

Information on the earthquake in Japan on 11 March 2011

Compilation by GRS

as at: 18 March 2011, 12:30 h (CET)

All times local time unless otherwise indicated (CET = local time minus 8 hours)

Updated compilation of information

Changes compared with the previous state in Chapter 2 are given in Section 1. The accident sequence so far can be found in Chapter 2. A short description in tabular form of the safety-related situation can be found in Chapter 4. This also includes further specifications and supplementations of events and conditions reported over the past couple of days.

1 Changes compared with the previous state

1.1 Fukushima Daiichi

According to TEPCO, the emergency power supply to Units 5 and 6 has been re-established. All efforts are directed at ensuring cooling of the fuel pools of Units 3 and 4.

1.1.1 Unit 1

According to information by NISA of 18-03-2011, 6:00 h, the injection of sea water into the reactor pressure vessel via the fire extinguishing system is being continued.

Pressure in the reactor pressure vessel has risen:

Measuring location 1:

17-03-2011, 12:00 h: 0.173 MPa

18-03-2011, 2:50 h: 0.265 MPa

Measuring location 2:

17-03-2011, 12:00 h: 0.144 MPa

18-03-2011, 2:50 h: 0.243 MPa

During the same period, the water level in the reactor has risen from von -1800 mm to -1700mm.

INES classification by the authority

The INES classification was revised upwards to INES 5 on 18-03-2011.

1.1.2 Unit 2

According to information by NISA of 18-03-2011, 6:00 h, the injection of sea water into the reactor pressure vessel via the fire extinguishing system is being continued. There is white steam rising from the reactor building.

Pressure in the reactor pressure vessel has risen:

Measuring location 1:

17-03-2011, 12:00 h: 0.029 MPa

18-03-2011, 2:50 h: 0.085 MPa

Measuring location 2:

17-03-2011, 12:00 h: 0.047 MPa

18-03-2011, 2:50 h: 0.069 MPa

During the same period, the water level in the reactor has risen from von -1800 mm to -1400mm.

INES classification by the authority

The event in Unit 2 had been provisionally classified by the authority as INES 3 on 12-03-2011. The classification was revised upwards to INES 5 on 18-03-2011.

1.1.3 Unit 3

NHK reported on 17-03-2011 that according to NISA, 30 t of water had been added to the fuel pool by the military water cannon.

According to information by NISA of 18-03-2011, 6:00 h, the injection of sea water into the reactor pressure vessel via the fire extinguishing system is being continued.

INES classification by the authority

The event in Unit 3 was classified by the authority on 18-03-2011 as INES 5.

1.1.4 Unit 4

INES classification by the authority

The event in Unit 4 was classified by the authority on 18-03-2011 as INES 3.

1.1.5 Units 5 and 6

On 17-03-2011, 17:30 h, NISA said that in the meantime an emergency diesel generator in Unit was supplying the electricity for injecting water into the fuel pools of Units 5 and 6. Water injection is carried out by the condensate purification system. Once the external grid connection has been re-established, injection into the RPV is to be resumed.

1.1.6 Interim storage facility at the Fukushima Daiichi site

As at 18-03-2011, 6:00 h CET, NISA states that the interim storage pool is completely filled with water. TEPCO confirms on 18-03-2011, 10:00 h that the water level in the interim storage pool is ensured. The interim storage pool is yet to be closely inspected.

The dry-storage facility was subjected to a visual inspection on 17-03-2011. This revealed no deviations from normal conditions. An inspection of the dry-storage facility is being prepared.

1.2 Fukushima Daini

INES classification by the authority

The event in Unit 1 was classified on 12-03-2011 as INES 3.

The event in Unit 2 was classified on 18-03-2011 as INES 3.

The event in Unit 4 was classified by the authority on 18-03-2011 as INES 3.

1.3 Onagawa 1-3 and Tokai

No changes in these units.

1.4 Radiological situation

According to the operator, on 17-03-2011 at around 10:00 h, local dose rates of 400 mSv/h were measured on the landward side of Unit 3 and 100 mSv/h on the landward side of Unit 4.

In a press release on 18-03-2011, the operator confirmed that radioactive materials (e.g. iodine) had been measured within the plant premises and that the measured activity levels were exceeding natural background radiation levels with time.

An updated version of the illustration showing the local dose rates at the Fukushima Daiichi site can be found at the end of this report.

2 Summary of the plant situation so far

On 11-03-2011 at 14:46h (6:46 CET), an earthquake struck Japan. This earthquake and the subsequent tsunami also affected the nuclear power plant sites Fukushima I (Daiichi), Fukushima II (Daini), Onagawa and Tokai.

2.1 Fukushima Daiichi

At this site, Units 1-3 were in power operation mode at the time of the onset of the accident. Units 4-6 were shut down when the event set in. At the site, the emergency diesel generators failed as a consequence of the tsunami. Mobile emergency diesel generators were taken to the plant.

Due to the high levels of radiation, the plant was evacuated completely on 16-03-2011 at 10:45 h (2:45 h CET). It is only entered to carry out important measures or record measurements (government press conference at 12:00 h (4:00 h CET)). The local dose rate at the main gate lies within a range of 2.5 – 6.5 mSv/h. In the meantime, part of the personnel have returned as radiation levels have fallen.

NISA reports that TEPCO wants to establish electricity supplies from power lines in the vicinity. Power to these lines is provided by Tohoku Electric Power. A corresponding connection was to be established by the afternoon of 17-03-2011. The exact status of the re-establishment of the electricity supply is presently not known. According to NHK it is intended to repair the auxiliary service water pumps. According to TEPCO (quoted by ASAHI), however, it is not yet guaranteed that the emergency cooling system will work again when the electricity supply is re-established.

2.1.1 Unit 1

According to media information, pressure inside the containment of Unit 1 rose during the course of 12-03-2011. Filtered containment venting was carried out as from 14:30 h on 12-03-2011. A hydrogen explosion occurred inside the reactor building, but outside the containment, at 15:36 h on 12-03-2011. Borated sea water was pumped into the reactor pressure vessel (it remains unclear whether the containment was flooded as well). Injection was begun on 12-03-2011 at 20:20 h.

On 13-03-2011 at 11:13 h, the Kyodo news agency reported that the authority suspected a leak in Unit 1. Government spokesman Edano said that there may have been a core meltdown. According to TBS (Japanese TV station), approx. 70 % of the fuel assemblies are damaged. According to IAEA information, electricity supply by mobile generators is ensured. There followed an injection of sea water.

According to information of 16-03-2011, the number of damaged fuel assemblies is said to have risen from 43% to 70% (source: German Federal Foreign Office).

According to information of 16-03-2011, the fuel rods inside the reactor pressure vessel are uncovered along 1.8 metres of their length (17:00 h).

According to TEPCO, a fire engine with a pump has been deployed for cooling the reactor. (16-3-2011, no time given). According to information by NISA of 18-03-2011, 6:00 h, the injection of sea water into the reactor pressure vessel via the fire extinguishing system is being continued.

Pressure in the reactor pressure vessel has risen:

Measuring location 1:

17-03-2011, 12:00 h: 0.173 MPa

18-03-2011, 2:50 h: 0.265 MPa

Measuring location 2:

17-03-2011, 12:00 h: 0.144 MPa

18-03-2011, 2:50 h: 0.243 MPa

During the same period, the water level in the reactor has risen from von -1800 mm to -1700mm.

According to JAIF (Japan Atomic Industrial Forum), as at 9:00 h on 17-03-2011, there is no information about the integrity of the fuel assemblies in the fuel pool of Unit 1.

INES classification by the authority

Due to the release to the outside of the plant, on 12-03-2011 the authority provisionally classified the event in Unit 1 as INES 4. This INES classification was revised upwards to INES 5 on 18-03-2011.

2.1.2 Unit 2

The coolant level in the reactor pressure vessel of Unit 2 was below the normal level until 14-03-2011. Initially, it did not drop any further. Injection was by means of an emergency cooling system. It was reported by NISA that on 13-03-2011 at 11:55 local

time, the electrical power supply was secured (according to the IAEA via mobile generators) and that injection into the reactor was maintained.

On 14-03-2011 at 13:25 h, cooling in Unit 2 failed. For some time, cooling was re-established with sea water. The fuel assemblies were temporarily not covered by water. On 14-03-2011 at about 20:00 h, containment pressure rose to approx. 4.15 bar (corresponds to about design pressure). At 20:37 h, containment venting was begun. According to TEPCO an opening was made in the reactor building to prevent an explosion of the hydrogen in the reactor building.

On 15-3-2011 at 06:20 h, an explosion occurred in Unit 2. According to the IAEA, up to 400 mSv/h were measured on the plant premises. JAIF reports 30 mSv/h between Units 2 and 3, 400 mSv/h next to Unit 3 and 100 mSv/h next to Unit 4. According to press reports, the assumption – based on the fact that containment pressure is falling - is that the pressure suppression pool is damaged.

According to Kyodo, TEPCO says that approx. 33% of the fuel assemblies are damaged. NISA assumes that the high levels of radiation measured since approx. 10:00 h originate from Unit 2. However, it may also be that there is a link between the high radiation levels and the vapour plume emanating from Unit 3.

According to TBS (TV station), pressure levels inside the containment and the reactor pressure vessel are falling. The water level is said to be constant despite injection.

The fuel rods inside the reactor pressure vessel are uncovered along approx. 1.4 metres of their length.

According to JAIF (Japan Atomic Industrial Forum), as at 9:00 h on 17-03-2011, there is no information about the integrity of the fuel assemblies in the fuel pool of Unit 2.

According to information by NISA of 18-03-2011, 6:00 h, the injection of sea water into the reactor pressure vessel via the fire extinguishing system is being continued. There is white steam rising from the reactor building.

Pressure in the reactor pressure vessel has risen:

Measuring location 1:

17-03-2011, 12:00 h: 0.029 MPa

18-03-2011, 2:50 h: 0.085 MPa

Measuring location 2:

17-03-2011, 12:00 h: 0.047 MPa

18-03-2011, 2:50 h: 0.069 MPa

During the same period, the water level in the reactor has risen from -1800 mm to -1400mm.

INES classification by the authority

The event in Unit 2 had been provisionally classified by the authority as INES 3 on 12-03-2011. The classification was revised upwards to INES 5 on 18-03-2011.

2.1.3 Unit 3

In Unit 3, the emergency cooling system failed on 13-03-2011 at around 5:30 h. There followed a depressurisation of the reactor pressure vessel, and borated water was pumped into the reactor from 13:12 h onwards on 13-03-2011. Sea water was injected with the help of fire extinguishing pumps. Containment venting was carried out.

On 14-03-2011 at 11:00 a hydrogen explosion occurred in Unit 3. According to IAEA information, the containment was not damaged. According to TEPCO, containment pressure is stable.

According to NHK, a plume of vapour is said to have been visible above Unit 3 since 8:30 h on 16-03-2011. According to NISA, it is assumed that the containment is damaged.

It was tried on 16-03-2011 to pour water from a helicopter into the fuel pool. This measure was abandoned without success due to the high activity levels in the surroundings. On 16-03-2011, the fuel rods inside the reactor pressure vessel are uncovered along approx. 2.30 metres of their length.

According to information given by JAIF on 16-03-11 at 19:00 h CET, water is presumably evaporating from the fuel pool.

As containment damage is assumed, the personnel from the common main control room of Units 3 and 4 was evacuated on 16-03-2011 at 10:45 h. At 11:30 h, the operating personnel returned to resume the injection of water. (source: NISA)

According to JAIF (Japan Atomic Industrial Forum), as at 9:00 h on 17-03-2011, the water level in the fuel pool of Unit 3 is low.

TV images on 17-03-2011 from 9:48 h show water being dumped from helicopters on four occasions within about 20 minutes. This was later confirmed by the Japanese government spokesman and by NISA. According to the Japanese police authority, 44 t of water were dumped from helicopters.

According to NHK it was reported that the filling of the fuel pool with police water cannon was not successful. The mission was abandoned due to the high radiation exposure. The water level in the fuel pool is dropping (TEPCO at 18:00 h). Since 19:35 h (according to NHK), the military has begun to fill water into the fuel pool by means of five water cannon. NHK reported on 17-03-2011 that according to NISA, 30 t of water had been added to the fuel pool by the military water cannon.

According to information by NISA of 18-03-2011, 6:00 h, the injection of sea water into the reactor pressure vessel via the fire extinguishing system is being continued.

INES classification by the authority

The event in Unit 3 was classified by the authority on 18-03-2011 as INES 5.

2.1.4 Block 4

In Unit 4, there were a fire and an explosion in the reactor building in the area of the fuel pool on 15-03-2011 at around 6:00 h. The IAEA confirmed that the fire was extinguished at about 11:14 h. The fire/explosion created two holes in the reactor building, both approx. 8 m² wide. Press reports say that it has so far not been possible to refill the pool. Attempts are made to pour water into the fuel pool by means of a helicopter or fire engines.

According to TEPCO (as reported in media reports) and NISA, another fire broke out in the area of the fuel pool at about 5:45 h (16-03-2011). In this connection, the roof of the

reactor building was also severely damaged. The TV station NHK reported that following attempts to extinguish the fire, no flames were visible any more. Media reports say that two workers have been missing since the fire broke out.

Kyodo Breaking News reported at 8:45 h local time that spraying with boric acid is to prevent criticality (presumably in the fuel pool).

On a photo of Unit 4 published by TEPCO, a hole in the outer wall of the reactor building is visible, measuring approx. 8 m². The outer shell of the reactor building facing Unit 3 is damaged severely, also near the ground. The roof of the reactor building is damaged.

There are furthermore reports saying that the reactor core had been completely unloaded into the fuel pool during the refuelling outage. There are thus no fuel assemblies inside the RPV.



Photo of the Fukushima Daiichi plant, Units 1-4 (from right to left) of 16-03-2011

The fuel assemblies in the fuel pool are presumably damaged. According to JAIF (12:30 h), the reactor building is also damaged. The fuel pool is to be injected with the help of fire fighting equipment (fire engine).

According to media information of 16-03-11, 19:00 h CET, the water in the fuel pool is boiling. A police water cannon has arrived at the site but cannot be used yet as rubble first has to be cleared.

Water injection was stopped on 16-03-2011 at 14:00 h (NISA). At this point in time, the IAEA gives no details about the water temperature in the fuel pool (last information had been on 15-03-2011 at 19:00 h).

Data by IAEA on water temperature in the fuel pool (normal levels below 25 °C):

14-03-2011, 19:08 h: 84 °C

15-03-2011, 19:00 h: 84 °C

16-03-2011, 14:00 h: no data

According to JAIF (Japan Atomic Industrial Forum), as at 9:00 h on 17-03-2011, the water level in the fuel pool of Unit 4 is low. According to Jiji, TEPCO reports at 18:00 h that the fuel assemblies in the fuel pool are partly covered by water.

INES classification by the authority

The event in Unit 4 was classified by the authority on 18-03-2011 as INES 3.

2.1.5 Units 5 and 6

The IAEA reports about Unit 5 that on 15-03-2011 at 21:00 h (13:00 h CET), the water level in the fuel pool has dropped to 201 cm above the fuel assemblies. This was a drop of 40 cm since 16:00 h (8:00 h CET). It is planned to use an available emergency diesel generator from Unit 6 for water injection.

According to JAIF (8:00 h, 16-3-2011), the water level in the fuel pools of both units is sinking. At 14:00 h, TEPCO reports a fuel pool temperature of approx. 60 °C in both units. The fuel pool temperature is rising.

Further sources say on 16-03-2011 that venting of the reactor building is under preparation to prevent a hydrogen explosion.

On 17-03-2011, 17:30 h, NISA said that in the meantime an emergency diesel generator in Unit was supplying the electricity for injecting water into the fuel pools of Units 5 and 6. Water injection is carried out by the condensate purification system. Once the external grid connection has been re-established, injection into the RPV is to be resumed.

Data by IAEA on water temperature in the fuel pool of Unit 5 (normal levels below 25 °C):

14-03-2011, 19:08 h: 59.7 °C

15-03-2011, 19:00 h: 60.4 °C

16-03-2011, 14:00 h: 62.7 °C

17-03-2011, 3:00 h: 64.2°C

17-03-2011, 18:00 h: 65.5°C

Data by IAEA on water temperature in the fuel pool of Unit 6 (normal levels below 25 °C):

14-03-2011, 19:08 h: 58.0 °C

15-03-2011, 19:00 h: 58.5 °C

16-03-2011, 14:00 h: 60.0 °C

17-03-2011, 3:00 h: 62.5°C

17-03-2011, 18:00 h: 62.0°C

2.1.6 Interim storage facility at the Fukushima Daiichi site

IRSN (Institut de Radioprotection et the Sûreté Nucléaire) estimates that there are approx. 6000 fuel assemblies in the interim storage facility pool. The radioactive material of these fuel assemblies there has been decaying for longer that that of the fuel assemblies in the fuel pools of the 6 units and therefore produce less decay heat. There is no in-formation available about the cooling status.

As at 18-03-2011, 6:00 h CET, NISA states that the interim storage pool is completely filled with water. TEPCO confirms on 18-03-2011, 10:00 h that the water level in the interim storage pool is ensured. The interim storage pool is yet to be closely inspected.

The dry-storage facility was subjected to a visual inspection on 17-03-2011. This revealed no deviations from normal conditions. An inspection of the dry-storage facility is being prepared.

2.2 Fukushima Daini

A small fire in the auxiliary building of Unit 1 was extinguished within 2 hours (source: European Clearinghouse).

Initially, residual-heat removal from the pressure suppression pools of Units 1, 2 and 4 was not possible. In Units 1, 2 and 4, the pressure suppression pool temperature of 100°C was exceeded. There is no such information about Unit 3. There are reports that Unit 3 reached a cold subcritical condition on 12-03-2011.

Coolant levels in the reactor pressure vessels of the four units did not drop. Electricity supply from an external grid is available in these units.

According to TEPCO, containment venting was being prepared for all 4 units. It was, however, not carried out.

Following repairs of the auxiliary service water pumps that had been inundated by sea water, all units reached cold subcritical conditions on 14-3-2011.

According to information by the operator, the residual-heat removal system was turned off for approx. 1 hour on 15-03-2011. It was subsequently made operational again.

INES classification by the authority

The event in Unit 1 was classified on 12-03-2011 as INES 3.

The event in Unit 2 was classified on 18-03-2011 as INES 3.

The event in Unit 4 was classified by the authority on 18-03-2011 as INES 3.

2.3 Onagawa and Tokai

According to current information, the Onagawa and Tokai sites have no acute safety-related problems. At the Onagawa plant, a fire in the turbine building was detected and extinguished. All three units at Onagawa are in shutdown condition and cold. The plant is currently being inspected.

According to media reports, two diesel generators failed at the Tokai plant, with one diesel generator remaining operable. Of two pumps provided for cooling, one was not available. TEPCO (17-03-2011, 16:00 h) reports that an external grid supply was established on 13-03-2011. Core cooling has been in operation since then.

3 Radiological situation

On 12-03-2011 between 04:00 h and 04:40 h, the operator and the supervisory authority NISA reported an increase of the local dose rate in two locations near the plant gate of Daiichi from background values (approx. 70 nSv/h) to initially more than 10 times this level (approx. 0.9 μ Sv/h at 04:40 h) and to up to about 5 μ Sv/h at approx. 06:30 h. This increase could possibly be related to the beginning of containment venting at that point in time, although there is no corresponding confirmation.

According to further information by NISA, the local dose rate readings in the vicinity of Unit 1 of the Fukushima Daiichi plant increased during the course of containment venting until the explosion in the reactor building at 15:36 h (Japan local time) on 12-03-2011 to about 1000 μ Sv/h. Within approx. three hours after the explosion, the local dose rate readings in the vicinity of the plant dropped to ~70 μ Sv/h. According to TEPCO, the local dose rate increased until 8:00 h on 13-03-2011 to a maximum of 8.5 μ Sv/h. Presumably in connection with the pressure relief of Unit 3, the measured values at the main gate rose between 9:00 h and 9:30 h to up to approx. 280 μ Sv/h. At 10:00 h, the measured values dropped again below 10 μ Sv/h in this measuring location.

According to the authority (quoted by the Kyodo news agency), local dose rates of more than 1200 μ Sv/h were measured again in the vicinity of Unit 1 at 11:13 h on 13-03-2011. At around 14:00 h, TEPCO recorded an increase of the measured values to up to 900 μ Sv/h. After that, the values dropped again to below 100 μ Sv/h. On 15-03-

2011 at 10:20 h, local dose rates of 400000 $\mu\text{Sv/h}$ were measured in the vicinity of Unit 3, 100000 $\mu\text{Sv/h}$ in the vicinity of Unit 4, and 30000 $\mu\text{Sv/h}$ between Units 2 and 3.

NISA has confirmed that caesium-137 and iodine-131 were detected in the vicinity of Unit 1 of the Fukushima Daiichi plant. GRS assumes that radioactive materials were released into the containment and were mainly retained there. The operator, too, confirmed in a press release on 18-03-2011 that radioactive materials (e.g. iodine) had been measured within the plant premises and that the measured activity levels were exceeding natural background radiation levels with time.

On 17-03-2011 at approx. 10:00 h, local dose rate measurements were carried out by a helicopter flying over the plant. At a height of about 300 m above ground (240 m above the roof level of the reactor units), a local dose rate of 4.13 mSv/h was measured; at approx. 100 m height above ground (40 m above roof level), the local dose rate was 87.7 mSv/h. The readings correlate with the hypothesis that the local dose rate is caused by the direct radiation emanating from the uncovered nuclear material. According to up-to-date media information, on 17-03-2011, there were four helicopters flight over the site at a height of less than 100 m above ground. Also on 17-03-2011 at around 10:00 h, the operator said that local dose rates of 400 mSv/h were measured on the landward side of Unit 3 and 100 mSv/h on the landward side of Unit 4.

3.1 Measures taken

Within the evacuation radius of Daiichi (20 km) and of Daini (10 km), a total of 210,000 people have been evacuated.

Within a radius of 30 km around the Daiichi evacuation zone, the population was recommended to stay indoors. According to the IAEA, a no-fly area was established in a radius of 30 km around the plant. Also according to the IAEA, the Japanese coast guard ordered coastal waters to be cleared within a radius of 10 km around Daiichi and 3 km around Daini. According to the latest information, the zones up to 20 km were evacuated; for the wider 30-km zone, the population was instructed to stay indoors.

3.2 Meteorological situation

According to the German Meteorological Service, a flow situation characterised by the passage of a weak low-pressure area with its centre to the southeast of the Japanese coast prevailed during the first half of the day of 15-03-2011, transporting the radioactive materials released with low winds in south-westerly direction along the coast. During the second half of the day, weather stations reported dominating weak circulating winds. During the night from 15-03-2011 to 16-03-2011, the wind freshened from north-easterly direction, so that there is now again a transport of the airborne materials released at the Fukushima site in easterly direction. Measuring data from the Ibaraki prefecture bordering on Fukushima in the south showed prevailing northerly to north-westerly winds until the afternoon of 17-03-2011, with wind speeds of between 3 and 7 m/s. At present, the stations of this region show either weak winds from north-easterly directions or a somewhat stronger flow from south- to south-westerly directions. These observations also confirm reports by the German Meteorological Service. With the temporary change to southerly directions, possible releases from the plant may transitionally be transported into northern parts of the country.

3.3 Radiological situation at the Daiichi and Daini sites

Illustration 1 shows the local dose rate measurements at the Fukushima I (Daiichi) site in different measuring locations for the period between 12-03-2011, 10:00 h and 17-03-2011, 19:10 h. There are, however, no data available for the main gate for the period between 16-03-2011 15:50 h – 17-03-2011 10:50 h; new values are available for 17-03-2011 for the measuring locations at the west gate as well as at the main gate to the north.

The measured values show generally unsteady distributions with values between 60 nSv/h (background radiation) up to about 12000 μ Sv/h. some of the maximum values can be correlated to confirmed measures at the plant (e.g. venting), especially the venting at Unit 2 on 14-03-2011 between 21:20 h and 23:00 h and the fire in the fuel pool in Unit 4 on 15-03-2011. The data relating to the fire affecting the fuel pool show an exponential decrease. This could be caused by short-lived radioactive materials deposited on the ground.

According to information by the operator, the measuring location MP 1 was shifted to the position of MP 2 on 13-03-2010 at around 20:10 h. This is near Unit 1. In this loca-

tion, values between 400 and 500 $\mu\text{Sv/h}$ are measured. Since 14-03-2011, approx. 15:30 h, there have been no data from measuring locations MP3 and MP4. The local dose rates communicated by the authority (NISA) at the time of the explosion in Unit 1 are not contained in the data provided by the operator. On 15-03-2011 after approx. 6:20 h, the values measured at the measuring location at the main gate rise up to a maximum of approx. 12000 $\mu\text{Sv/h}$ at around 09:00 h. This rise is presumably linked to the fire in the fuel pool of Unit 4. The values drop again after 09:00 h. This decrease continues until 18:00 h, when a level of approx. 450 $\mu\text{Sv/h}$ is reached. The data provided by the operator for the measuring location at the main gate show renewed increases around 23:00 h to up to 8000 $\mu\text{Sv/h}$ at 23:00 h (15-03-2011) and around 11:00 h (16-03-2011), with a maximum of 10850 $\mu\text{Sv/h}$ at 12:30. The local dose rate decreases until 16-03-2011 15:50 h; further statements on the development of the local dose rate at the main gate are not possible due to the lack of data until 17-03-2011, 10:50 h. For the two communicated values on 17-03-2011 at 11:00 h and 11:10 h, the local dose rate is about 650 μSv . The dose rate at the new "central building" measuring location was around 3600 $\mu\text{Sv/h}$ in the afternoon of 17-03-2011, the dose rate at the new "west gate" measuring location has fallen to levels of around 260 $\mu\text{Sv/h}$.

At the Daini site, local dose rate measurements are available until 16-03-2011 15:00 h and on 17-03-2011 between 2:00 h and 21:00 h. Here, on 14-03-2011 from 22:00 h onwards, measuring location MP 4 records a rise of up to approx. 920 $\mu\text{Sv/h}$ at 03:10 h and 03:50 h on 15-03-2011, with a subsequent fall to levels of around 10 $\mu\text{Sv/h}$ until 18:00 h. The measured values of this peak between 03:10 h and 03:50 h were later (16-03-2011) revised downwards by the operator to approx. 92 $\mu\text{Sv/h}$.

Since 16-03-2011 at around 02:10 h, a renewed rise has been recorded, with a maximum of 39 $\mu\text{Sv/h}$ at 02:20 h, followed by a fall to 18 $\mu\text{Sv/h}$ at 09:00 h and a renewed maximum of 31 $\mu\text{Sv/h}$ at 11:10 h. The increased values are presumably linked to a transport of radioactive materials from Daiichi. At midday on 18-03-2011, the values lie at 17 $\mu\text{Sv/h}$.

3.4 Radiological situation in the vicinity

There are only individual measured values available in the Fukushima prefecture. According to the "Disaster Provision Main Office", the values measured on the morning of 18-03-2011 are show a maximum of 20 $\mu\text{Sv/h}$. Other values measured at the same

time on the border of the 30-km zone reach up to 170 $\mu\text{Sv/h}$. The majority of the values from the measuring locations lie clearly below these values.

In the neighbouring prefecture of Ibaraki, the national local dose rate measuring network registers increased local dose rate levels between approx. 200 and 900 nSv/h, presumably caused by the radioactive materials that deposited with the emissions on 15-03-2011 and 16-03-2011. The maximum at the Horiguchi Hitachinaka City measuring station (located at approx. 100 km from Fukushima 1) has only been decreasing very slowly over the last 36 hours.

Figure 2 shows a survey of the local dose rate measurements from different prefectures of Honshu island. Outside the provinces already mentioned, current readings are at background level. However, GRS disposes of no data from the Miyagi prefecture, which lies to the north of Fukushima and has been particularly heavily affected by the earthquake.

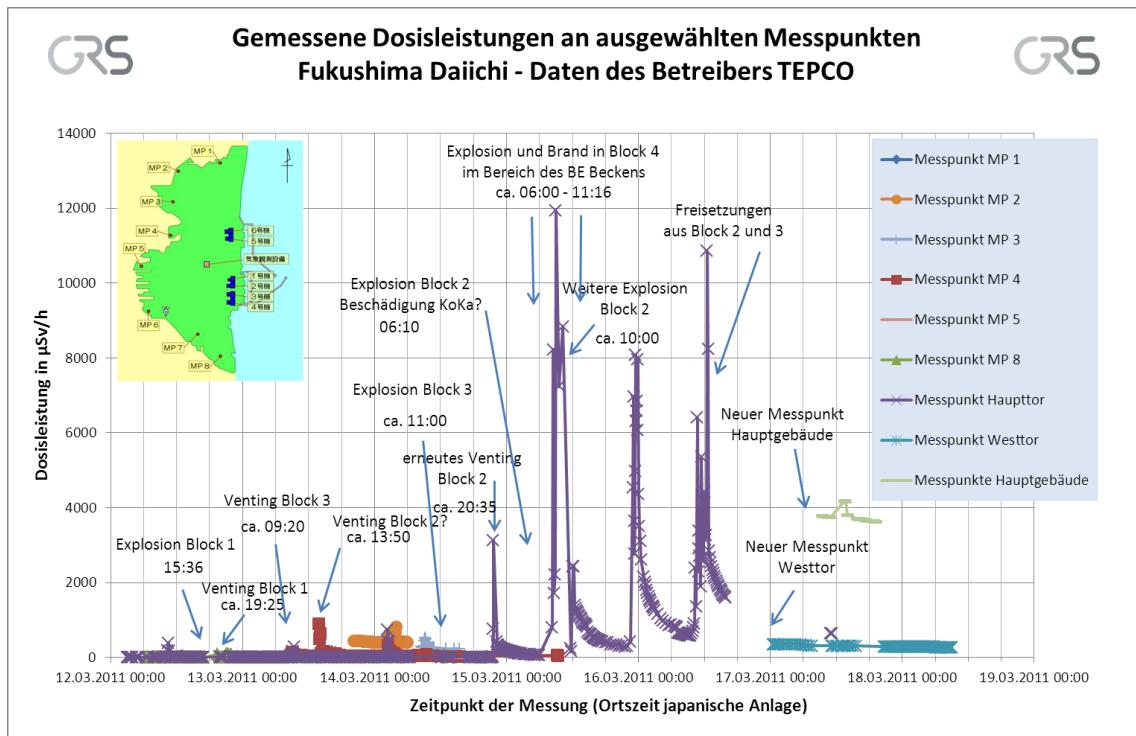


Figure 1

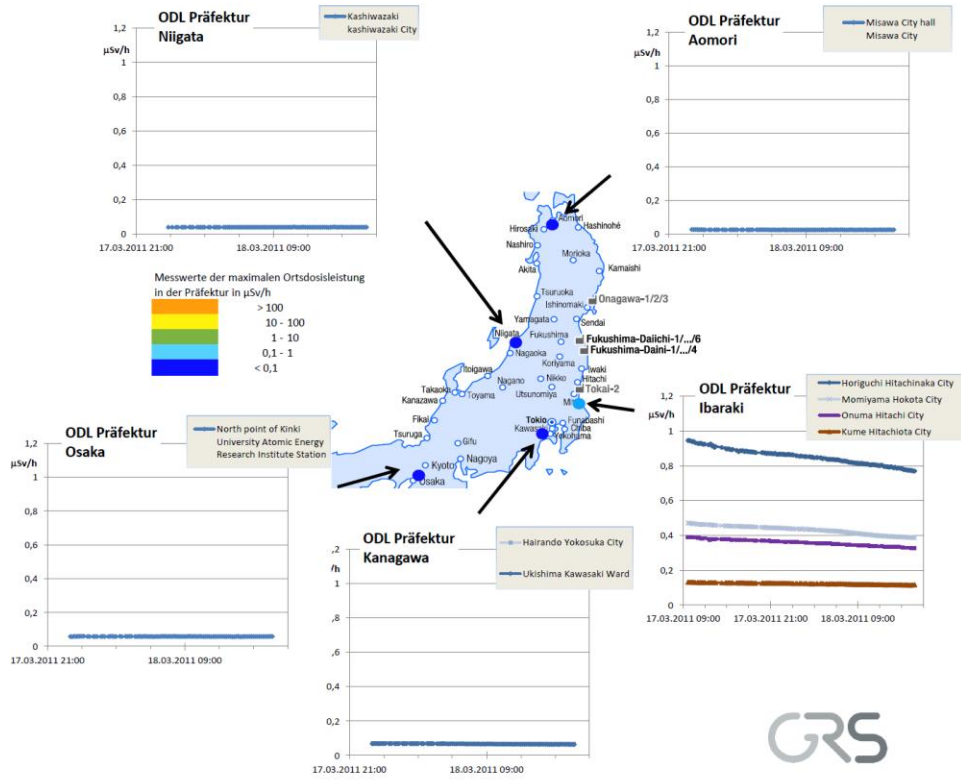


Figure 2

4 Brief overview of the current safety situation

Name	Power	Current status Confirmed: report by operator or NISA – unconfirmed: more detailed press report
Fukushima I (Daiichi 1)	460 MWe, 1380 MW _{therm}	<p>- Condition of core and building structures: Core damage assumed, containment intact. Depressurisation of reactor carried out. Containment venting carried out. Hydrogen explosion on 12-03-2011 at 15:36 h. Severe structural damage to reactor building. According to TBS (Japanese TV station), presumably 70% of fuel assemblies damaged.</p> <p>- Condition of feeding/injection: Electrical power supply via mobile generators. Flooding of reactor with sea water. Sea water injection into containment via pipes of fire water system since 13-03-2011, 11:55 h (temporarily interrupted on 14-03-2011 at 1:10 due to water shortage in the sea water pool).</p> <p>- Important plant parameters (time of measurement always 18-03-2011, 2:50 h): Reactor pressure : 0.265 MPa (measuring location A), 0.243 MPa (measuring location B) Water level in the reactor: 1700 mm below upper core edge (measuring location A, measuring location B below scale) Containment pressure: unknown Pressure suppression pool water temperature and pressure unknown</p> <p>- Information on fuel pool: Internationally available information on estimates and figures relating to the number of fuel assemblies vary between 1+1/3 cores and 292 fuel assemblies (1 core consists of 400 fuel assemblies (source: TEPCO)) No information available on the condition of the fuel assemblies in the fuel pool.</p>
Fukushima I (Daiichi 2)	784 MWe, 2381	- Condition of core and building structures:

	MW_{therm}	<p>Core damage assumed. According to information by NISA, an evaluation by TEPCO on 14-03-2011 at 22:14 h shows core damage to be "less than 5%", according to Kyodo on 15-03-2011, TEPCO reports that approx. 33% of the fuel assemblies are damaged. Containment damaged (pressure suppression pool). Depressurisation of reactor carried out. Containment venting carried out. Hydrogen explosion on 15-03-2011 at 6:20 h. Structural damage to reactor building.</p> <p>- Condition of feeding/injection: Electrical power supply via mobile generators. Sea water injection into containment via pipes of fire water system since 14-03-2011, 22:50 h.</p> <p>- Important plant parameters (time of measurement always 18-03-2011, 2:50 h): Reactor pressure: 0.085 MPa (measuring location A), 0.069 MPa (measuring location B) Water level in the reactor: 1400 mm below upper core edge (measuring location A, measuring location B not available) Containment pressure: 130 kPa Pressure suppression pool water temperature and pressure: unknown Efforts currently underway to establish electricity supply (by 19-03-2011)</p> <p>- Information on fuel pool: Internationally available information on estimates and figures relating to the number of fuel assemblies vary between 1+1/3 cores and 587 fuel assemblies (1 core consists of 584 fuel assemblies (source: TEPCO)) No information available on the condition of the fuel assemblies in the fuel pool.</p>
Fukushima I (Daiichi 3)	784 MWe, 2381 MW_{therm}	<p>- Condition of core and building structures: Core damage assumed. Depressurisation of reactor carried out. Containment venting carried out. Hydrogen explosion on 14-03-2011 at 11:00 h. Severe structural damage to reactor building. Containment presumably damaged. White smoke or vapour visible since 16-03-2011, 11:45 h.</p> <p>- Condition of feeding/injection: Electrical power supply via mobile generators. Flooding with sea water. Freshwater injection into the containment via pipes of fire water system since 13-03-2011, 11:55 h. Since 13:12 h on 13-03-2011, sea water has been injected (temporarily interrupted on 14-03-2011 from 1:10 h until 3:20 h due to water shortage in the sea water</p>

		<p>pool).</p> <p>- Important plant parameters (time of measurement always 17-03-2011, 2:45 h): Reactor pressure: 0.096 MPa (measuring location A), 0.115 MPa (measuring location B) Water level in the reactor: 2000 mm (measuring location A) and 2300 mm (measuring location B), respectively, below upper core edge Containment pressure: 155 kPa Pressure suppression pool water temperature: unknown Pressure suppression pool pressure: below measuring range</p> <p>- Information on fuel pool: Evaporation of water in the fuel pool Low water level on 17-03-2011, 16:00 h (source: JAIF), water dumping from 9:48 h by helicopter and from 19:35 h with military water cannon. According to NHK, NISA states that 30 t of water were sprayed by water cannon into the fuel pool.</p> <p>Internationally available information on estimates and figures relating to the number of fuel assemblies vary between 1+1/3 cores and 514 fuel assemblies (1 core consists of 548 fuel assemblies (source: TEPCO))</p>
<p>Fukushima I (Daiichi 4) shut down before earthquake</p>	<p>784 MWe, 2381 MW_{therm}</p>	<p>Unit was shut down before the earthquake, according to information by ENSI on 30-11-2010. Core had been fully unloaded from the reactor. Hydrogen explosion in the reactor building (fuel pool). Damage to the reactor building (15-03-2011 at 6:40 h) First fire in reactor building on 15-03-2011 at 9:38 h, ending at 11:00 h. Second fire on 15-03-2011 at 5:45 h, no longer visible from the plant premises at 6:15. According to press reports, the pool could not yet be refilled again. Attempts to do so by means of helicopter and fire engines. Roof of reactor building severely damaged.</p> <p>- Information on fuel pool: Temperature on 14-03-2011: 84 °C Low water level on 17-03-2011, 9:00 h (source: JAIF), water injection from 9:48 h (helicopter and water cannon) under preparation. Core damage in fuel pool assumed Internationally available information on estimates and figures relating to the number of fuel assemblies vary between 2+1/3 cores (1279 fuel assemblies) and 514 fuel assemblies (1 core consists of 548 fuel assemblies</p>

		(source: TEPCO))
Fukushima I (Daiichi 5)	784 MWe, 2381 MW _{therm}	<p>Unit was shut down before the earthquake, according to information by ENSI on 03-01-2011. Core in the reactor. Water level in fuel pool sinking, temperature rising</p> <p>- Important plant parameters (measuring time always 18-03-2011, 3:00 h): Reactor pressure: 0.843 MPa Water level in the reactor: 2018 mm above upper core edge Containment pressure: unknown Pressure suppression pool water temperature: unknown Pressure suppression pool pressure: unknown</p> <p>- Information on fuel pool: 17-03-2011 16:00 h temperature rising, temperature on 18-03-2011 at 3:00 h: 65.5 °C Internationally available information on estimates and figures relating to the number of fuel assemblies vary between 2*1/3 cores (365 fuel assemblies) and 826 fuel assemblies (1 core consists of 548 fuel assemblies (source: TEPCO))</p>
Fukushima I (Daiichi 6)	1100 MWe, 3293 MW _{therm}	<p>Unit was shut down before the earthquake, according to information by ENSI on 12-08-2010. Core in the reactor. Water level in fuel pool sinking, temperature rising</p> <p>- Important plant parameters (measuring time always 18-03-2011, 3:00 h): Reactor pressure: 0.632 MPa Water level in the reactor: 1909 mm above upper core edge Containment pressure: unknown Pressure suppression pool water temperature: unknown Pressure suppression pool pressure: unknown</p> <p>- Information on fuel pool: 17-03-2011 16:00 h temperature rising, temperature on 18-03-2011 at 3:00 h: 62.0 °C Internationally available information on estimates and figures relating to the number of fuel assemblies vary between 2*1/3 cores (498 fuel assemblies) and 876 fuel assemblies (1 core consists of 746 fuel assemblies (source: TEPCO))</p>
Fukushima II (Daini 1)	1100 MWe, 3293	No containment venting. External electricity supply, plant state subcritical cold since 14-03-2011. Reactor pressure: 0.09 MPa

	MW _{therm}	<p>Reactor water temperature: 44.5 °C</p> <p>Water level in the reactor: 10.796 m above upper core edge</p> <p>Pressure suppression pool water temperature: 34 °C</p> <p>Pressure suppression pool pressure: 132 kPa</p> <p>(time of each measurement 17-03-2011 17:00 h)</p>
Fukushima II (Daini 2)	1100 MWe, 3293 MW _{therm}	<p>No containment venting. External electricity supply, plant state subcritical cold since 14-03-2011.</p> <p>Reactor pressure: 0.04 MPa</p> <p>Reactor water temperature: 53.0 °C</p> <p>Water level in the reactor: 11.246 m above upper core edge</p> <p>Pressure suppression pool water temperature: 28 °C</p> <p>Pressure suppression pool pressure: 121 kPa</p> <p>(time of each measurement 17-03-2011 17:00 h)</p>
Fukushima II (Daini 3)	1100 MWe, 3293 MW _{therm}	<p>No containment venting. External electricity supply, plant state subcritical cold since 12-03-2011.</p> <p>Reactor pressure: 0.04 MPa</p> <p>Reactor water temperature: 26.8 °C</p> <p>Water level in the reactor: 7.516 m above upper core edge</p> <p>Pressure suppression pool water temperature: 43 °C</p> <p>Pressure suppression pool pressure: 136 kPa</p> <p>(time of each measurement 17-03-2011 17:00 h)</p>
Fukushima II (Daini 4)	1100 MWe, 3293 MW _{therm}	<p>No containment venting. External electricity supply, plant state subcritical cold since 15-03-2011.</p> <p>Reactor pressure: 0.06 MPa</p> <p>Reactor water temperature: 40.6 °C</p> <p>Water level in the reactor: 8.893 m above upper core edge</p> <p>Pressure suppression pool water temperature: 39 °C</p> <p>Pressure suppression pool pressure: 134 kPa</p> <p>(time of each measurement 17-03-2011 17:00 h)</p>
Onagawa 1	524 MWe	<p>According to information on the Japanese homepage of the operator of Onagawa, all 3 units are in shutdown and cold (below 100 °C) condition. The plant is currently being inspected.</p>
Onagawa 2	825 MWe	

Onagawa 3	825 MWe	
Tokai 2	1100 MWe, 3293 MW _{therm}	Press: partial failure of diesel and pump, cooling ensured on 13-03-2011 since re-establishment of external electricity supply

MWe: electrical power, MW_{therm}: thermal power

GRS, kre, sor, sog, mil 18-03-2011, 12:30 h