

SCJ Symposium on
“Role and Responsibility of Scientists in the Response to
TEPCO Fukushima Nuclear Power Plant Accident “

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What Scientists and Engineers,
in the field of Mechanical
Engineering, can do?

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due to 3.11 Great East Japan Earthquake

The Japan Society of Mechanical Engineers
(JSME) has Constituted an **Investigation
Committee on the Damages due to
3.11 Great East Japan Earthquake**

- **Period: April 2011~March 2013**
- Chairman: Masaki Shiratori (Yokohama National Univ.)
- Secretary: Shinobu Yoshimura (University of Tokyo)
- Other 9 members

The IC consists of the following 6 working groups:

- WG1: Damages of machines and devices and effectiveness of the earthquake-proof technologies
- WG2: Mechanism of damages due to tsunami
- WG3: Applications of robots
- WG4: Traffics and logistics
- WG5: Energy infrastructure
- WG6: Codes and standards for NPPs
- WG7: Risk management

Investigation Policy

- Investigation should be “**fair, right and open**”.
- Damages due to earthquakes and/or tsunami
- Questionnaire and hearing investigations are recommended as well as the information published by TEPCO, government, etc.
- **Find out good practices**
- Send messages to the public as well as JSME members as quick as possible

Subjects to be Investigated about the NPP Accident

(1) Before 3.11

- Why the accident could not be prospected or prevented?

(2) Just after 3.11: short term subjects

- Were the severe accident managements proper?
- How we can contribute to make a scenario up to the stable cooling?

(3) Middle and long term subjects

- Develop and implement codes and standards for BDBA (Beyond Design Based Accident)

WG3: Activities of Robots in Fukushima NPP

(1) Removal of debris

Outdoors: unmanned robot,

Indoors: Wollier

(2) Investigation of damage appearance

From the air: T-Hawk

Indoor: Packbot, Quince

Subject: high radiation environment,
reliability, and radio control

WG3: Subjects Left Behind

- Monitoring of radiation, moisture, etc.
- Remote sensing of pipes and nozzles
- Removal and clean up of radiation materials
- Carry instruments and materials
- Support for the stable cooling
- Support for the covering of the buildings
- Taking out of the fuels
- Scrap and demolition of the nuclear reactor

WG4 : Railroad Traffics

- Many damages in station buildings, railroads and wires.
- Most of them are the damages in the civil structures due to the earthquake and/or tsunami.
- There are few damages in the mechanical devices.
- The 27 trains are in service in Tohoku super express line.
- All of them could quickly slow down and stop without derailment through quick earthquake detect and alarm system called “Yuredasu”.
- There were some trains attacked by tsunami but all the passengers had evacuated before the tsunami attack.

WG4 : Automobile Traffics

- Automobile traffics did not work due to the failure of the traffic roads, traffic control, shortage of gasoline, etc..
- Information about available roads are open to the drivers from the early stage through the introduction of **information map of passage records**.
- Similar system worked as well for large vehicles such as trucks.
- The **“kushinoha sakusen (teeth of comb strategy)”** greatly contributed to the quick recovery of the traffic roads and physical distribution supports.

WG6

Issues and Future Vision
in the Codes and Standards
Nuclear Power Plants

WG6 : Objectives for Investigation

- Investigate damages due to the earthquake and tsunami, and the following accidents that happened in the NPP's within the framework where JSME can approach
- Root cause analyses of the accidents and consideration about the relation with the codes and standards
- Find examples of good practices in design accommodations and countermeasures against earthquake and tsunami
- Discuss about future needs for codes and standards
- Propose suggestions to improve safety of NPP

WG6 : Fukushima-daiichi NPP's

- Automatic shut down right after the earthquake
- Loss of outside electric power because of the earthquake
- Loss of functions of emergency power generation devices and systems by tsunami
- Long time loss of the total electric power (station blackout)
- Failure of nuclear reactor core cooling
- Meltdown of core and hydrogen explosion

WG6 : Other NPP's

- Automatic reactor shutdown right after the earthquake
- Loss of external electric power due to the earthquake
- Emergency power generation systems continued to work
- No report on failure or damage in structures, systems and components important to safety
- Success of cooling of nuclear reactors

WG6 : Viewpoint 1

Why the accidents cannot be prevented?

- Why the risk management did not work?
- Examine the current regulation system and management system about NP

Investigate the appropriate regulation and codes and standards systems to assure safety

WG6 : Viewpoint 2:

What is the plan to improve the safety against severe hazard?

(1) To prevent the accident

- Update the design condition of severe external hazards and improve the measure of safety
- Prepare a safety measures against beyond design based accidents (BDBA) events

Establish a design guideline about preparing devices to settle down the accident

(ex. The function of water injection into the core in case of station black out (SBO))

WG6 : Viewpoint 2 (continued):
What is the plan to improve the safety
against severe hazard?

- (2) Mitigation of the influence of the accident
- At the accident of meltdown of the core it is very important to maintain structural integrity of the reactor pressure vessel and the containment vessel in order to prevent radioactive material release to the environment.
 - It is necessary to maintain leak toughness of the containment vessel from the viewpoint of the accident management

Establish a structural evaluation guideline corresponding to the severe accident (evaluation procedure and criteria)

WG6 : Viewpoint 3:

Did the design against earthquake work?

What is the subjects left behind?

- Design against earthquake seems to have worked.
 - All the plants shut down automatically and safely just after the earthquake.
 - No report on failure, damage or loss of function in structures, systems and components important to safety

It is important to know quantitatively the ultimate failure capacity and the safety margin against earthquakes beyond design.

Concluding Remarks

Comment on the “unique voice”

- In JSME the objective of the society is stated in the article of association while canons of individual members are provided by the code of ethics.
- Also, in the center of the code and standard, there is a rule for the formation of agreement.
- Since this rule is essentially based upon the principle of “fair, right and open”, enough time is necessary to get agreement .
- Therefore, it is difficult to get agreement for the urgent accident although it is possible to tackle with the middle or long term subjects.
- Engineers and/or scientists may have to decide by themselves depending upon their own judgment at the emergent accidents.
- Therefore, they need enough training to make proper judgment at emergency.