

# Safety of Nuclear Installations

## Objective

*To continuously improve the safety of nuclear installations during site evaluation, design, construction and operation through the availability of safety standards and their application. To support Member States in developing and implementing the appropriate safety infrastructure. To assist adherence to, and implementation of, the Convention on Nuclear Safety (CNS) and the Code of Conduct on the Safety of Research Reactors and to strengthen international cooperation.*

## Nuclear Safety Infrastructure

The Agency's Integrated Regulatory Review Service (IRRS) assists Member States in strengthening and enhancing the effectiveness of their national regulatory infrastructure. IRRS peer reviews consider both technical and policy issues of a regulatory nature against Agency safety standards and, where appropriate, against good practice elsewhere. In 2016, the Agency conducted five IRRS missions to Member States with operating nuclear power plants: two IRRS missions to Japan and South Africa, and three IRRS follow-up missions to Bulgaria, China (Fig. 1) and Sweden.



FIG. 1. IRRS team members and staff of the Chinese National Nuclear Safety Authority visit the Fuqing nuclear power plant as part of an Agency led peer review of China's regulatory framework for nuclear and radiation safety.

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The Agency continued to assist Member States with emerging or expanding nuclear power programmes. During the year, it organized around 200 expert missions, workshops and training courses, involving 44 Member States, to provide guidance and information on all elements of establishing an effective nuclear safety infrastructure. The activities focused predominantly on the development of national nuclear safety regulations; the establishment of a management system at the regulatory body; and the preparation of a national plan for human resource development, particularly for the regulatory body. The Agency also organized 25 capacity and competency building activities based on the Agency’s Safety Assessment Education and Training Programme, involving over 400 participants from 15 Member States. These activities were aimed at providing staff of regulatory bodies, future nuclear power plant owner/operator organizations, and technical and scientific support organizations with essential knowledge and practical training in safety assessment.

The Agency placed increased importance on the coordination of support for regulatory bodies in Member States embarking on a new nuclear power programme through, for example, the Regulatory Cooperation Forum (RCF). Support plans were identified for the current RCF recipient countries (Belarus, Jordan, Poland and Viet Nam) for 2016 and beyond. These plans included coordination with other regional networks such as the Asian Nuclear Safety Network (ANSN), the Arab Network of Nuclear Regulators (ANNuR) and the Forum of Nuclear Regulatory Bodies in Africa (FNRBA).

The Agency also established the European and Central Asian Safety Network (EuCAS Network), involving the regulatory bodies and technical support organizations of 21 Member States. The new network is expected to focus initially on addressing the management of radioactive waste resulting from nuclear power plants and other nuclear applications. Other areas identified for future activities include environmental remediation and the decommissioning of power and research reactors. The first EuCAS Steering Committee meeting was held in Vienna, Austria, in December.

The Agency organized four national workshops to assist Member States in strengthening and enhancing the effectiveness of their national regulatory infrastructure. These workshops were conducted in Indonesia, on establishing a communication strategy to build public confidence in the regulatory body, involving 17 participants; in Viet Nam, on project management of a safety evaluation report, with 20 participants; and in Egypt and Turkey, on construction and vendor inspections for new nuclear power plants, involving 22 and 20 participants, respectively. The Agency also conducted four regional workshops: on review and assessment by the regulatory body, held in Vienna, Austria, involving 25 participants from 6 Member States; on knowledge management at the regulatory body and its technical support organization and on information and communication technology interfaces, held in the Republic of Korea, involving 14 participants from 8 Member States; on drafting nuclear safety regulations, held in Viet Nam, involving 16 participants from 9 Member States; and on communication by the regulatory body, held in Pakistan, involving 20 participants from 9 Member States. In addition, the Agency organized two hands-on training courses for regulatory inspectors at Zwentendorf, Austria, involving 30 participants from 12 Member States.

## Convention on Nuclear Safety

The Agency hosted several preparatory meetings at its Headquarters in Vienna, Austria, in support of the Seventh Review Meeting of Contracting Parties to the Convention on Nuclear Safety (CNS), to take place in March–April 2017. In particular, a working group was established to prepare templates for the Country Review Reports and national presentations to be used during the forthcoming review meeting. Also, an Officer’s ‘turnover meeting’ was convened in March to share experience and lessons learned among incoming and outgoing CNS Officers.

## Design Safety and Safety Assessment

In February, the Agency published the revised Safety Requirements publication *Safety of Nuclear Power Plants: Design* (IAEA Safety Standards Series No. SSR-2/1 (Rev. 1)), which takes into account lessons from the accident at the Fukushima Daiichi nuclear power plant. To support Member States in the practical application of the design principles and requirements established in SSR-2/1, the Agency issued *Considerations on the Application of the IAEA Safety Requirements for the Design of Nuclear Power Plants* (IAEA-TECDOC-1791), aimed at facilitating understanding of new topics and terminology introduced in SSR-2/1 (Rev. 1), and organized workshops in China, involving 90 participants, and in Jordan, involving 23 participants. It also issued *Design of Instrumentation and Control Systems for Nuclear Power Plants* (IAEA Safety Standards Series No. SSG-39). This revised Safety Guide takes into account ongoing developments in instrumentation and control, including the development of computer applications and the evolution of the methods necessary for their safe, secure and practical use, developments in human factors engineering and the need for computer security.

The Agency facilitated meetings of the Small Modular Reactor (SMR) Regulators' Forum Steering Committee and its three Working Groups, held in March in Vienna, Austria. The Working Group meetings were used to prepare reports relating to the size of emergency planning zones and the application of the concepts of defence in depth and the graded approach. The Agency also organized two workshops on SMR safety and licensing in Vienna, Austria: one for members of ANNuR, involving 18 participants from 10 Member States, and one for members of FNRBA, involving 20 participants from 15 Member States.

## Protection against External Hazards

In February, the Agency issued *Site Evaluation for Nuclear Installations* (IAEA Safety Standards Series No. NS-R-3 (Rev. 1)), which establishes the requirements for a site evaluation for a nuclear installation that fully characterizes the site specific conditions pertinent to the safety of the installation. Three other publications were issued on protection against external hazards. *Diffuse Seismicity in Seismic Hazard Assessment for Site Evaluation of Nuclear Installations* (Safety Reports Series No. 89) describes procedures that can be used to estimate the seismic hazard in diffuse seismicity regions. *Seismic Hazard Assessment in Site Evaluation for Nuclear Installations: Ground Motion Prediction Equations and Site Response* (IAEA-TECDOC-1796) provides information on the state-of-the-art practice and detailed technical elements related to ground motion evaluation by ground motion prediction equations and site response. *Volcanic Hazard Assessments for Nuclear Installations: Methods and Examples in Site Evaluation* (IAEA-TECDOC-1795) provides information on detailed methodologies for, and examples of the application of, volcanic hazard assessment for nuclear installation site evaluation.

The Agency's Site and External Events Design (SEED) review service provides an independent review of the site evaluation and the designed safety of the nuclear installation against the demands of external hazards. In 2016, the Agency conducted three preparatory SEED missions, to Belarus, France and the Islamic Republic of Iran, and five SEED peer review missions, to Japan, Jordan, Pakistan, Poland and Tunisia. It also organized six SEED training workshops involving a total of 115 participants from 19 Member States. The Agency conducted two expert missions to Egypt: in January to assist the Egyptian Nuclear and Radiological Regulatory Authority (ENRRA) in reviewing regulations on siting; and in May to assist ENRRA in reviewing the population distribution at the El-Dabaa site.

In November, the Agency organized a Technical Meeting on Lessons Learned and Safety Improvements Related to External Hazards Based on the IAEA Fukushima Report, attended

by more than 50 participants from 30 Member States. The participants shared their experience concerning the actions taken after the Fukushima Daiichi accident to strengthen nuclear safety with regard to protection against external hazards. The participants also shared best practices in the identification of potential safety issues and areas for improvement related to external hazards and how these issues were addressed.

## Operational Safety

The Operational Safety Review Team (OSART) programme has provided advice and assistance to Member States for over 30 years, to enhance the safety of nuclear power plants during construction, commissioning and operation. Under the OSART programme, international teams of experts conduct in-depth reviews of operational safety performance at a nuclear power plant, reviewing the factors affecting the management of safety and the performance of personnel. The Agency conducted three missions in 2016, to Canada, France and Romania. It also conducted five OSART follow-up missions, including two to France, and one each to Hungary, the Netherlands and the Russian Federation.

In 2016, the Agency published *OSART Guidelines: 2015 Edition* (IAEA Services Series 12 (Rev. 1)). The revised guidelines take into account the lessons arising from the Fukushima Daiichi accident and the experience gained from application of the Agency's safety standards. Two new modules were incorporated into the OSART service: one on the assessment of leadership and management for safety, and one on the technological, human and organizational interfaces.

The Agency issued *Leadership and Management for Safety* (IAEA Safety Standards Series No. GSR Part 2), establishing requirements concerning effective leadership and management for safety in organizations concerned with, and facilities and activities that give rise to, radiation risks.

The Agency conducted four Safety Aspects of Long Term Operation (SALTO) missions, to Argentina, Armenia, Bulgaria and Sweden, and three SALTO follow-up missions, to Belgium, the Czech Republic and Sweden. It also made available to Member State regulatory bodies and nuclear utilities a SALTO mission highlights report summarizing the results of 22 SALTO missions and 6 SALTO follow-up missions conducted from 2005 to 2015. The Agency conducted SALTO workshops and seminars, workshops on long term operations and ageing management, and support missions to Argentina, Armenia, Brazil, China, the Czech Republic, Finland, France, Mexico, Pakistan, Romania, the Russian Federation, Slovenia, South Africa, Sweden, Ukraine and the United States of America. The third phase of the Agency's International Generic Ageing Lessons Learned (IGALL) programme was initiated in 2016, with the participation of 29 Member States having operating nuclear power plants.

In April, the Agency held the fourth annual IAEA Workshop for Senior Managers on Leadership and Culture for Safety. The workshop provided an international forum for senior executive managers to share their experience and learn more about how leadership and culture for safety can be continuously improved. The Agency launched a new series of training workshops on a systemic approach to safety for middle managers. The workshops focus on how a systemic approach to safety is achieved in practice. During the year, the Agency issued two publications relating to safety culture assessment: *Performing Safety Culture Self-assessments* (Safety Reports Series No. 83) and *OSART Independent Safety Culture Assessment (ISCA) Guidelines* (IAEA Services Series 32)).

The Agency organized a Technical Meeting to Share Lessons Learned from Recent Human Performance Related Events at Nuclear Power Plants and Considerations for Performance Improvement in Vienna, Austria, in late May and early June, involving 30 participants from 22 Member States. In October, it organized a Technical Meeting of the Technical Committee of the International Reporting System for Operating Experience National Coordinators in

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Vienna, Austria. The meeting was attended by 40 participants from 25 Member States, who shared experience and information on significant events at nuclear power plants.

The Agency conducted four national training courses on the International Reporting System for Operating Experience and root cause analysis techniques: one in Ukraine, with 40 participants; one in Slovakia, with 30 participants; and two in Pakistan, with a total of 100 participants. A joint Agency–WANO Moscow Centre meeting was held in Belarus, attended by 33 participants from 8 Member States. Participants discussed the lessons from recent nuclear events and ways to improve the effectiveness of operating experience programmes. The Agency conducted one Peer Review of Operational Safety Performance Experience (PROSPER) mission, to the Russian Federation.

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## Safety of Research Reactors

The Agency issued *Safety of Research Reactors* (IAEA Safety Standards Series No. SSR-3), establishing requirements on a range of aspects for safety and safety assessment for all stages in the lifetime of a research reactor. It also published *Management of the Interface between Nuclear Safety and Security for Research Reactors* (IAEA-TECDOC-1801), providing technical guidelines and practical information for aligning the safety–security interface at research reactor sites.

In 2016, the Agency conducted Integrated Safety Assessment of Research Reactors (INSARR) missions to Jordan, the Netherlands and Portugal, and a follow-up INSARR mission to Malaysia. It conducted advisory missions to Indonesia, Jamaica, Malaysia, Peru and Poland, to assist research reactor operating organizations in implementing safety enhancements based on the recommendations of previous INSARR missions. An Agency expert mission to Ghana conducted in late June and early July provided recommendations to ensure the safe conversion of the core of its Miniature Neutron Source Reactor from high enriched uranium to low enriched uranium fuel.

The Agency organized a Technical Meeting on the Use of a Graded Approach in the Application of the Safety Requirements for Research Reactors, held in May. The meeting was attended by 54 participants from 38 Member States, who shared information and exchanged knowledge and experience and provided feedback on related Agency safety standards. The Agency also organized a regional meeting on application of the Code of Conduct on the Safety of Research Reactors, held in Egypt in November, and involving 18 participants from seven Member States in Africa. The meeting provided support to participating Member States in strengthening their programmes for preparing safety documentation for research reactors.

## Safety of Fuel Cycle Facilities

In July, the Agency issued *Safety Reassessment for Nuclear Fuel Cycle Facilities in Light of the Accident at the Fukushima Daiichi Nuclear Power Plant* (Safety Reports Series No. 90). The publication provides information on carrying out safety reassessments for nuclear fuel cycle facilities based on Agency safety standards and current international experience, taking into account the available feedback from the Fukushima Daiichi accident. The Agency also organized a workshop on the topic, held in April in Vienna, Austria, with 29 participants from 21 Member States. The workshop participants exchanged information on experience acquired since the Fukushima Daiichi accident relevant to fuel cycle facilities, including regulatory aspects of safety reassessments, design reviews and the application of a graded approach.

The Agency organized a workshop on safety analysis and safety documents for nuclear fuel cycle facilities, held in November in Vienna, Austria, with 19 participants from

17 Member States. Participants received practical information on performing safety analyses for fuel cycle facilities, and on preparing, updating and assessing safety documents for such facilities based on the Agency's safety standards.

The Agency and the OECD Nuclear Energy Agency jointly organized the biennial Technical Meeting for the National Coordinators of the Joint IAEA–OECD/NEA Fuel Incident Notification and Analysis System (FINAS). Held in Paris, France, in October, the meeting was attended by 24 participants from 19 Member States. Participants exchanged operating experience and discussed the events reported to FINAS in the previous two years, including their root causes and actions taken to prevent their recurrence.