Summary of Session 2

IEM on

"Strengthening R&D Effectiveness in the Light of the Accident at the Fukushima Daiichi NPP"

IAEA Headquarters, Vienna, Austria
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SESSION 2

Technologies to Prevent and Mitigate Severe Accidents

SUBJECT OF THE SESSION

1. Measures to prevent & mitigate core damage
2. Measures to maintain containment & confinement integrity
3. Measures to prevent hydrogen explosions
4. Instrumentation for safety-related parameters and monitoring equipment
5. Measures to suppress radioactive material release & transport

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Technologies to Prevent and Mitigate Severe Accidents

KEYNOTE PRESENTATIONS	Technologies to Prevent and Mitigate Severe Accidents *(Maria Kosnick, Exelon Generation)*
INVITED PRESENTATIONS	Severe Accident Mitigation Strategies Considered for U.S. Mark I Boiling Water Reactors *(Edward Fuller, NRC)*
TECHNICAL PRESENTATIONS	1. CAP1400 Core-Melt In-Vessel Retention Measure Design and research *(Kemei Cao, SNERDI)* 2. ASVAD: A New Element to Improve the Plant Response against ELAP Accident *(Laborda Rami, Asco Nuclear Power Plant)* 3. Assessment of the Mitigative Strategy Using External Coolant Injection for OPR-1000 Plant *(Soo Yong Park, KAERI)* 4. The European PASSAM Project on Severe Accident Source Term Mitigation: Halfway Status *(Thierry Albiol, IRSN)*

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TECHNICAL PRESENTATIONS

5. Development of Inherently Safe Technologies for BWRs *(Kazuaki Kitou, Hitachi)*
6. Application of Technologies in CANDU Reactors to Prevent and Mitigate the Consequences of a Severe Accident *(Lovell Gilbert, Bruce Power LP)*

TECHNICAL POSTERS

1. ANPP Unit 2 Response to feedwater Restoration Techniques in case of Ultimate Heat Sink Loss *(Tsolak Malakyan, Nuclear and Radiation Safety Center)*
2. Preliminary Study on Passive System Experimental with Water Initial Temperature Variation in transient Condition using NC-Queen Apparatus *(Mulya Juarsa, BATAN)*
3. Thermal Parameters of Elongated Heat Conductors of Evaporation-Condensation Type for Passive Emergency Cooling of Reactor Vessels *(Victor Razumovskiy, National Technical University of Ukraine)*

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Key Points from Presentations & Posters

1 Improvement and Development of Existing or New Mitigation Technology

Mainly focused on the experimental studies to improve the existing mitigation devices or technologies

- Pool scrubbing systems, sand bed filters plus metallic pre-filters, spray agglomeration systems, Electric, Zeolite, & combined filtration system… (from PASSM project)

Mainly focused on the design of innovative or inherent safety systems and measures

- To prevent/mitigate core damage (e.g., passive water-cooling system, automatic safety valve for accumulator depressurization),
- To maintain containment/confinement integrity (e.g., In-Vessel Retention (IVR)),
- To prevent hydrogen explosions (e.g., high temperature resistant (SiC) fuel cladding, passive autocatalytic recombiner (PAR))...

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Key Points from Presentations & Posters

2 Assessment of Mitigation Strategies through the Analysis of Plant Behavior

Mainly focused on the analysis and evaluation of the effectiveness and impacts on the mitigation strategies considering the event of extended loss of AC power (ELAP)

- External cooling water injection using fire trucks,
- Operator actions to prevent core damage, etc.

Mainly applied computer code to understand and predict the accident progressions for the proposed strategies

- MELCOR, MAAP, etc.

Key Points from Presentations & Posters

3 Preliminary Research of Scientific and Experimental Base

Mainly focused on the study of phenomenon and behavior of the plant through the laboratory experiment or analysis

- To provide insights for designing passive systems of heat removal and transfer
- To provide insights for reflecting the research results into the emergency operating procedures and operators' training

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Key Points from Discussion & Technical Exchanges

1 **The Fukushima accident has stimulated R&D activities, and various technologies are under development or planning**

Most of the R&D works are plant specific. Therefore, the R&D works should consider for the generic issues…

- To understand the root causes of the accident & its consequences and to ensure fulfilment of safety capability even under extreme accident conditions

2 **IEM is a good opportunity to start discussing and exchanging information continuously**

There is a lot of work that can be done together. However, It is important…

- To know what kind of information we should share to avoid duplication on an international level

Key Issues and Areas to be Addressed in Future R&D

1 R&D Opportunities for Measures to Prevent & Mitigate Core Damage

- Determination to beyond design basis capability of installed equipment, etc.

2 R&D Opportunities for Instrumentation and Monitoring equipment

- Instrumentation to improve recognition of vessel breach signature,
- Portable and remote instrumentation capability, etc.

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Key Issues and Areas to be Addressed in Future R&D

3 R&D Opportunities for Measures to Suppress Radioactive Material Release/Transport

- Accident tolerant fuels,
- Forensic investigation of Fukushima,
- Core melt progression, molten debris cooling & spread behavior,
- Containment failure modes from elevated pressure & temperature effects, etc.

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Lessons Learned with regard to Sessions Topic

1	R&D work for technologies to prevent and mitigate severe accidents is a continuous process and requires ongoing attention
2	R&D topics are focused on the advanced design concepts as diverse mitigation strategies and their assessment
3	The new (conceptual or basic) design needs the international collaborative evaluation with the prototype conditions before implementation into the reactors

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Lessons Learned with regard to Sessions Topic

4	The comprehensive discussions and understanding are needed for the procedures and guidelines (e.g., EOP, SAMG, EDMG) to provide an operational capability for responding severe accident

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Recommendations for Future International Collaborative Work

To strengthen R&D effectiveness in the light of the accident of Fukushima NPPs, IAEA…

1 **Should continue to share the lessons learned from the Fukushima accident by disseminating the technical issues and R&D status & trend**

- **Through the international collaborative relationships for sharing the findings and lessons learned**

2 **Should provide encourage to the Member States for strengthening the international collaborative R&D work**

- **Through the continuous forum and technical meeting for the technologies to prevent and mitigate severe accident**

Thank you for your attention!