for performing safety reassessments of research reactors (ensuring harmonization of methods and approaches);*
  - *Provides information on the use of the IAEA relevant safety standards in performing this reassessment;*
  - *Does not replace or supersede any of the existing IAEA safety standards.*



# Recent IAEA activities on the implications of Fukushima on research reactor safety - Publications

- The IAEA Safety Requirements document (NS-R-4) is under revision to incorporate the relevant feedback from the Fukushima-Daiichi accident.

- Development of the first draft was finalized and the document is currently under review by the IAEA Member States.



# Recent IAEA activities on the implications of Fukushima on research reactor safety – Technical Meetings and Workshops

- Questionnaires were distributed at the International Conference on Research Reactors, Morocco, November 2011 (dedicated Session of the Conference on the implication of the accident on research reactors);
- Technical Meeting on Implications of the Fukushima Accident on the Safety of Research Reactors, 14-18 May 2012;
- Regional Workshop (Asia) on Review of Safety Documents, USA, (2012);
- Technical Meeting on Safety Reassessment of Research Reactors following the Fukushima Accident, Vienna (2013);
- Series of regional training workshops on Safety Reassessment following the Fukushima Accident, (2013);
- Workshop on Safety Analysis and Safety Documents for Research Reactors, Vienna (2014);

# Recent IAEA activities on the implications of Fukushima on research reactor safety – Technical Meetings and Workshops

- The implications of the accident on research reactor safety was one of the topics of the following IAEA activities:
  - *International Meetings on the Code of Conduct on the Safety of Research Reactors, (2011) and (2014);*
  - *Meeting of the Regional Advisory Safety Committee for Research Reactors in Europe (2012) and in Asia (2013);*
  - *Regional Meetings on the Code of Conduct in Africa (2012) and Europe (2012);*
  - *Workshop on Regulatory Supervision of Research Reactors, Vienna (2012);*

# Recent IAEA activities on the implications of Fukushima on research reactor safety – Technical Meetings and Workshops

- *TM on Considerations of Human Factors in Different Stages for Research Reactors, Vienna (2013).*
- *TM on the Incident Reporting System of Research Reactors (IRSRR), Vienna (2013).*
- *TM on Safety of Research Reactors under Project and Supply Agreements and review of the Safety Performance Indicators of the Facilities, Vienna (2013).*
- *Workshop on Integrated Management System for Research Reactors, Vienna (2013-2014);*
- *Workshop on Regulatory Inspection Programme for Research Reactors, Africa and ANNuR, Cairo (2014).*

# Recent IAEA activities on the implications of Fukushima on research reactor safety – Technical Meetings and Workshops

- These meetings and workshops discussed the safety reassessments (stress-tests) performed by the participating MSs, difficulties encountered, and the actions that need to be taken by MSs based on the results of the reassessments.

- Several workshops were dedicated to training on performing safety analysis and safety reassessment.

- More than 40 MSs participated in these activities (operators, regulators, and technical support organizations).

# Nature and background of the meeting

- The purpose was to discuss, exchange information and share knowledge on application of the lessons learned from the Fukushima-Daiichi accident to the safety of research reactors.
- In particular, the workshop discussed the safety reassessments that have been performed, the results of the reassessments, difficulties encountered and the actions that need to be taken by MSs based on the feedback from the accident and the results of their reassessments.
- 24 MSs participated in the workshop (safety analysts, operators, and regulators).

# Workshop on Safety Reassessment following the feedback from the Fukushima-Daiichi Accident

24-28 June 2013, Vienna

(Jointly implemented by NSNI and NEFW)

# Main conclusions and recommendations

- With respect to the regulatory aspects of safety reassessment, a few countries reported on substantial changes in the regulatory structure or regulations that have occurred since the Fukushima Daiichi accident:
  - *Japan reported on a reorganization of its regulatory structure that took effect recently;*
  - *Several other countries reported additional or revised regulations in response to the accident.*
  - *In a few cases, progress in achieving effective independence of the regulatory bodies was reported and in many cases regulations applicable to research reactors have been reviewed and strengthened, although most attention has been focused on NPPs.*

# Main conclusions and recommendations

- Most of the participants reported on their complementary safety assessment of research reactors and sites, which varied widely in scope and depth (many were based on SRS No. 80):
  - *In no case was the result such that an immediate shut-down of the research reactor for modification or decommissioning was necessary;*
  - *In some cases it was concluded that the reactors could sustain certain initiating events beyond the design basis without significant radiological release;*
  - *However, in many cases, the need for certain short-term and long-term modifications and upgrades were identified.*

# Main conclusions and recommendations

- Examples of the identified facility modifications and upgrades include:
  - *Upgrades to emergency electrical power supplies, through redundant connections to the off-site power grid, supplementary emergency power generators, provision for connection of auxiliary power supplies and/or improved back-up batteries;*
  - *Provisions for maintaining coolant inventory, including provision for connection of alternative sources such as fire hoses, and provisions for recycling water from sub-pile rooms to the reactor pool in the event of a LOCA;*
  - *Hardening of various structures, systems and components, especially those required to prevent core damage in an extreme event, against earthquake, flooding, tornado, etc., as appropriate for the location of the research reactor.*

# Main conclusions and recommendations

- Planning for emergency preparedness and response was addressed in most country presentations. Several examples of improvements were presented:
  - *Improved and/or additional emergency equipment;*
  - *Provisions for protection of that equipment from extreme events;*
  - *Provisions for connection of external power and water supplies;*
  - *Improved emergency procedures;*
  - *Operator training and exercises of the emergency response plans were presented.*
- The participants requested the IAEA to continue organization of meetings/workshop on the topic.

# ANSN REGIONAL WORKSHOP ON COMPLEMENTARY SAFETY REASSESSMENTS OF RESEARCH REACTORS FOLLOWING THE LESSONS LEARNED FROM THE FUKUSHIMA DAIICHI ACCIDENT

ANSN
Asian Nuclear Safety Network

**Argonne National Laboratory, 9-13 December 2013**

# Main conclusions and recommendations

- 18 Participants from 9 ANSN Member States attended the Workshop
- All of the member states represented had performed, or planned to perform, complementary safety assessment of their research reactors. The scope and methods varied widely (some considered nearly the entire range of extreme external events and others considered only a few; some used detailed computer models and analysis and others used a “walk-down” approach):

  – *Discussion indicated a need for clarification and assistance in identifying beyond design basis initiating events for consideration in safety reassessments of research reactors;*

  – *Lack of expertise and analytical tools, and lack of regulatory guidance identified by several MS as a difficulty – SRS 80 recommended;*

  – *In many cases the reassessments identified facility modifications, enhancements to emergency preparedness and response plans and revisions to regulatory requirements that could improve safety of RRs in case of extreme external events.*

# Regional Workshop on Safety Reassessments of Research Reactors in Light of the Feedback from the Fukushima Daiichi Accident

**16-20 March 2015, Rabat, Morocco**

# Main conclusions and recommendations

- 12 participants from 5 Member States in the Region attended the Workshop

- Most of the research reactor operating organizations represented have not completed the safety reassessments in light of the feedback from the Fukushima accident. Some have not yet initiated activities to undertake the assessment.

  – *Discussions indicated a need for clarification of the difference between a safety reassessment focussed on severe external events potentially leading to beyond design basis accidents and cliff-edge effects, versus the conduct of a regular periodic safety assessment;*

  – *There is a need for clarification and assistance in identifying beyond design basis initiating events for consideration in the safety reassessments;*

  – *Lack of regulatory guidance identified by several MS as a difficulty – SRS 80 recommended for a systematic and comprehensive approach;*

  – *MS encouraged to utilize regional networks, share analytical tools and experience and obtain peer reviews of their safety reassessments.*

# Consultancy Meeting on the Implications of the Fukushima Daiichi NPP Accident on Research Reactors

**27-30 April 2015, Tel Aviv, Israel**

The purpose was to:

- discuss, exchange information and share knowledge and lessons learned on the actions that have been taken (or planned) by Member States related to safety reassessments of research reactors in light of the feedback from the Fukushima-Daiichi accident;
- Obtain feedback on the application of the IAEA Safety Report Series No. 80 (SRS-80) at their facilities and to advise the IAEA and MS on future actions to be considered.

# Main conclusions and recommendations

- 30 participants, including 12 consultants from 10 Member States attended the meeting (operators and regulators).
- All of the Member States represented have performed complementary safety assessment of their research reactors, consistent with the guidance in SRS-80.

  – *The implementation plans developed in response to the safety reassessments are in various stages of completion. In all cases, the urgent safety significant items have been completed and for some, longer-term activities are ongoing;*

  – *Facility modifications and enhancements have improved the safety of RRs in case of extreme external events;*

  – *Several organizations have conducted assessments of severe accidents beyond the design basis (design extension conditions);*

  – *The reassessments have informed improvements in their emergency preparedness and response plans. However, some reviews did not include an assessment of the ability of the off-site response organizations.*

# Main conclusions and recommendations

- Feedback on the application of the IAEA Safety Report Series No. 80 (SRS-80) at the research reactor facilities.
  - *In several cases, the regulatory body provided instructions for the safety reassessment prior to the publication of SRS-80 and different methodologies were used but overall, the approach was consistent with the guidelines in SRS-80.*
  - *The participants found the guidance in SRS-80 to be adequate and relevant, with no significant gaps identified at the meeting.*

- *Recommendations to the IAEA:*
  - *The IAEA should consider the provision of additional guidance on the performance of analysis of Design Extension Conditions.*
  - *To follow-up on the lessons learned from the F-D accident, including lessons that may be identified subsequent to this meeting, the IAEA should continue to support workshops and technical meetings on the implications of the accident on the safety of research reactors.*
  - *To complement the revision of NS-R-4 into the updated requirements document (future SSR-3), the IAEA should ensure that supporting guidance documents (e.g., on Periodic Safety Review) are consistent with the guidance currently contained in SRS-80.*

# Main conclusions and recommendations

Recommendations to the Member States:

- *MSs are encouraged to promote more rapid sharing of operating and incident experience through regional or interregional networks for the safety of research reactors and to actively participate in the IAEA IRSRR system.*
- *MSs that have not already completed a safety reassessment of their research reactors should do so in accordance with SRS-80.*
- *MSs are encouraged to apply the safety reassessment approach outlined in SRS-80 to other hazardous nuclear facilities associated with research reactors (e.g. waste facilities, radioisotope production facilities).*
- *MSs are encouraged to request peer reviews of their safety reassessments to ensure consistency. MSs may request a peer review service through the IAEA.*
- *Where appropriate, MSs should provide clarity on the role and scope of involvement of the regulatory body in EPR and on how their effectiveness should be improved through practices and drills.*
- *MSs are encouraged to address the capabilities of the State and the regulatory body in EPR, consistent with the provisions in the Code of Conduct on the Safety of Research Reactors and in SRS-80*

# Forthcoming activities - 2015

- Meetings on the actions taken by Member States in view of the results of the safety reassessments (2015).

- Training workshops/Technical meetings on technical areas relevant to feedback from Fukushima, including regulatory inspection programmes, assessment of external and internal hazards, ageing management, periodic safety review, self-assessment, and safety of experimental facilities.

- A session on the implications of Fukushima accident at the International Conference on Research Reactors, Vienna, 12-16 November 2015.

- Safety review missions - as requested by Member States.

# Thanks for your Attention!


http://www-pub.iaea.org/iaeameetings/46533/International-Conference-on-Research-Reactors-Safe-Management-and-Effective-Utilization

*…Thank you.*