Tohoku Pacific Earthquake and the seismic damage to the NPSs

As of 19:30 March 24th, 2011 (JST)
Ministry of Economy, Trade and industry

Earthquake and automatic shut-down of nuclear reactors

The Tohoku Pacific Earthquake of historic magnitude 9.0 struck the northeastern part of Japan at 14:46 on March 11th, 2011.

At the time of the earthquake occurrence, 3 reactors (Units 4, 5 and 6 at Fukushima Dai-ichi (I) Nuclear Power Station of Tokyo Electric Power Co. Inc.(TEPCO)) were under periodic inspection outage, and 11 reactors (Units 1, 2 and 3 at Onagawa Nuclear Power Station of Tohoku Electric Power Co. Ltd.; Units 1, 2 and 3 at Fukushima Dai-ichi (I) Nuclear Power Station of TEPCO; Units 1, 2, 3 and 4 of Fukushima-Dai-ni (II) Nuclear Power Station of TEPCO; and an unit of Tokai Dai-ni (II) Nuclear Power Station of Japan Atomic Power Co. Ltd.) were automatically shut-down.

After the automatic shut-down, Units 1, 2 and 3 at Onagawa, Unit 3 at Fukushima II, and the Unit at Tokai II have been cold shut down safely. As for the Units 1, 2 and 4 at Fukushima II, TEPCO operator of the station reported the nuclear emergency situation to Nuclear and Industrial Safety Agency (NISA), but afterward the three units have been cold shut down.
Tsunami damaged the cooling systems at the Fukushima Dai-ichi (I)

Since the external power supply was cut off upon the earthquake occurrence at 14:46 on March 11th, the emergency diesel power generators at Fukushima I automatically started generating electricity and the cooling systems began their operation. Then, the massive earthquake triggered the devastating Tsunami wiping away houses, buildings, cars along the widespread areas of the northeast coast.

The emergency diesel power generators and the pumps supplying seawater to the cooling system were halted at 15:41 due to the Tsunami estimated more than 10 meters high from the seawater level. Fukushima I lost the AC power sources for Unit 1, 2, 3 and 4 and lost function necessary for cooling down the reactor cores(Unit1,2,3) and spent fuel kept in the pools(Unit1,2,3,4) inside reactor buildings. Consequently, the pressure and temperature of reactor cores and the water temperature of spent fuel pools went up.

For counter measures, seawater is being injected into the reactor pressure vessels of Units 1, 2 and 3. At the same time, police, fire brigade and the Self Defense Force are attempting to pour water into the spent fuel pool of Unit 3 and Unit 4 by spraying seawater from helicopters, water cannon trucks and fire engine. Further, TEPCO engineers are working to restore external power supply by installing the electricity cable connecting to the transmission line of Tohoku Electric Power Co. Ltd. and other transmission route.

Report concerning incidents at the Fukushima Dai-ichi (I)

Unit 1  Seawater is being injected into the reactor pressure vessel as of 19:30 March 24th.

- After the reactor was automatically shut-down and the Tsunami disabled the equipments, the temperature of the reactor core went up and the water level inside the pressure vessel dropped and the reaction of cladding metal of fuel and water generated hydrogen. The hydrogen leaked outside of the containment vessel and caused the explosion at the upper-part of a concrete building housing at 15:36 on March 12.

- There is no risk of a hydrogen explosion in the containment vessel because there is no oxygen in it.

- Seawater is being injected into the reactor pressure vessel as of 19:30 March 24th. The amount of injected water to the reactor core was increased by utilizing feedwater
line in addition to the fire extinguish line at 2:33am, and later, it was switched to the feed water line only at 9:00am on March 23rd.

- Lighting in the main control room was recovered at 11:30am on March 24th.

**Unit 2**  
*Seawater is being injected into the reactor pressure vessel as of 19:30 March 24th.*

- After the automatic shut-down of the reactor, the water injection function was sustained, but the reactor water level tended to decrease.

- At 6:10am on March 15th, TEPCO reported that there was an explosion sound at Unit 2. Given the fact that the pressure in the suppression chamber of Unit 2 decreased, it is presumed that there is the possibility of certain damage on the suppression chamber.

- Electric power receiving at the emergency power source transformer from the external transmission line was completed. And the work for laying the electricity cable from the facility to the load side was carried out as of 13:30 on March 19th. The power center of Unit 2 received electricity at 15:46 on Match 20th.

- Seawater is being injected into the reactor pressure vessel as of 19:30 March 24th. Injection of 40 tons and 18 tons of seawater to the spent fuel pool of Unit 2 was carried out from 15:00 till 17:20 March 20th and from 16:07 till 17:01 March 22nd. At 17:00 on March 24th, the temperature in the spent fuel pool was 40 degree centigrade.

- White smoke generated from Unit 2 at 18:22 on March 21st died down and became almost invisible as of 7:11am on March 22nd.

**Unit 3**  
*Seawater is being injected into the reactor pressure vessel as of 19:30 March 24th. Several counter measures are being used to cool down the spent fuel pool of Unit 3.*

- After the automatic shut-down of the reactor, fresh water and subsequently seawater were injected into the reactor pressure vessel through the fire extinguishing system line. However, the pressure in the primary containment vessel rose up unusually and the explosion took place around the reactor building at 11:01am on March 14th.

- At 8:30am on March 16th, white smoke like steam was generated from Unit 3. Because of the possibility that the primary containment vessel of Unit 3 was
damaged, the operators evacuated from the main control room of Unit 3 and 4 at 10:45am on March 16th. Thereafter, the operators returned to the room and restarted the operation for water injection into the reactor pressure vessel at 11:30am on March 16th.

- For counter measures, seawater is being injected into the reactor pressure vessel. At the same time, to pour water into the spent fuel pool, helicopters and water cannon trucks of Self Defense Forces discharge water to Unit 3 from sky and ground. Riot Police and Hyper Rescue Unit of Tokyo Fire Department sprayed water.

- Injection of seawater to the spent fuel pool via the cooling and purification line was carried out from 11:03am till 13:20 March 23rd and from around 5:35am till around 16:05 March 24th.

- The pressure in the primary containment vessel of Unit 3 rose (320 kPa as of 11:00 March 20th). Preparation to relieve the pressure had started. But afterward, judging from the situation, immediate pressure relief was not required, and monitoring of the pressure continues (120 kPa as of 12:15 March 21st and 200kPa as of 18:00 March 24th).

- Works for the recovery of external power supply is being carried out.

- Grayish smoke generated from Unit 3 around 15:55 on March 21st changed to be whitish and seems to be ceasing as of 7:11am March 22nd. At around 16:20 on March 23rd, slightly blackish smoke generated from the reactor building and at around 23:30 on March 23rd and around 4:50am on March 24th, it was reported that the smoke seemed to cease.

- Lighting in the main control room was recovered at 22:43 on March 22nd.

**Unit 1, 2 & 3**

- As a small amount of radioactive material was detected, it was believed that a part of nuclear fuel was damaged.

**Unit 4  Water spray over the spent fuel pool of Unit 4 is continued as of March 24th.**

- The temperature of water in the spent fuel pool went up. At 4:08am on March 14th, the temperature in the spent fuel pool of Unit 4 was 84 degree centigrade.
It was confirmed that a part of wall of the operation floor of the reactor building of Unit 4 was damaged at 6:14am on March 15th. A fire took place at Unit 4 at 9:38am on March 15th, but the fire was extinguished spontaneously as of 11:00am March 15th.

At 5:45am on March 16th, it was reported that a fire occurred at Unit 4; however, no fire was confirmed by TEPCO staff on the ground at 6:15am on March 16th.

There is no fuel in the reactor pressure vessel due to replacement work of a shroud.

Water spray over the spent fuel pool of Unit 4 by Self-Defence Force was started at 9:43am March 20th, and restarted from 18:30 to 19:46 March 20th, and continued from 6:37am till 8:41am March 21st. And water spray using a concrete pump truck was carried out three times (from 17:17 till 20:32 March 22nd, from 10:00am till 13:02 March 23rd and from 14:36 till 17:30 March 24th).

Works for laying the electricity cable to the power center was completed at around 15:00 on March 21st. The power center received electricity as of 10:35am March 22nd.

**Unit 5&6 Unit 5 & 6 is under cold shut down as of March 20th.**

- Fresh water is being injected into reactor pressure vessels and spent fuel pools by make-up water condensate system.

- The temperature of water in the spent fuel pool of Unit 5 and Unit 6 were 49.0 degree centigrade and 28.5 degree centigrade, respectively as of 17:00 March 24th.

- The pump for residual heat removal system (RHR) (C) for Unit 5 (5:00am March 19th) and RHR (B) for Unit 6 (22:14 March 19th) started up and recovered heat removal function.

- Unit 5 was under cold shut down at 14:30 and Unit 6 was under cold shut down at 19:27 on March 20th.

- Unit 5 and Unit 6 received electricity reached to the starting transformer at 19:52 March 20th. The power supply of Unit 5 and Unit 6 was switched from the emergency diesel generator to the external power supply at 11:36am on March 21st and 19:17 on March 22nd.

- The temporary pump of RHR seawater system (RHRS) for Unit 5 was automatically stopped at 17:24 on March 23rd when the power supply was switched
from the temporary to the permanent. Thereafter, repair of the temporary pump of RHRS was completed at 16:14 and cooling was started again at 16:35 on March 24th.

**Common Spent Fuel Pool**

- It was confirmed that the water level of the spent fuel pool was maintained full at after 6:00am March 18th.

- Water injection into the Common Spent Fuel Pool was done from 10:37am till 15:30 on March 21st.

- The power supply was started at 15:37 and cooling was also started at 18:05 on March 24th. As of 18:40 March 24th, the water temperature of the pool was around 73 degree centigrade.

**Current Situation**

- Evacuation as far as 20 kilometers from Fukushima I NPS and 10 kilometers from Fukushima II was almost completed (see the diagram below). The residents in the areas from 20 kilometers to 30 kilometers radius from Fukushima I NPS are directed to stay in-house.

- On March 16th, the Local Emergency Response Headquarter issued “the direction to administer the stable Iodine during evacuation from the evacuation area (20 km radius)” to the Prefecture Governors and the heads of cities, towns and villages.

**Monitoring Data**

1) The data of Monitoring Post out of 20 kilometers zone of Fukushima I NPS is available on the following website:

   [http://www.mext.go.jp/a_menu/saigaijohou/syousai/1303726.htm](http://www.mext.go.jp/a_menu/saigaijohou/syousai/1303726.htm)

2) The real-time radiation data collected via the System for Prediction of Environment Emergency Dose Information (SPEEDI) is available on the following website:

   [http://www.bousai.ne.jp/eng/](http://www.bousai.ne.jp/eng/)
Outline of the Fukushima I Nuclear Power Station

(Fukushima Dai-ichi nuclear power station)

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(Structure of BWR)
Location of Fukushima I and II in Japan

- Fukushima I
- Fukushima II
- Tokyo
- 20Km from Fukushima I
- 10Km from Fukushima II