Fukushima Accident: Actions for the Future

from Industry's Perspective

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What happened after the Earthquake on March 11?

- 3 operating units automatically shut down, another 3 units were under annual outage at Fukushima Daiichi NPS
- ~1hr after the earthquake, Tsunami reached to Fukushima site
- Long-term SBO
- Long-term loss of UHS

Consequences of Accident

- Multi-unit events simultaneously
- Core damage and containment failure
- R/B failure by H_2 explosion
- Heat up of SFP water in R/B
- Accumulation of radioactive effluent

Consequences of Accident (cont'd)

- Release of radioactive material into the environment
  - 0.3~0.6x10*18 Bq I-131 eq
  - ~1/10 of the case of Chernobyl accident (5.2x10*18 Bq I-131 eq)
- Radiation dose of workers (as of May 31)
  - Emergency exposure dose limit : 250mSv
  - over 100mSv : 30 workers
  (internal exposure dose of 2 workers is under evaluation)

Current Challenges

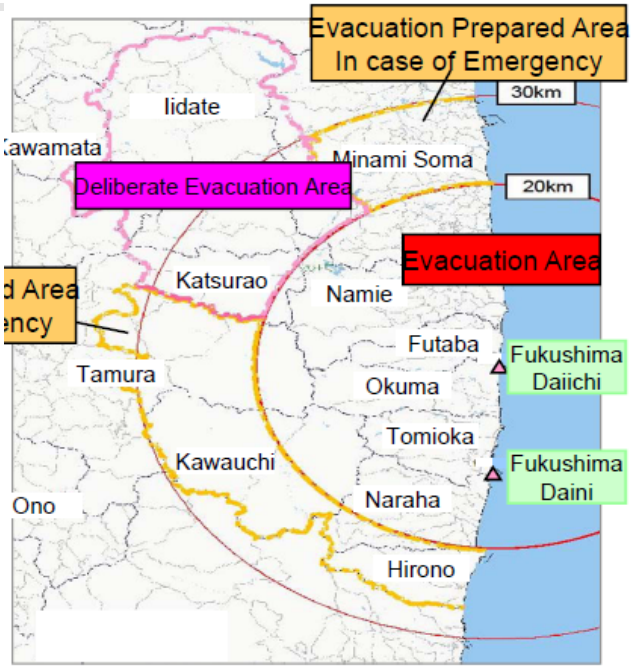
At the station :

- Core and SFP cooling
- Control of high contaminated water effluent
- Prevention of additional H_2 explosion
- Minimizing release of additional radioactive material into environment

Current Challenges (Cont'd)

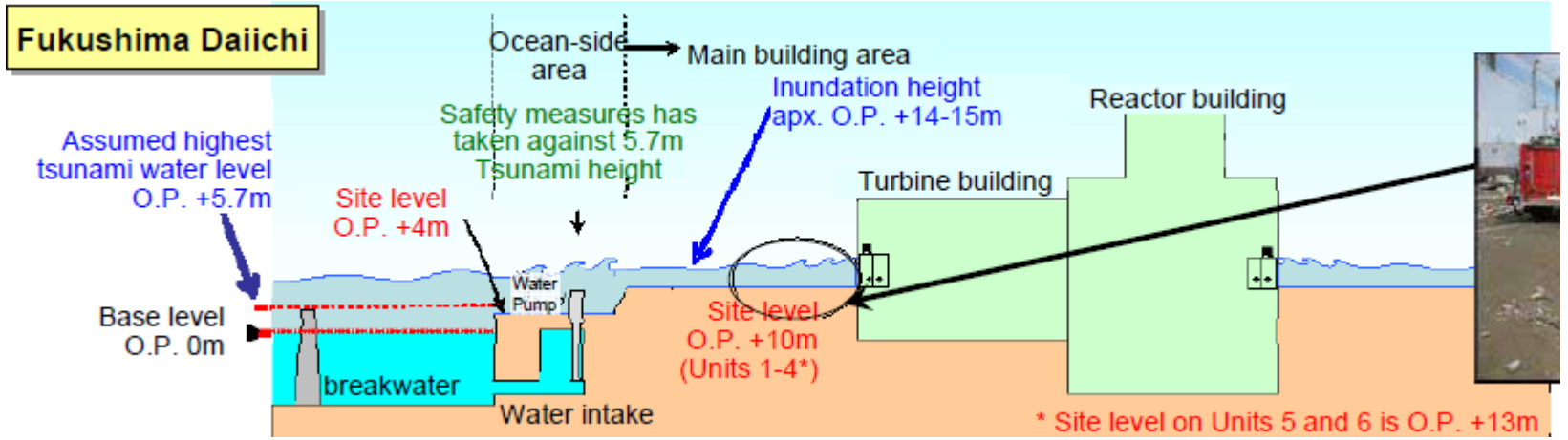
Outside site boundary :

- Evacuation of local residents ;
  * Restricted Area (20km)
  * Deliberate Evacuation Area
  * Prepared Area in case of Emergency
- Contamination of air, soil, vegetables, groundwater, grass, sea water, and so on
- Ingestion control ; I-131 300 Bq/kg in water
  2000 Bq/kg in food
  Cs 200 Bq/kg in water
  500 Bq/kg in food



Consideration of beyond Design Basis natural phenomena

- Design Basis Tsunami
  - original licensing application
    - * height +3.1m above sea water (based on Chile tsunami in 1960)
    - * elevation of ground level +10m
  - revised licensing application (2002)
    - * height +5.7m above sea water
- Tsunami on March 11, 2011
  - +14~15m height



Consideration for Emergency Preparedness

- Before March 11 :

  AM by utility's voluntary action to cope with B-DBE incl. SBO (1992~)

- After March 11 :

  On Mar.30, METI ordered all utilities to take necessary action to cope with SBO

Lessons learned

- Lack of imagination
- Robustness of design
- Crisis management
- Communication/transparency
- Nuclear Security
  (to be discussed separately)

Lessons learned (cont'd)

- Out of hypothesis ?
- Lack of imagination

  Because of long term safety operation record after Chernobyl accident,

  - we fell down in a pit that to follow the strict regulatory requirement is a synonym for to keep high level of safety
  - we have stopped stretching our imagination on nuclear safety prudently

Lessons learned (cont'd)

- To maintain or restore core cooling, containment and SFP cooling capability, Robustness of design under the circumstance of B-DBE should be re-evaluated
  - reliability of offsite power
  - reliability of emergency AC power
  - reliability of ultimate heat sink

Lessons learned (cont'd)

- To enhance Crisis management capability, effectiveness of SAM should be reviewed ;
  - SAM procedure and operational aids
    * instrumentation and tool for SAM
    * tracking of plant behavior
    * simulation of plant behavior
  - decision making and command & control
  - training and exercise on SAM

Lessons learned (cont'd)

- To improve Communication/transparency, methodology (tool and procedure) should be reviewed ;
  - Information for local residents
  - Information for general public
  - Information sharing with international community
  - Communication between MCR,TSC and EOF

Toward the Future

- World energy demand increase would be inevitable.
- For sustainable future, we have to challenge to realize low carbon society.
- Nuclear power have played an important role for energy supply assurance and reduction of CO2 emission.
- There is no silver bullet to realize low carbon society, but there would be no solution without nuclear.

Toward the Future (cont'd)

- For the responsible development of nuclear power, it is crucial to share the lessons learned from Fukushima accident as agreed in G8 summit
  - Enhancement of nuclear safety
  - Reassurance of public confidence
  - Strengthen international cooperation
  - Enhancement of nuclear security

International Cooperation

The Conventions after Chernobyl accident should be re-evaluated ;

- My proposal is to establish the regional International Nuclear Emergency Response Team (INERT) under the guidance of IAEA
- Major function of INERT
  - preparation of tools/equipments/systems for SAM
  - tracking/simulation of plant behavior
  - radiation monitoring/exposure prediction

Thank you for your attention

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Acronym List

- AC - alternating current
- AM - accident management
- B-DBE - beyond design basis event
- EOF - emergency offsite facility
- MCR - main control room
- METI – Ministry of Economy, Trade and Industry
- SAM - severe accident management
- SBO - station blackout
- SFP - spent fuel pool
- TSC - technical support center
- UHS – ultimate heat sink