International Experts' Meeting
on Strengthening the Effectiveness of Research and Development in the Light of the Fukushima Daiichi Power Plant Accident

February 16 – 20, 2015

IAEA Activities under the Nuclear Safety Action Plan

Gustavo Caruso
Special Coordinator for the Implementation of the Action Plan

IAEA
International Atomic Energy Agency

Background

IAEA response to the Fukushima accident includes:

- **Nuclear Safety Action Plan:**
  - Defines a programme of work to strengthen the global nuclear safety framework
  - Covers all relevant aspects relating to nuclear safety, emergency preparedness and response, and radiation protection of people and the environment as well as the relevant international legal framework

- **IAEA Fukushima Report:**
  Assessment of the accident that is technically comprehensive, factual and balanced, addressing the causes and consequences as well as lessons learned.

NSAP Stakeholders

Success of NSAP dependent on its implementation through the full cooperation and participation of Member States and involvement of many other stakeholders

Member States

IAEA (NSAT)

- Nuclear Energy
- Nuclear Applications
- Nuclear Safety
- Technical Cooperation
- Office of Legal Affairs
- Monaco & Seibesdorf labs

SAFER
The IAEA Action Plan

- Regulatory bodies
- Operating Organizations
- Nuclear industry
- Technical Support Org. (TSO)
- Research institutions
- Education institutions

Other International Organizations

- European Commission
- CTBTO
- FAO
- ICRP
- ILO
- INSAG
- OECD/NEA
- WANO
- WHO
- WMO
- UNSCEAR

NSAP Programme

12 Actions

Safety Assessments

IAEA Peer Reviews

Emergency Preparedness and Response

4. National Regulatory Bodies

Operating Organizations

IAEA Safety Standards

International Legal Framework

Member States Embarking on Nuclear Power

Capacity Building

Protection from Ionizing Radiation

Communication

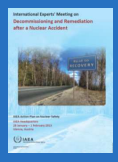
Research & Development

International Expert Meetings':

IEMs **to analyse** all relevant technical aspects and **learn the lessons** from the Fukushima Daiichi accident and IAEA **shares** these lessons worldwide

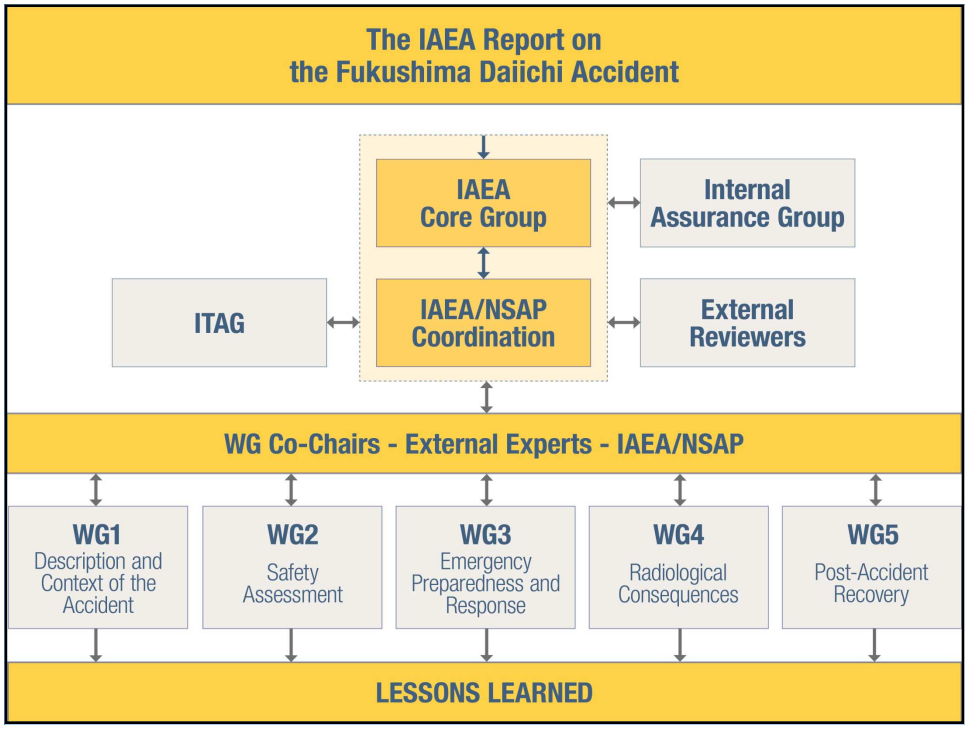
International Expert Meetings'

Action 11: Communication

IEM 1:	IEM 2:	IEM 3:	IEM 4:	IEM 5:	IEM 6:	IEM 7:	IEM 8:
							
Reactor and Spent Fuel Safety March 2012	Transparency & Communication June 2012	Protection Against External Events Sept 2012	Decommissioning and Remediation January 2013	Human & Organizational Factors May 2013	Radiation protection February 2014	Severe accident management March 2014	Research and Development February 2015

IEM 9: Assessment and Prognosis in Response to an Emergency

April 2015



Current status:

March 2013 July 2014 December 2014

Drafting → **Review and revision** → Final editing and dissemination

- *External reviewers;*
- *Internal Assurance Group;*
- *Core Group;*
- *WGs;*
- *ITAG;*
- *Gov. of Japan (factual review).*

Formal publication of the report is planned for the 59th IAEA General Conference in September 2015.

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Research & Development

Research and Development:

- key area for continuous improvement on Nuclear Safety
- Cross-cutting area carried out throughout the NSAP

Research and Development as a key area under the Nuclear Safety Action Plan

Action 12 of the Action Plan:
"Effectively utilize research and development"

- *Relevant stakeholders, shall, with assistance provided by the IAEA Secretariat, conduct necessary research and development in nuclear safety, technology and engineering, including that related to existing and new design-specific aspects*
- *The research and development shall be utilized effectively, and shall be shared, as appropriate, to the benefit of all Member States*

Action 12 Objectives

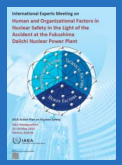
- **Acquiring new scientific knowledge**
  - better understanding, for a better and safer nuclear industry
  - Understand the root causes of the accident and its consequences
- **Developing technical tools**
  - Control risks
  - Develop preventive measures
  - Develop mitigation technologies to prevent severe consequences
  - Develop expertise and capabilities
- **Covers a wide range of topics**
  - Integrity of structures, systems and components important to safety
  - Fuel behaviour during severe accidents
  - Fire protection measures
  - Human and organisational factors and safety culture
  - Lifetime management of NPPs
  - Evaluation of external hazards

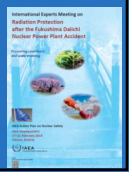
The role of the Secretariat in implementing Action 12

As provided by the Action Plan

- Continued coordinated activities to support Member States (OECD/NEA, WANO etc)
- Organization of a series of international conferences, technical meetings and workshops to collect, discuss, analyse and assimilate the technologies
- Develop a plan with Member States and relevant stakeholders to coordinate the needs for further research and development, and identify gaps
- Strengthen existing mechanisms and networks to effectively share results of the research and developments and to assess their effectiveness
- Review activities undertaken in Member States to integrate research efforts, and to improve efficiency and effectiveness
- Preparation of several technical documents

Research and Development Activities





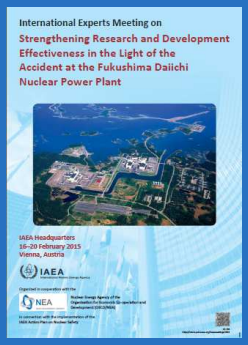
- **IEM 1 – Reactor and Spent Fuel Safety**
  An internationally coordinated, or integrated, approach is needed to efficiently manage and perform the Research and Development required to implement measures to improve safety and knowledge.

- **IEM 3 – Protection against External Events**
  Research activities need to apply all lessons learned from recent events and results from all ongoing evaluation, upgrading and research activities.

- **IEM 5 – Human & Organizational Factors**
  An integrated approach will require research and development to incorporate knowledge and expertise from a wide range of disciplines.

- **IEM 6 – Radiation Protection**
  Research and Development is an essential element in the overarching process of capacity building.

IEM 8 on Research and Development



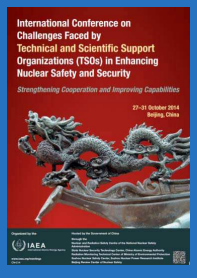
- Organised in cooperation with the Nuclear Energy Agency (NEA) of the OECD
- Forum for experts to exchange information and experience, with a view to assisting Member States in planning and implementing R&D activities
- IEM focuses on collecting information from Member States, on discussing and assessing the features and effectiveness of current technologies, and on identifying and prioritizing areas in which possible international collaboration would be beneficial
- Topics covered include: Common cause failures due to external and internal events, technologies to prevent/mitigate severe accidents, severe accident analysis, emergency preparedness and response, radiation safety and post-accident recovery

Research and Development Activities

Technical and Scientific Support Organisation (TSO) Forum

- Objectives:
  - encourage open dialogue and sharing of scientific and technical information among TSOs worldwide
  - aims to strengthen scientific and technical coordination and collaboration among Member States,
- Regular meetings of the Steering Committee

- International Conference on Challenges Faced by Technical and Scientific Support Organizations (TSOs) in Enhancing Nuclear Safety and Security: Strengthening Cooperation and Improving Capabilities, October 2014, China
  - aimed to assess and review ways to further improve the effectiveness of TSOs taking into account lessons learned
  - discussed the role of R&D, facilitated the exchange of experience and good practices in planning and implementing cooperative activities for capacity building and in identifying needs for assistance
  - considered appropriate approaches for enhancing cooperation



Research and Development Activities

Identifies the relevant stakeholders carrying out Research and Development

- Information collected as part of a survey will allow the compilation of a database to capture the relevant R&D activities
- Compilation of a database of lessons learned and recommendations with focus on technical issues
  - Used in meetings with experts from Member States to discuss prevention and mitigation methods
  - Used to identify the needs in technologies to be developed

Project on Reliable Containment Cooling and Filtered Venting (RCCFV)

- In cooperation with the Russian Federation, started early 2014 - ongoing
- Objective: Analysis of systems by which an NPP containment can be safely cooled and depressurised
- Technical report containing the current approaches for reliable containment cooling and filtered venting with suggested enhancements to be published

Research and Development Activities

Meeting on Management of Ageing of Low Voltage Cables in Nuclear Power Plants; Knoxville, USA - July 2012

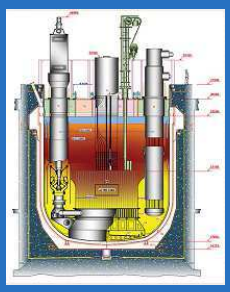
- Aimed to cover accelerated pre-aging of cables followed by qualification testing, monitoring the performance of cable insulation material and conductors, environmental monitoring to verify ongoing qualification, and development of a testing program and maintenance schedules for cables that are important for safe operation of NPPs

Technical Meeting on Flow Accelerated Corrosion, Vienna - July 2012

Discussed a programme of work to benchmark the computer-based tools used to assess corrosion
Producing guideline document for implementing a FAC programme (to be issued 2016)

Research and Development Activities

Small and medium sized reactors (SMRs), Vienna - September 2012



- Meeting with experts from Member States to consider SMR design issues
- Incorporate the lessons learned from the Fukushima Daiichi accident
- Discuss reliability of passive and active safety systems
- Identify research and development activities in the area of probabilistic safety assessment
- Specific topics: non-electric emergency core and containment cooling system designs, designs for the mitigation of severe accidents, and the development of a performance evaluation methodology

Research and Development Activities

Meeting on Lessons Learned from the Fukushima Daiichi accident and Water Cooled Reactors (WCR) technology development to cope with Fukushima-type accidents, April 2013, Japan

- Addressed the technical lessons learned from Boiling Water Reactors (BWR) regarding the impact of external events
- Topics discussed included:
  - Water cooled reactor technology development;
  - Effectiveness and Challenges by applying lessons learned from the Fukushima accident
  - Research and development needs;
  - Opportunities for international collaboration
- Report to be published

Research and Development Activities

Development of a Symptom-Based Accident Management Toolkit (SAMT) in NPPS

- The Secretariat published in November 2013 a version of SAMT comprising modules on:
  - Fundamentals on nuclear safety
  - Severe Accident Challenges and Mitigation Strategies, and
  - Guidelines/examples on SAMG
  - Implementation, requirements and infrastructure
- Valuable tool to support Member States in the education and training of NPP operators and regulators
- Support capacity building in newcomer countries
- Provides a suitable reference level and refresher training tool in countries with well-established nuclear power programmes

Research and Development Activities

Technical Meeting on the degradation of primary system components of water cooled nuclear power plants, Vienna - November 2013

- In cooperation with the EC-JRC
- Looked at current issues and future challenges
- Results of Meeting:
  - Meeting highlighted that environmentally-induced effects on materials are an issue for NPPs especially as the age of current NPPs increases
  - Discussed the mechanisms of radiation damage to the system structure and components important to safety and possible mitigation approaches including upgrading equipment and systems, monitoring and testing
  - Provided the participants with information on the degradation of ferritic and stainless steels in reactor pressure vessels, core internals, piping steel, steam generators and other components

Research and Development Activities

Meeting on R&D to cope with Fukushima-type Accidents, Vienna

- December 2013, 11 experts from 8 Member States and 2 international organizations
- Share information on on-going and planned R&D activities
- Discuss R&D needs and international collaboration to develop technologies to cope with severe accidents
- Discuss Survey and Technology Information Sheet for matrix to classify the R&D facilities and programmes

6th Review Meeting of the Convention on Nuclear Safety

National activities

Most Contracting Parties to the CNS regularly report on their R&D activities, carried out by their regulatory bodies, operating organizations and technical support organization

International activities

- Many Contracting Parties have bilateral and multilateral agreements for cooperation in R&D in place
- International organizations as the IAEA, WANO, and OECD/NEA among others act as hub for international research work and information sharing

Research and Development - Next Steps

Meetings focusing on the engineered safety features performance evaluation through balanced used of deterministic and probabilistic approaches

- Covers: assessment of low probability yet high consequence events and contribution of non-electric cooling systems on core damage frequency

Continue to coordinate activities to support Member States in their Research and Development efforts, with OECD/NEA and other organisations

Continue to integrate lessons learned from the Fukushima accident into new Research and Development