Annex III of Technical Volume 1

UNIT 3 SEQUENCE OF EVENTS

Colour indication:

Main event	Core Cooling	Power/station auxiliary	Confinement	Reactivity	Emergency Management	Radiation	Other Unit Event

Date and time[1]	Time elapsed after initiating event	Event/action	Auto/manual; local/remote	Set point; criterion/value	Remarks	Time elapsed after SBO
2011-03-11 14:46	00:00 min	Earthquake occurred.			Initiating external event.	- 52:00 min
2011-03-11 14:47	01:00 min	Reactor trip on seismic trip set point.	Auto	100 Gal V 135 Gal H	Sensors B and C (two out of four).	- 51:00 min
2011-03-11 14:47	01:00 min	Turbine trip.	Manual	—	Operators tripped the turbine.	- 51:00 min
2011-03-11 14:48	02:00 min	Loss of off-site power.	—	—	Concurrent event. The earthquake caused damage to the breakers of the switchyards of Units 1 and 2. With respect to the 66 kV TEPCO nuclear line from Tohoku Electric Power, the cables were damaged, although it was not possible to estimate the cause. Concerning Units 3 and 4, in addition to the Okuma No. 3 transmission line under construction, the breakers of Nos 3 and 4 transmission lines on the side of Shin Fukushima Power Substation failed. For Units 5 and 6, one transmission line tower (No. 27 tower) connecting to the switchyards of Units 5 and 6 had collapsed.	- 50:00 min
2011-03-11 14:48	02:00 min	Reactor water level dropped initially because of the collapsing steam voids.	—	~TAF + 4120	Since the reactor water level was within the normal band, the operators did not need to initiate HPCI (HPCI set point was L2, which is <148 cm from the bottom of the separator).	- 50:00 min
2011-03-11 14:48	02:00 min	Reactor pressure dropped initially after trip.	—	~64 bar	—	- 50:00 min
2011-03-11 14:48	02:00 min	Level 3 state of emergency was declared and Emergency Plan was activated.	—	Seismic intensity >6 on Japanese scale	The TEPCO Headquarters and other offices simultaneously declared a Level 3 state of emergency and established the ERC according to the Operation Plan for Disaster Preparation for general disasters and internal rules. Post-Earthquake actions initiated.	- 50:00 min
		Entered into AOP ‘Natural Disaster Accident’, Section IV, ‘Natural Event’.	—	> 45 Gal		
		Earthquake Emergency Response Team activated at the ERC.	—	—		
2011-03-11 14:48	02:00 min	All control rods fully inserted.	Auto	ARI	—	- 50:00 min
2011-03-11 14:48	02:00 min	PCIS generated.	Auto	Low Rx Level L3 (18 cm from bottom of separator).	Or the loss of the reactor protection system power. It is unknown which logic initiated the isolation. (time is approximate).	- 50:00 min
2011-03-11 14:48	02:00 min	MSIVs closed.	Auto	LOOP — Fail close	Reactor isolation from steam/power conversion system (normal core cooling via condenser ceased) due to power interruption.	- 50:00 min
2011-03-11 14:48	02:00 min	Normal HVAC stopped.	Auto	LOOP	PCV cooling ceased.	- 50:00 min
2011-03-11 14:48	02:00 min	SFP cooling and make-up lost.	—	LOOP	The SFPs, which store the used and new fuel assemblies, are filled with water providing radiation shielding and removal of heat from the nuclear fuel located there. However, without cooling, the pool water would heat up and eventually start evaporating. Alternative SFP cooling would have been possible via the residual heat removal system (RHR), which was supplied with power by the EDG. However, switching from RHR cooling to SFP cooling would have required manual actions, which had not taken place before the arrival of the tsunami which affected the RHR components.	- 50:00 min
2011-03-11 14:48	02:00 min	EDGs started and loaded.	Auto	Loss of AC	—	- 50:00 min
2011-03-11 14:48	02:00 min	AC power restored by on-site power source.	Auto	EDG	—	- 50:00 min
2011-03-11 14:48	02:00 min	Entered into AOP ‘Natural Disaster Accident’, Section II, ‘Turbine and Electrical’.	—	LOOP	Chapters 12, 13, and 14 of the Accident Operating Manual with the external system fault.	- 50:00 min
2011-03-11 14:51	05:00 min	Reactor pressure vessel (RPV) pressure begins to increase.	—	—	—	- 47:00 min

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UNIT 3 SEQUENCE OF EVENTS

Colour indication:

Main event	Core Cooling	Power/station auxiliary	Confinement	Reactivity	Emergency Management	Radiation	Other Unit Event

Date and time[1]	Time elapsed after initiating event	Event/action	Auto/manual; local/remote	Set point; criterion/value	Remarks	Time elapsed after SBO
2011-03-11 14:52	06:00 min	Safety relief valve C opened and cycled.	—	75.4 bar	SRV opens at 75.4 bar and close at 72 bar, maintaining the reactor pressure by cycling. The SRV C cycled 54 times between 14:52 and 15:43.	- 46:00 min
2011-03-11 14:54	08:00 min	Reactor confirmed to be subcritical.	—	Intermediate range monitor levels steadily decreasing.	—	- 44:00 min
2011-03-11 15:05	19:00 min	RCIC started,	Manual	—	—	- 33:00 min
2011-03-11 15:06	20:00 min	Headquarters for Major Disaster Countermeasures established.	—	—	In the TEPCO office in Tokyo to assess damage from the earthquake and recover from the electric outage in TEPCO's service area.	- 32:00 min
2011-03-11 15:25	39:00 min	RCIC stopped.	Auto	Water level >L-8 (TAF + 5655)	—	- 13:00 min
2011-03-11 15:27	41:00 min	The first wave of the tsunami arrived at the station.	—	—	Consequent external event .	- 11:00 min
2011-03-11 15:29	43:00 min	High-high alarm issued at some MPs.	—	>430 nGy/h	However, low radiation MPs located in the same place took proper measurements with stable readings at about 40 nGy/h.	- 09:00 min
2011-03-11 15:36	50:00 min	The second wave of tsunami arrived at the station.	—	—	Flooded the site and the buildings (time is approximate).	- 02:00 min
2011-03-11 15:36	50:00 min	High-high alarm at some MPs cleared.	—	—	—	- 02:00 min
2011-03-11 15:38	52:00 min	EDGs tripped.	—	—	The two EDGs and associated M/Cs were in the basement of the T/B, and one M/C was in the basement of the control building. They were all flooded and lost their function.	00:00 min
2011-03-11 15:38	52:00 min	Station blackout (SBO).	—	Loss of all AC	—	00:00 min
2011-03-11 15:42	56:00 min	Emergency for Nuclear Disaster declared based on Article 10 of the Nuclear Disaster Act.	—	SBO	Article 10, Paragraph 1 of the Nuclear Disaster Act. Nuclear Emergency Act Article 10 Notification was issued by the nuclear operator to the Government and local public organizations when the radiation dose of 5 μSv/h or higher, which is higher than normal, was detected in the vicinity of the nuclear site or if some safety systems become unavailable. When the competent Minister (in this case, the Minister of METI) receives an Article 10 notification, the minister then establishes the METI Nuclear Disaster Alert Headquarters, along with the Local Alert Headquarters at the off-site centre. The nuclear disaster preparedness officials and others residing in nuclear plant siting communities coordinated with the nuclear operator and local public organizations to start activities such as collecting information.	04:00 min
2011-03-11 15:42	56:00 min	Corporate Nuclear Emergency Response Centre established.	—	SBO	—	04:00 min
2011-03-11 15:42	56:00 min	Government officials were notified on SBO and Article 10 Declaration of Emergency.	—	SBO	—	04:00 min
2011-03-11 15:50	01 h 04 min	Safety relief valve G opened and cycled.	—	75.4 bar	SRV opens at 75.4 bar and close at 72 bar maintaining the reactor pressure by cycling. It is presumed that firstly SRV C was activated but frequent activation and subsequent loss of operation pressure caused the switch over to valve G, after which the same phenomenon led to the switch over to valve A.	12:00 min
2011-03-11 16:00	01 h 14 min	TEPCO and contractor workers dispatched to assess damage from the earthquake and tsunami.	—	—	Including assessment of off-site power sources and damages to the access routes to the site (approximate time)	22:00 min
2011-03-11 16:02	01 h 16 min	Safety relief valve A opened and cycled.	—	75.4 bar	SRV opened at 75.4 bar and closed at 72 bar, maintaining the reactor pressure by cycling. It is presumed that first the SRV C was activated, but frequent activation and subsequent loss of operation pressure caused the switchover to valve G, after which the same phenomenon led to the switchover to valve A.	24:00 min

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UNIT 3 SEQUENCE OF EVENTS

Colour indication:

Main event	Core Cooling	Power/station auxiliary	Confinement	Reactivity	Emergency Management	Radiation	Other Unit Event

Date and time[1]	Time elapsed after initiating event	Event/action	Auto/manual; local/remote	Set point; criterion/value	Remarks	Time elapsed after SBO
2011-03-11 16:03	01 h 17 min	RCIC started.	Manual	Flow: 75–100% of 25.2 L/s.	Because each start and stop of the RCIC required utilization of DC power, the operators controlled the water injection rate into the RPV by using the test line to avoid repeated starts and stops of the system, and thus preserve the DC power.	25:00 min
2011-03-11 16:03	01 h 17 min	Increasing SC (and DW) temperature.	—	—	As a result of pressure control via cycling of the SRV and the use of the RCIC.	25:00 min
2011-03-11 16:03	01 h 17 min	Operators started load-shedding of equipment to preserve DC power.	—	—	The operators tried to minimize the use of DC power. This included disconnecting lighting and non-essential instrumentation at the MCR. Further, to avoid power consuming valve activations of the RCIC, due to automatic shutdown at high reactor water levels and automatic restart at low water levels, the operations adjusted the RPV water injection rate of the RCIC to keep the reactor water level nearly constant. This was done by suitably distributing the pump discharge flow of the RCIC into the RPV and, via a test line, back into the CST	25:00 min
2011-03-11 16:10	01 h 24 min	TEPCO Headquarters ERC orders all facilities to assemble and account for mobile high/low voltage supply vehicles.	—	—	Transport routes were also ordered to be determined.	32:00 min
2011-03-11 16:30	01 h 44 min	Radiation monitoring vehicles dispatched.	—	—	—	52:00 min
2011-03-11 16:36	01 h 50 min	Emergency for Nuclear Disaster declared for Units 1 and 2 based on Article 15 of the Nuclear Disaster Act.	—	—	Level 2 emergency.	58:00 min
2011-03-11 16:50	02 h 04 min	Mobile high/low voltage supply vehicles were mobilized to Fukushima prefecture	—	—	To the Fukushima Daini and Fukushima Daiichi sites.	01 h 12 min
2011-03-11 17:30	02 h 44 min	Main Gate radiation reading.	—	49 nGy/h	—	01 h 52 min
2011-03-11 17:37	02 h 51 min	Government officials were notified on radiation levels being within normal range in the area surrounding the plant.	—	—	—	01 h 59 min
2011-03-11 17:40	02 h 54 min	Main gate radiation reading.	—	56 nGy/h	—	02 h 02 min
2011-03-11 18:00	03 h 14 min	Field operators dispatched to perform power supply inspection/investigation.	—	—	The shift supervisor decided that the danger due to aftershocks declined sufficiently enough to send teams.	02 h 22 min
2011-03-11 19:00	04 h 14 min	Gate between Units 2 and 3 opened.	—	—	Securing vehicle travel routes to Units 1–4.	03 h 22 min
2011-03-11 19:03	04 h 17 min	Nuclear Emergency declared by the Government.	—	—	—	03 h 25 min
2011-03-11 19:52	05 h 06 min	Radiation monitor data around plant monitoring points.	—	~60 nGy/h	MP location 3, 4 and 6 read around 57-61 nGy/h between 18:30 and 17:30.	04 h 14 min
2011-03-11 20:50	06 h 04 min	2 km zone evacuation order issued.	—	—	Facing a still uncontrolled situation in Fukushima Daiichi, the Governor of Fukushima Prefecture instructed the evacuation of residents within 2 km of the NPP.	05 h 12 min
2011-03-11 20:56	06 h 10 min	Survey team reported that all M/Cs and P/Cs were available.	—	—	—	05 h 18 min
2011-03-11 21:01	06 h 15 min	Government officials informed that Unit 2’s core cooling could not be confirmed.	—	—	Start of work to calculate uncovering of Unit 2 core, as well as preparation of request for local governments to evacuate residents were also communicated.	05 h 23 min
2011-03-11 21:13	06 h 27 min	Time for uncovering of Unit 2 core estimated.	—	~21:40	Assessed based on non-operation of Unit 2 RCIC.	05 h 35 min
2011-03-11 21:23	06 h 37 min	3 km zone evacuation and 3–10 km-zone shelter order issued.	—	—	Order issued by the Prime Minister upon uncovering of Unit 2 core.	05 h 45 min
2011-03-11 21:27	06 h 41 min	Some temporary lights restored in the MCR.	—	—	A small portable electric generator was installed.	05 h 49 min
2011-03-11 22:00	07 h 14 min	First mobile power supply vehicle arrived at site.	—	—	From Tohoku EPC (approximate time). Elapsed time since dispatch: ~5 h.	06 h 22 min
2011-03-11 22:00	07 h 14 min	Reading of DW pressure.	Local manual	~2 bar	Indicated no need for venting.	06 h 22 min

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UNIT 3 SEQUENCE OF EVENTS

Colour indication:

Main event	Core Cooling	Power/station auxiliary	Confinement	Reactivity	Emergency Management	Radiation	Other Unit Event

Date and time[1]	Time elapsed after initiating event	Event/action	Auto/manual; local/remote	Set point; criterion/value	Remarks	Time elapsed after SBO
2011-03-11 22:10	07 h 24 min	Radiation monitor data around plant monitoring points reported to Government.	—	~60 nGy/h	MP location 6 read around 60 nGy/h between 21:30 and 21:50.	06 h 32 min
2011-03-11 23:00	08 h 14 min	High dose rate reading in front of the Unit 1 reactor building north door on the 1st floor of the TB.	Manual	1200 μSv/h	—	07 h 22 min
2011-03-11 23:00	08 h 14 min	High dose rate reading in front of the Unit 1 reactor building south door on the 1st floor of the TB.	Manual	500 μSv/h	—	07 h 22 min
2011-03-11 23:05	08 h 19 min	Entry to the Unit 1 reactor building restricted.	—	High radiation levels	Due to rising radiation levels, ordered by the Site Superintendent.	07 h 27 min
2011-03-11 23:05	08 h 19 min	High dose rate in the Units 1 and 2 MCR.	—	—	—	07 h 27 min
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2011-03-12 00:30	09 h 44 min	3 km zone evacuation completed.	—	—	Government confirmed the completion of evacuation.	08 h 52 min
2011-03-12 01:20	10 h 34 min	Power supply vehicle from TEPCO arrived at the site.	—	—	Approximate time.	09 h 42 min
2011-03-12 01:30	10 h 44 min	The Prime Minister, Minister of METI and NISA informed of plans for Unit 1 and 2 containment venting.	—	—	The Prime Minister, Minister of METI and NISA concurred on the venting plans. The TEPCO corporate ERC told the NPP that the venting of Unit 1 should proceed after 03:00, when the Minister of METI would announce the venting.	09 h 52 min
2011-03-12 01:45	10 h 59 min	Government reconfirms the completion of 3 km zone evacuation.	—	3 km radius	—	10 h 07 min
2011-03-12 03:06	12 h 20 min	Plans to vent Unit 1 and 2 PCV announced to the public.	—	—	A press conference was used to announce the plans. An announcement was made for Units 1 and 2 (it was unclear which unit had priority) venting plans.	11 h 28 min
2011-03-12 03:27	12 h 41 min	Attempt to start DDFP from MCR unsuccessful.	Remote manual	Off	Alternate SC spray via DDFP to control SC and DW pressure increase was planned. After the earthquake, the ‘OFF’ light was on for DDFP in the MCR status display. It could not be activated by MCR operation switches.	11 h 49 min
2011-03-12 04:00	13 h 14 min	Operators sent to reactor building and TB (two teams) to line up an alternate SC spray line from the FP system via the RHR system.	Local manual	—	The MOVs could not be operated from the MCR since there was no power source. (time is approximate) Operators manually opened the five valves, including RHR, during the morning of 12 March.	12 h 22 min
2011-03-12 04:00	13 h 14 min	Main Gate radiation measurement.	—	0.069 μSv/h	—	12 h 22 min
2011-03-12 04:01	13 h 15 min	Government informed on the release and dose consequence predictions from Unit 1 containment venting.	—	—	—	12 h 23 min
2011-03-12 04:23	13 h 37 min	Increased main gate radiation measurement.	—	0.59 μSv/h	—	12 h 45 min
2011-03-12 04:23	13 h 37 min	Evacuation of field workers is ordered.	—		On increased radiation levels (time is approximate).	12 h 45 min
2011-03-12 04:45	13 h 59 min	MCR staff were provided high range APDs.	—	100 mSv APD	—	13 h 07 min
2011-03-12 04:55	14 h 09 min	Government notified that radiation levels were increasing at the site.	—	—	—	13 h 17 min
2011-03-12 04:57	14 h 11 min	Orders to wear full face mask and charcoal respirators for field workers issued.	—	—	ERC issues recommendation on rising site radiation levels and the workers being found to be contaminated when they came back from the field.	13 h 19 min
2011-03-12 05:04	14 h 18 min	Requirements issued to wear full face mask charcoal respirators in MCR.	—	—	Shift managers issued the order to operational personnel.	13 h 26 min
2011-03-12 05:44	14 h 58 min	Government orders evacuation of 10 km zone.	—	10 km radius	—	14 h 06 min
2011-03-12 06:00	15 h 14 min	Additional fire engines from the Japan Self-Defense Forces started arriving at the site.	—	—	Between 06:00–07:00.	14 h 22 min
2011-03-12 06:33	15 h 47 min	Progress of evacuation from Okuma City to Miyakoji was confirmed.	—	—	—	14 h 55 min

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Main event | Core Cooling | Power/station auxiliary | Confinement | Reactivity | Emergency Management | Radiation | Other Unit Event

Date and time[1]	Time elapsed after initiating event	Event/action	Auto/manual; local/remote	Set point; criterion/value	Remarks	Time elapsed after SBO
2011-03-12 06:34	15 h 48 min	2 V DC batteries arrived from Hirono thermal power station.	—	—	—	14 h 56 min
2011-03-12 06:50	16 h 04 min	METI issued the order for Unit 1 and 2 containment venting.	—	—	Venting of both Units 1 and 2 containments was issued in accordance with the Act on Special Measures Concerning Nuclear Emergency Preparedness.	15 h 12 min
2011-03-12 06:50	16 h 04 min	Radiation measurement started within the seismically isolated building.	—	—	Periodic (daily) surveillance of the radiation measurements afterwards.	15 h 12 min
2011-03-12 07:11	16 h 25 min	Prime Minister arrived at the site.	—	—	—	15 h 33 min
2011-03-12 07:20	16 h 34 min	Power restoration work started.	—	—	Parts of the power supply could be restored by utilization of high and low voltage power supply trucks.	15 h 42 min
2011-03-12 08:03	17 h 17 min	Site Superintendent orders Unit 1 venting to start at 09:00.	—	—	—	16 h 25 min
2011-03-12 08:04	17 h 18 min	Prime Minister left the site.	—	—	—	16 h 26 min
2011-03-12 09:03	18 h 17 min	Evacuation of Okuma (south direction of the unit) reported ‘complete’.	—	Complete	Pre-requisite for Unit 1 venting.	17 h 25 min
2011-03-12 09:04	18 h 18 min	Unit 1 venting evolution started.	—	—	—	17 h 26 min
2011-03-12 09:53	19 h 07 min	Government was informed on the dose consequence predictions from containment venting on the operators.	—	—	—	18 h 15 min
2011-03-12 10:40	19 h 54 min	Increased radiation reading at the main gate and MPs.	—	—	Workers assumed that this was probably from venting the Unit 1 PCV.	19 h 02 min
2011-03-12 10:52	20 h 06 min	Total number of mobile power supply vehicles at the site, coming from TEPCO and Tohoku Electric, reached 19.	—	—	12 high voltage power supply cars and 7 low voltage power supply cars.	19 h 14 min
2011-03-12 11:13	20 h 27 min	DDFP started	Auto	—	The DDFP automatically started and operators kept manually shutting it off locally in the FP control panel emergency shutdown button.	19 h 35 min
2011-03-12 11:15	20 h 29 min	Radiation reading at the main gate and MPs started to decrease.	—	—	This indicated that the venting was not fully effective.	19 h 37 min
2011-03-12 11:36	20 h 50 min	Reactor pressure.	—	~7.6 MPa (g)	Chart recorder (time is approximate before RCIC trip).	19 h 58 min
2011-03-12 11:36	20 h 50 min	Reactor water level.	—	TAF + 4000 mm		19 h 58 min
2011-03-12 11:36	20 h 50 min	DDFP tripped.	—	—	—	19 h 58 min
2011-03-12 11:36	20 h 50 min	RCIC tripped.	—	Failure	The operators tried to restart the RCIC several times; however, the efforts were not successful. A physical inspection of the system showed a certain oil leakage of the system as a potential cause for RCIC trip. It is reported recently that the latch for the trip mechanism of the RCIC turbine trip throttle valve had been found detached and the valve closed during inspection.	19 h 58 min
2011-03-12 11:40	20 h 54 min	Attempts to restart RCIC unsuccessful.	—	—	Approximate time.	20 h 02 min
2011-03-12 12:06	21 h 20 min	DDFP started.	Local manual	—	The DDFP automatically started and operators kept manually shutting it off locally in the FP control panel emergency shutdown button.	20 h 28 min
2011-03-12 12:06	21 h 20 min	SC spray started via FP line.	Remote manual	—	Via DDFP.	20 h 28 min
2011-03-12 12:10	21 h 24 min	SC pressure stopped increasing.	—	393 kPa	—	20 h 32 min
2011-03-12 12:10	21 h 24 min	Reactor pressure.	—	7.53 MPa (g)	Approximate time before HPCI start.	20 h 32 min

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Colour indication:

Main event	Core Cooling	Power/station auxiliary	Confinement	Reactivity	Emergency Management	Radiation	Other Unit Event

Date and time[1]	Time elapsed after initiating event	Event/action	Auto/manual; local/remote	Set point; criterion/value	Remarks	Time elapsed after SBO
2011-03-12 12:35	21 h 49 min	HPCI started.	Auto	Reactor water level low signal at 'L-2' (–1220 mm, corresponding to TAF + 2950 mm).	Because each start and stop of the HPCI required utilization of DC-power, the operators controlled the water injection rate into the RPV by using the test line to avoid repeated starts and stops of the system and thus preserve DC power.	20 h 57 min
2011-03-12 12:45	21 h 59 min	Reactor pressure.	—	5.6 MPa (g)	Approximate time after HPCI started.	21 h 07 min
2011-03-12 12:45	21 h 59 min	DW pressure.	—	380 kPa	—	21 h 07 min
2011-03-12 14:30	23 h 44 min	Unit 1 venting commenced.	—	—	—	22 h 52 min
2011-03-12 15:29	01 d 00 h 43 min	Site radiation readings (corrected from 15:50 discovery).	—	1015 µSv/h	Discovered at 16:53 that radiation levels were 1015 µSv/h at 15:29.	23 h 51 min
2011-03-12 15:36	01 d 00 h 50 min	Explosion in Unit 1.	—	—	—	23 h 58 min
2011-03-12 15:49	01 d 01 h 03 min	Worker injury reported to the site ERC.	—	—	Five people (three TEPCO employees and two contractors) had been injured by the Unit 1 explosion while performing injection via fire engine.	01 d 00 h 11 min
2011-03-12 15:54	01 d 01 h 08 min	Evacuation of field workers ordered.	—	—	—	01 d 00 h 16 min
2011-03-12 15:54	01 d 01 h 08 min	Site ERC ordered the evacuation of the staff from two MCRs (Units 1 and 2 and Units 3 and 4), except for the most senior staff.	—	—	The Shift Supervisor, Deputy Shift Supervisor, and the Senior Operator stayed in the MCR to collect data and continue field response under guidance from the ERC (time is approximate).	01 d 00 h 16 min
2011-03-12 16:17	01 d 01 h 31 min	Site radiation readings.	—	569 µSv/h	It was confirmed at 16:17 that radiation levels measured near MP-4 were 569 µSv/h as of 15:31. This situation was deemed to fall under Article 15 of the Nuclear Emergency Act and government agencies were notified (notification was corrected when it was discovered that at 16:53 radiation levels were 1015 µSv/h at 15:29). The RP staff, escorting the evacuees from the field and MCR, reported as high as 10 mSv/h readings on the way to ERC when they arrived to the Seismically Isolated Building.	01 d 00 h 39 min
2011-03-12 16:27	01 d 01 h 41 min	Incident declared according to Nuclear Emergency Act, Article 15 'abnormal site boundary radiation level increase'.	—	>500 µSv/h	Abnormal site boundary radiation level increase. It was discovered at 16:53 that radiation levels were 1015 µSv/h at 15:29.	01 d 00 h 49 min
2011-03-12 17:00	01 d 02 h 14 min	Reactor pressure.	—	2.9 MPa (g)	Approximate time	01 d 01 h 22 min
2011-03-12 17:00	01 d 02 h 14 min	DW pressure.	—	300 kPa	—	01 d 01 h 22 min
2011-03-12 17:20	01 d 02 h 34 min	Dispatch of damage survey teams.	—	—	—	01 d 01 h 42 min
2011-03-12 17:30	01 d 02 h 44 min	Site Superintendent ordered preparations for Unit 2 and Unit 3 PCV venting.	—	—	Although the relatively stable pressure inside the DW meant that venting of Unit 3 was not imminent, the Site Superintendent ordered preparations for the unit PCV venting vessel to be started considering relatively less harsh radiological conditions.	01 d 01 h 52 min
2011-03-12 18:25	01 d 03 h 39 min	Evacuation Zone extended.	—	20 km	—	01 d 02 h 47 min
2011-03-12 19:00	01 d 04 h 14 min	Reactor pressure reading.	—	0.95 MPa	Combined effects of water injection and the steam consumption by the HPCI, the reactor pressure decreased significantly.	01 d 03 h 22 min
2011-03-12 20:36	01 d 05 h 50 min	24 V DC batteries depleted.	—	—	—	01 d 04 h 58 min
2011-03-12 20:36	01 d 05 h 50 min	Reactor water level indicators lost due to DC power loss.	—	—	24 V DC batteries depleted.	01 d 04 h 58 min
2011-03-12 22:00	01 d 07 h 14 min	Reading of DW pressure.	Local manual	~2 bar	—	01 d 06 h 22 min
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2011-03-13 02:30	01 d 11 h 44 min	Reactor pressure reading.	—	0.79 MPa	Below the set point of the automatic isolation of the HPCI.1.	01 d 10 h 52 min

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UNIT 3 SEQUENCE OF EVENTS

Colour indication:

Main event	Core Cooling	Power/station auxiliary	Confinement	Reactivity	Emergency Management	Radiation	Other Unit Event

Date and time[1]	Time elapsed after initiating event	Event/action	Auto/manual; local/remote	Set point; criterion/value	Remarks	Time elapsed after SBO
2011-03-13 02:30	01 d 11 h 44 min	HPCI fails to auto stop.	Auto-fail	Rx pressure <0.8 Mpa	The discharge pressure of the HPCI pump gradually decreased approaching the RPV pressure. Therefore, the operators were concerned about failure of the HPCI turbine.	01 d 10 h 52 min
2011-03-13 02:30	01 d 11 h 44 min	Decision to switch core cooling function from HPCI to DDFP.	—	—	Decision was not reported to the Site Superintendent.	01 d 10 h 52 min
2011-03-13 02:30	01 d 11 h 44 min	Team dispatched to reactor building to switch DDFP line up to RPV injection from SC spray.	—	—	Time is approximate.	01 d 10 h 52 min
2011-03-13 02:42	01 d 11 h 56 min	DDFP line up was changed from SC spray to RPV injection.	—	—	The shift team, in consensus with some members of the ERC, decided to switch the core cooling function from the HPCI to the DDFP, which at this time sprayed the SC.	01 d 11 h 04 min
2011-03-13 02:42	01 d 11 h 56 min	HPCI stopped.	Remote manual	—	Due to the possibility of reactor pressure drop causing a further slowing of HPCI turbine revolution speed, which would increase turbine vibrations and ultimately result in reactor steam release due to equipment damage.	01 d 11 h 04 min
2011-03-13 02:42	01 d 11 h 56 min	Reactor pressure started increasing.	—	—	—	01 d 11 h 04 min
2011-03-13 02:44	01 d 11 h 58 min	Reactor pressure reading.	—	0.58 MPa	Time is approximate.	01 d 11 h 06 min
2011-03-13 02:45	01 d 11 h 59 min	Attempt to open SRV unsuccessful.	Remote manual	—	The SRVs did not open, although the valve status in the MCR displayed them as functional. It is considered that the battery capacity was enough to display the status indicator lamps, but not enough to operate the SRVs.	01 d 11 h 07 min
2011-03-13 03:00	01 d 12 h 14 min	Reactor pressure reading.	—	0.87 MPa	DDFP discharge pressure was lower than the reactor pressure.	01 d 11 h 22 min
2011-03-13 03:05	01 d 12 h 19 min	Attempt to inject water via DDFP unsuccessful.	—	—	The discharge pressure of the DDFP was 7.1 bar, which was lower than the reactor pressure.	01 d 11 h 27 min
2011-03-13 03:35	01 d 12 h 49 min	Attempt to restart HPCI.	Remote manual	Fail	Presumably due to the fading DC power supply, the HPCI could not be restarted. The operation control FIC display light was off.	01 d 11 h 57 min
2011-03-13 03:37	01 d 12 h 51 min	Attempt to restart RCIC.	Remote manual	Fail	Startup of the vacuum pump via the RCIC control panel was unsuccessfully attempted as part of RCIC restart.	01 d 11 h 59 min
2011-03-13 03:37	01 d 12 h 51 min	Team dispatched to HPCI room to local manual start of HPCI.	—	—	After failed attempt from MCR.	01 d 11 h 59 min
2011-03-13 03:38	01 d 12 h 52 min	Attempt to open SRV unsuccessful.	Remote manual	—	The SRVs did not open, although the valve status in the MCR displayed them as being functional. It is considered that the battery capacity was enough to display the status indicator lamps, but not enough to operate SRVs.	01 d 12 h 00 min
2011-03-13 03:39	01 d 12 h 53 min	Operators start load shedding of HPCI equipment to preserve DC power.	Remote manual	—	The HPCI auxiliary oil pump (still operating after HPCI shutdown) was shut down at 03:39. At 04:06, the HPCI condensate pump was also shut down for the same reason.	01 d 12 h 01 min
2011-03-13 03:44	01 d 12 h 58 min	Reactor pressure reading.	—	4.1 MPa	—	01 d 12 h 06 min
2011-03-13 03:51	01 d 13 h 05 min	Reactor water level monitor restored.	—	—	Using batteries from the Hirono Thermal power station.	01 d 12 h 13 min
2011-03-13 03:51	01 d 13 h 05 min	Reactor water level reading.	—	~TAF	—	01 d 12 h 13 min
2011-03-13 04:30	01 d 13 h 44 min	Reactor pressure reading.	—	7.0 MPa	Remained between approximately 7.0–7.3 MPa afterwards.	01 d 12 h 52 min
2011-03-13 04:52	01 d 14 h 06 min	Attempted to open large isolation SC vent AOV unsuccessful.	Local manual	—	No air tank pressure (time is approximate).	01 d 13 h 14 min
2011-03-13 05:08	01 d 14 h 22 min	Started realigning DDFP to SC spray.	Local manual	—	DDFP being unable to inject water to the reactor, to suppress an increase in the containment pressure, the shift team started alternate SC spray via DDFP by manually closing the RHR discharge valve to the core and opening the SC spray valve in the torus room.	01 d 13 h 30 min

[1] Time may be approximate, especially during the first two minutes of the main event, due to data recording frequency, chart recorder scale or delays in the operator reports and logs.

UNIT 3 SEQUENCE OF EVENTS

Colour indication:

Main event | Core Cooling | Power/station auxiliary | Confinement | Reactivity | Emergency Management | Radiation | Other Unit Event

Date and time[1]	Time elapsed after initiating event	Event/action	Auto/manual; local/remote	Set point; criterion/value	Remarks	Time elapsed after SBO
2011-03-13 05:08	01 d 14 h 22 min	Attempted to restart RCIC.	Local manual	Fail	Local manual reactivation attempt of the RCIC was unsuccessful.	01 d 13 h 30 min
2011-03-13 05:10	01 d 14 h 24 min	Emergency for Nuclear Disaster declared based on Article 15 of the Nuclear Disaster Act.	—	Loss of ECCS.	Operators could not determine reactor water level or the status of injection into the reactor. Article 15, paragraph 1 of the Nuclear Disaster Act. If the nuclear disaster conditions degrade and a radiation dose of 500 μSv/h or higher is detected, the nuclear operator issues a Nuclear Emergency Act Article 15 Notification to the government and local public organizations. When the competent Minister receives this notification and recognizes that a nuclear emergency situation has occurred, the Minister reports this to the Prime Minister. The Prime Minister then declares a nuclear emergency situation and establishes the Nuclear Disaster Response Headquarters, with the Prime Minister serving as chief. The Local Nuclear Disaster Response Headquarters is established locally at the off-site centre, with the Senior-Vice Minister or Parliamentary Secretary serving as chief.	01 d 13 h 32 min
2011-03-13 05:10	01 d 14 h 24 min	Entry to the Severe Accident Operating Procedure (at MCR) and to the Accident Management Guidelines (at the ERC).	—	Loss of ECCS/reactor water level determination.	The Emergency Response Centre (ERC) began reviewing the accident management procedures and checking the vent procedures to determine how to open the containment vent valves without power. Workers in the ERC went through the administration building and retrieved drawings and manuals needed to develop the procedure.	01 d 13 h 32 min
2011-03-13 05:15	01 d 14 h 29 min	Site Superintendent ordered completion of vent line up.	—	—	—	01 d 13 h 37 min
2011-03-13 05:21	01 d 14 h 35 min	The fire engines located at the Unit 5–6 complex and an additional fire engine from the Kashiwazaki-Kariwa NPP (which was on standby at the Fukushima Daini NPP) were dispatched.	—	—	—	01 d 13 h 43 min
2011-03-13 05:23	01 d 14 h 37 min	New air tank installation began to open large isolation SC vent valve.	—	—	—	01 d 13 h 45 min
2011-03-13 05:50	01 d 15 h 04 min	Plans to vent Unit3 PCV announced to the public	—	—	—	01 d 14 h 12 min
2011-03-13 06:00	01 d 15 h 14 min	Fire engines from Units 5 and 6 were placed by Unit 3 backwash valve pit.	—	—	—	01 d 14 h 22 min
2011-03-13 06:30	01 d 15 h 44 min	Fire engines from Kashiwazaki-Kariwa NPP arrived at site and placed near Unit 3 backwash valve pit.	—	—	They left the Fukushima Daini NPP at 05:30 (approximately 1 h drive time).	01 d 14 h 52 min
2011-03-13 07:00	01 d 16 h 14 min	Seawater injection line up completed.	—	Standby	However, it was not used since the Site Superintendent, in accordance with ‘directions’ from the TEPCO head office, to continue to inject fresh water not sea water, as long as fresh water was available. As such, the injection line was changed to fresh water.	01 d 15 h 22 min
2011-03-13 07:35	01 d 16 h 49 min	The Government was informed of consequences of, and predictions concerning, containment venting.	—	—	—	01 d 15 h 57 min
2011-03-13 07:43	01 d 16 h 57 min	DDFP line up changed from SC spray to DW spray.	—	—	Directed by the ERC, the shift team operated the relevant valves to switch the DDFP from the SC spray and started DW spray in order to sufficiently decrease DW pressure before depressurization. Operators manually operated valves, switching from the SC spray line to the DW spray line and DW spray started. The SC spray valve was manually closed at 07:43. This provided no further pressurization of DW.	01 d 16 h 05 min
2011-03-13 08:00	01 d 17 h 14 min	Pressure increase in the DW halted with spray actuation.	—	—	Time is approximate. The NPP ERC decided to stop the DW spray and expedite PCV venting line assembly toward early implementation of PCV venting. Operators manually opened the RHR intake valve, manually closed the DW spray valve, and switched to the reactor alternate injection line between 08:40 and 09:10.	01 d 16 h 22 min

[1] Time may be approximate, especially during the first two minutes of the main event, due to data recording frequency, chart recorder scale or delays in the operator reports and logs.

UNIT 3 SEQUENCE OF EVENTS

Colour indication:

Main event	Core Cooling	Power/station auxiliary	Confinement	Reactivity	Emergency Management	Radiation	Other Unit Event

Date and time[1]	Time elapsed after initiating event	Event/action	Auto/manual; local/remote	Set point; criterion/value	Remarks	Time elapsed after SBO
2011-03-13 08:35	01 d 17 h 49 min	Containment vent valve (MOV) partially opened.	Local manual	15%	Operators opened the motor operated containment vent valve approximately 15%. The shift team had some concerns about the PCV buckling under negative pressure. Thus, they opened the valve 15%, instead of 25%, as defined in the procedures and implemented in Units 1 and 2.	01 d 16 h 57 min
2011-03-13 08:41	01 d 17 h 55 min	Large SC AOV opened for venting.	Local manual	100%	As the pressure inside the SC was 3.7 bar, which is well below the disc rupture pressure of 5.28 bar, the venting was set but did not occur. It was reported to the station ERC at 08:41.	01 d 17 h 03 min
2011-03-13 08:41	01 d 17 h 55 min	Batteries were collected to be connected to SRV actuation in the MCR.	—	—	Batteries collected from cars were brought to the MCR and were to be utilized to open SRVs (time is approximate).	01 d 17 h 03 min
2011-03-13 08:56	01 d 18 h 10 min	Site radiation readings.	—	882 µSv/h	MP-4.	01 d 17 h 18 min
2011-03-13 08:56	01 d 18 h 10 min	Incident according to Nuclear Emergency Act Article 15 ‘Abnormal site boundary radiation level increase’ issued.	—	>500 µSv/h	Abnormal increase in the site boundary radiation level.	01 d 17 h 18 min
2011-03-13 09:08	01 d 18 h 22 min	Reactor pressure decreased.	—	—	The exact cause of this pressure drop is unknown. The status indication lamps of two SRVs while the operators were trying to connect batteries to the control panel showed an erratic behaviour.	01 d 17 h 30 min
2011-03-13 09:10	01 d 18 h 24 min	Increased SC pressure.	—	637 kPa	Presumed depressurization via SRV caused surge in SC pressure.	01 d 17 h 32 min
2011-03-13 09:20	01 d 18 h 34 min	Maximum recorded SC pressure.	—	6.3 bar > design pressure of 5.28 bar.	—	01 d 17 h 42 min
2011-03-13 09:20	01 d 18 h 34 min	Drop in SC pressure observed.	—	—	Rapid drop presumed rupture of the disc.	01 d 17 h 42 min
2011-03-13 09:20	01 d 18 h 34 min	Unit 3 PCV venting.	—	—	Upon drop following the maximum SC pressure, the ERC judged that the PCV venting started at 09:20 with the rupture of the disc.	01 d 17 h 42 min
2011-03-13 09:24	01 d 18 h 38 min	Decreased SC pressure.	—	540 kPa	—	01 d 17 h 46 min
2011-03-13 09:25	01 d 18 h 39 min	Borated freshwater injection into the reactor started though the FP line.	—	~2000 m^3/min	Via two fire engines. It is suspected that the backflow might have occurred preventing full flow from reaching the core.	01 d 17 h 47 min
2011-03-13 09:50	01 d 19 h 04 min	Ten 12 V batteries connected to the SRV control panel.	—	—	To perform remote manual RPV depressurization from the MCR, batteries were gathered from the vehicles.	01 d 18 h 12 min
2011-03-13 09:50	01 d 19 h 04 min	SRV opened.	Remote manual	—	—	01 d 18 h 12 min
2011-03-13 10:30	01 d 19 h 44 min	Site Superintendent ordered preparations for seawater injection.	—	—	The fire engines were connected to the FP lines, as the Unit 3 backwash valve pit was the water source.	01 d 18 h 52 min
2011-03-13 11:17	01 d 20 h 31 min	Large isolation SC AOV for venting found closed.	—	Fail	Depleted instrument air in compressed air cylinder. Closure time unknown.	01 d 19 h 39 min
2011-03-13 11:30	01 d 20 h 44 min	Local manual opening attempt of AOV was abandoned, but the regrouped due to high radiation in torus room	—	—	Two teams wearing air-supplies were established with a stay time of 15 min. The first team was to place the air tank near the valve and the second team was to connect and test.	01 d 19 h 52 min
2011-03-13 12:20	01 d 21 h 34 min	Fresh water from the FP tanks at Unit 3 and 4 was depleted.	—	—	—	01 d 20 h 42 min
2011-03-13 12:30	01 d 21 h 44 min	Large SC AOV opened for venting.	Local manual	100%	The AOV was manually opened again with the use of a new compressed air cylinder. Two teams worked between 11:17 and 12:30. Attempts to lock the valve open were unsuccessful.	01 d 20 h 52 min
2011-03-13 13:12	01 d 22 h 26 min	Seawater injection from the backwash valve pit of Unit 3 started.	Manual	—	By the fire engines that were connected to the FP lines, since the Unit 3 backwash valve pit was the water source.	01 d 21 h 34 min
2011-03-13 14:15	01 d 23 h 29 min	Site radiation readings.	—	905 µSv/h	MP-4.	01 d 22 h 37 min
2011-03-13 14:15	01 d 23 h 29 min	Incident based on Nuclear Emergency Act Article 15 ‘Abnormal site boundary radiation level increase’ declared.	—	>500 µSv/h	Government was notified at 14:23.	01 d 22 h 37 min
2011-03-13 14:31	01 d 23 h 45 min	Reactor building north side radiation reading.	—	300 mSv/h	The ERC believed there was a possibility of a hydrogen explosion similar to the one at Unit 1.	01 d 22 h 53 min

[1] Time may be approximate, especially during the first two minutes of the main event, due to data recording frequency, chart recorder scale or delays in the operator reports and logs.

UNIT 3 SEQUENCE OF EVENTS

Colour indication:

Main event	Core Cooling	Power/station auxiliary	Confinement	Reactivity	Emergency Management	Radiation	Other Unit Event

Date and time[1]	Time elapsed after initiating event	Event/action	Auto/manual; local/remote	Set point; criterion/value	Remarks	Time elapsed after SBO
		Reactor building south side radiation reading.	—	100 mSv/h		
2011-03-13 14:45	01 d 23 h 59 min	Temporary evacuation of the MCR and workers in the field.	—	—	ERC expected a hydrogen explosion similar to Unit 1.	01 d 23 h 07 min
2011-03-13 15:28	02 d 00 h 42 min	MCR radiation readings.	—	12 mSv/h	As the dose rates at the Unit 3 side of the MCR exceeded 12 mSv/h, and the shift team moved to the Unit 4 side of the MCR	01 d 23 h 50 min
2011-03-13 17:00	02 d 02 h 14 min	Workers returned to Unit 3 area to resume activities.	—	—	Including activities on the seawater injection line and venting operations.	02 d 01 h 22 min
2011-03-13 17:52	02 d 03 h 06 min	Work to install an air compressor replacing compressed air tanks for instrument air system started.	—	—	—	02 d 02 h 14 min
2011-03-13 19:00	02 d 04 h 14 min	Air compressor replacing compressed air tanks for instrument air system was connected.	—	—	The field operators continued refuelling the compressor every few hours in a highly radioactive field, thus maintaining temporary compressor operation.	02 d 03 h 22 min
2011-03-13 19:00	02 d 04 h 14 min	Large SC AOV was opened for venting.	Local manual	100%	AOV was manually opened again with the use of a new compressed air cylinder (opening was confirmed/judged later at 21:10 since the temporary compressor had low capacity, and it took time to pressurize the entire instrument air line, meaning that signs of DW pressure drop could not be seen for some time).	02 d 03 h 22 min
2011-03-13 20:30	02 d 05 h 44 min	DW pressure reading.	—	425 kPa	—	02 d 04 h 52 min
2011-03-13 20:45	02 d 05 h 59 min	DW pressure reading.	—	410 kPa	—	02 d 05 h 07 min
2011-03-13 21:00	02 d 06 h 14 min	DW pressure reading.	—	395 kPa	—	02 d 05 h 22 min
2011-03-13 21:10	02 d 06 h 24 min	Confirmed that the large SC AOV was opened for venting.	—	Decreasing DW pressure.	After recording decreasing DW pressure.	02 d 05 h 32 min
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2011-03-14 01:00	02 d 10 h 14 min	DW pressure reading.	—	240 kPa	—	02 d 09 h 22 min
2011-03-14 01:10	02 d 10 h 24 min	Water injection to the reactor halted.	—	Low level at backwash valve pit.	All water injection to the Unit 1 and 3 reactors was halted as a result of a low level in the Unit 3 main condenser backwash valve pit.	02 d 09 h 32 min
2011-03-14 01:30	02 d 10 h 44 min	DW pressure reading.	—	255 kPa	DW pressure began increasing after halting water injection.	02 d 09 h 52 min
2011-03-14 01:52	02 d 11 h 06 min	Temporary compressors from Fukushima Daini NPP arrived.	—	—	—	02 d 10 h 14 min
2011-03-14 02:00	02 d 11 h 14 min	DW pressure reading.	—	265 kPa	—	02 d 10 h 22 min
2011-03-14 02:20	02 d 11 h 34 min	Site radiation readings.	—	751 μSv/h	Near main gate.	02 d 10 h 42 min
2011-03-14 02:20	02 d 11 h 34 min	Incident declared according to Nuclear Emergency Act Article 15 ‘Abnormal site boundary radiation level increase’.	—	>500 μSv/h	Government was notified at 04:24.	02 d 10 h 42 min
2011-03-14 02:40	02 d 11 h 54 min	Site radiation readings.	—	650 μSv/h	MP-2.	02 d 11 h 02 min
2011-03-14 02:40	02 d 11 h 54 min	Incident declared according to Nuclear Emergency Act Article 15 ‘Abnormal site boundary radiation level increase’.	—	>500 μSv/h	Government was notified at 05:37.	02 d 11 h 02 min
2011-03-14 03:00	02 d 12 h 14 min	DW pressure reading.	—	315 kPa	—	02 d 11 h 22 min
2011-03-14 03:20	02 d 12 h 34 min	Water injection resumed after lowering the intake hose to the backwash valve pit.	—	—	Priority for water injection given to Unit 3 over other units (i.e. Unit 1).	02 d 11 h 42 min
2011-03-14 04:00	02 d 13 h 14 min	Site radiation readings.	—	820 μSv/h	MP-2.	02 d 12 h 22 min
2011-03-14 04:00	02 d 13 h 14 min	Incident declared according to Nuclear Emergency Act Article 15 ‘Abnormal site boundary radiation level increase’.	—	>500 μSv/h	Government was notified at 08:00.	02 d 12 h 22 min
2011-03-14 05:20	02 d 14 h 34 min	Decision to open the SC vent valve (AO valve) by-pass valve.	—	—	PCV pressure noted to be increasing despite water injection.	02 d 13 h 42 min
2011-03-14 06:10	02 d 15 h 24 min	SC vent valve solenoid is excited.	—	—	—	02 d 14 h 32 min
2011-03-14 06:20	02 d 15 h 34 min	DW pressure reading.	—	470 kPa	PCV pressure noted to be increasing despite water injection for the last three hours.	02 d 14 h 42 min

[1] Time may be approximate, especially during the first two minutes of the main event, due to data recording frequency, chart recorder scale or delays in the operator reports and logs.

UNIT 3 SEQUENCE OF EVENTS

Colour indication:

Main event | Core Cooling | Power/station auxiliary | Confinement | Reactivity | Emergency Management | Radiation | Other Unit Event

Date and time[1]	Time elapsed after initiating event	Event/action	Auto/manual; local/remote	Set point; criterion/value	Remarks	Time elapsed after SBO
2011-03-14 06:20	02 d 15 h 34 min	Reactor water level indication off-scale.	—	Off-scale	Earlier, reactor water level indication continued to decrease, indicating that the injection rate was not sufficient, and went off-scale, possibly indicating uncovering of the core.	02 d 14 h 42 min
2011-03-14 06:30	02 d 15 h 44 min	Site Superintendent ordered temporary evacuation of the workers in the field upon potential uncovering of the core and hydrogen explosion.	—	—	Activities around the Unit 3 backwash valve pit were halted. (time is approximate)	02 d 14 h 52 min
2011-03-14 07:00	02 d 16 h 14 min	Maximum recorded DW pressure.	—	520 kPa	5.2 bar >4.8 bar.	02 d 15 h 22 min
2011-03-14 07:20	02 d 16 h 34 min	DW pressure reading showed decrease.	—	500 kPa	Pressure remained around 5 bar afterwards.	02 d 15 h 42 min
2011-03-14 07:30	02 d 16 h 44 min	Temporary evacuation order lifted, workers returned to Unit 3 backwash valve pit.	—	—	Resuming activities for seawater injection.	02 d 15 h 52 min
2011-03-14 09:05	02 d 18 h 19 min	Filling of Unit 3 main condenser backwash valve pit commenced.	—	—	Two fire engines used to pump the water from the ocean to the valve pit. A water tank truck which came from a TEPCO Chiba branch office fed 1.9 t of water to the backwash valve pit.	02 d 17 h 27 min
2011-03-14 09:12	02 d 18 h 26 min	Site radiation readings.	—	518.7 µSv/h	MP-2.	02 d 17 h 34 min
2011-03-14 09:12	02 d 18 h 26 min	Incident declared according to Nuclear Emergency Act, Article 15 ‘Abnormal site boundary radiation level increase’.	—	>500 µSv/h	Government is notified at 09:34.	02 d 17 h 34 min
2011-03-14 10:00	02 d 19 h 14 min	Seven 5 t Japan Self-Defense Forces water supply vehicles arrived.	—	—	Two of them were sent to the Unit 3 backwash valve pit.	02 d 18 h 22 min
2011-03-14 10:55	02 d 20 h 09 min	DW pressure reading.	—	520 kPa	PCV pressure noted to be increasing despite water injection for the last three hours.	02 d 19 h 17 min
2011-03-14 11:01	02 d 20 h 15 min	Unit 3 backwash valve pit inventory replenished to allow Unit 1 injection to start.	—	—	Injection did not start because of the Unit 3 explosion.	02 d 19 h 23 min
2011-03-14 11:01	02 d 20 h 15 min	Explosion in Unit 3.	—	—	The explosion damaged the seawater injection setup.	02 d 19 h 23 min
2011-03-14 11:01	02 d 20 h 15 min	Unit 3 explosion caused damage to the seawater injection setup.	—	—	Due to scattered debris and high local radiation zones on-site, the Unit 3 backwash valve pit was no longer usable as water source.	02 d 19 h 23 min
2011-03-14 11:01	02 d 20 h 15 min	Seawater injection presumed stopped.	—	—	The Unit 3 explosion stopped seawater injection.	02 d 19 h 23 min
2011-03-14 11:02	02 d 20 h 16 min	Reactor pressure reading.	—	3.91 bar (Ch. A) 3.85 bar (Ch. B)	—	02 d 19 h 24 min
		DW pressure reading.	—	480 kPa		
		SC pressure reading.	—	4.7 bar		
2011-03-14 11:15	02 d 20 h 29 min	Reactor pressure reading.	—	2.95 bar (Ch. A) 3.03 bar (Ch. B)	The Site Superintendent presumed both the reactor and the PCV were sound.	02 d 19 h 37 min
		DW pressure reading.	—	3.8 bar		
		SC pressure reading.	—	3.9 bar		
2011-03-14 13:00	02 d 22 h 14 min	Unit 2 RCIC declared inoperable.	—	—	Increased reactor pressure and decreased water level reading was corroborated as the RCIC failure.	02 d 21 h 22 min
2011-03-14 13:00	02 d 22 h 14 min	Unit 2 Emergency for Nuclear Disaster declared based on Article 15 of the Nuclear Disaster Act.	—	Loss of ECCS	—	02 d 21 h 22 min
2011-03-14 13:05	02 d 22 h 19 min	Seawater injection line work restarted.	—	—	This time directly from the ocean since the damage caused to the fire engines and hoses by the Unit 3 explosion had damaged the previous injection line from the pit beyond repair.	02 d 21 h 27 min
2011-03-14 14:04	02 d 23 h 18 min	ERC informed by TEPCO Headquarters that NISA approved increasing the dose limit for emergency workers.	—	250 mSv	—	02 d 22 h 26 min
2011-03-14 15:30	03 d 00 h 44 min	Seawater injection re-established.	—	—	Though core spray line.	02 d 23 h 52 min
2011-03-14 19:20	03 d 04 h 34 min	Seawater injection stopped.	—	—	Fire truck ran out of fuel.	03 d 03 h 42 min

[1] Time may be approximate, especially during the first two minutes of the main event, due to data recording frequency, chart recorder scale or delays in the operator reports and logs.

UNIT 3 SEQUENCE OF EVENTS

Colour indication:

Main event | Core Cooling | Power/station auxiliary | Confinement | Reactivity | Emergency Management | Radiation | Other Unit Event

Date and time[1]	Time elapsed after initiating event	Event/action	Auto/manual; local/remote	Set point; criterion/value	Remarks	Time elapsed after SBO
2011-03-14 19:54	03 d 05 h 08 min	Seawater injection restarted.	—	—	Fire truck refuelled.	03 d 04 h 16 min
2011-03-14 21:14	03 d 06 h 28 min	Seawater injection stopped.	—	—	The water injection to Unit 3 was halted to ensure Unit 2 water injection	03 d 05 h 36 min
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2011-03-15 02:30	03 d 11 h 44 min	Seawater injection restarted.	—	—	—	03 d 10 h 52 min
2011-03-15 06:14	03 d 15 h 28 min	Explosion was heard at the site and tremors were felt in the MCR.	—	—	Unit 2 SC pressure dropped.	03 d 14 h 36 min
2011-03-15 06:14	03 d 15 h 28 min	Explosion in Unit 4.	—	—	At about the same time as the event associated with Unit 2, an explosion in the upper part of the Unit 4 reactor building was observed by the evacuating personnel and reported to the ERC at 08:20.	03 d 14 h 36 min
2011-03-15 06:30	03 d 15 h 44 min	Unit 2 SC pressure went off-scale, and atmospheric pressure is read.	—	—	Possibility of Unit 2 PCV damage concluded.	03 d 14 h 52 min
2011-03-15 06:30	03 d 15 h 44 min	All plant personnel in the units were ordered to temporarily evacuate to the Seismically Isolated Building.	—	—	Upon the atmospheric (0 bar) Unit 2 SC pressure reading at 06:30, due to the possibility of SC (PCV) damage and failure, all plant personnel in the units were ordered to temporarily evacuate to the Seismically Isolated Building, where the ERC is located.	03 d 14 h 52 min
2011-03-15 06:50	03 d 16 h 04 min	Site radiation readings.	—	583.7 μSv/h	Near the Main Gate.	03 d 15 h 12 min
2011-03-15 07:00	03 d 16 h 14 min	Incident declared according to Nuclear Emergency Act Article 15 ‘Abnormal site boundary radiation level increase’.	—	>500 μSv/h	Abnormal increase in the site boundary radiation level.	03 d 15 h 22 min
2011-03-15 07:00	03 d 16 h 14 min	Site evacuation of non-essential personnel, including temporary evacuation of some ERC personnel, ordered.	—	—	The Site Superintendent ordered the evacuation. Female employees (including A, B) evacuate (thereafter, female employee B works in the Fukushima Daiichi back office located at the Fukushima Daini NPP). Approximately 650 people were evacuated to the Fukushima Daini NPP; 50–70 people, including the Site Superintendent, remained at the Fukushima Daiichi ERC.	03 d 15 h 22 min
2011-03-15 07:20	03 d 16 h 34 min	Steam or white smoke released from 5th floor of Unit 2 reactor building.	—	—	—	03 d 15 h 42 min
2011-03-15 08:11	03 d 17 h 25 min	Site radiation readings.	—	807 μSv/h	Near the Main Gate.	03 d 16 h 33 min
2011-03-15 08:36	03 d 17 h 50 min	Incident declared according to Nuclear Emergency Act Article 15 ‘Abnormal site boundary radiation level increase’.	—	>500 μSv/h	Abnormal increase in the site boundary radiation level.	03 d 16 h 58 min
2011-03-15 09:00	03 d 18 h 14 min	Main Gate radiation reading.	—	11 930 μSv/h	The highest reading after the earthquake.	03 d 17 h 22 min
2011-03-15 11:00	03 d 20 h 14 min	Government issued order for residents to take shelter indoors.	—	20–30 km	—	03 d 19 h 22 min
2011-03-15 16:00	04 d 01 h 14 min	Site radiation readings.	—	531.6 μSv/h	Near the Main Gate.	04 d 00 h 22 min
2011-03-15 16:05	04 d 01 h 19 min	SC vent valve opened.	—	—	The valve was found closed.	04 d 00 h 27 min
2011-03-15 16:22	04 d 01 h 36 min	Incident declared according to Nuclear Emergency Act Article 15 ‘Abnormal site boundary radiation level increase’.	—	>500 μSv/h	Abnormal increase in the site boundary radiation level.	04 d 00 h 44 min
2011-03-15	—	TEPCO nuclear line circuit breaker energized.	—	—	Power via the Tohoku Electric Power Company. Integrity check of the TEPCO nuclear line between the power receiving circuit breaker and M/C was performed on 15 and 16 March.	—
2011-03-15 23:05	04 d 08 h 19 min	Site radiation readings.	—	4548 μSv/h	Near the Main Gate.	04 d 07 h 27 min
2011-03-15 23:20	04 d 08 h 34 min	Incident declared according to Nuclear Emergency Act Article 15 ‘Abnormal site boundary radiation level increase’.	—	>500 μSv/h	Abnormal increase in the site boundary radiation level.	04 d 07 h 42 min
16 March 2011						
2011-03-16 01:55	04 d 1 h 09 min	SC vent valve opened.	—	—	The valve was found closed.	04 d 10 h 17 min
2011-03-16	—	Inspection of spent fuel pool.	—	—	Remotely from a helicopter. Not conclusive as to sufficiency of the water to cover the fuel assemblies in the Unit 3 spent fuel pool, making its replenishment a high priority.	—

[1] Time may be approximate, especially during the first two minutes of the main event, due to data recording frequency, chart recorder scale or delays in the operator reports and logs.

UNIT 3 SEQUENCE OF EVENTS

Colour indication:

Main event | Core Cooling | Power/station auxiliary | Confinement | Reactivity | Emergency Management | Radiation | Other Unit Event

Date and time[1]	Time elapsed after initiating event	Event/action	Auto/manual; local/remote	Set point; criterion/value	Remarks	Time elapsed after SBO
17 March 2011						
2011-03-17 09:30	05 d 18 h 44 min	Helicopters dropped sea water into SFP.	—	~30 min	—	05 d 17 h 52 min
2011-03-17 19:05	06 d 04 h 19 min	Water cannon trucks spray fresh water into the spent fuel pool.	—	~1 h	Spraying into the pools continued daily in March, using water cannon and fire engine trucks or concrete pump vehicles, to ensure that the spent fuel was not exposed.	06 d 03 h 27 min
2011-03-17 21:00	06 d 06 h 14 min	SC vent valve found closed.	—	—	—	06 d 05 h 22 min
2011-03-17 21:30	06 d 06 h 44 min	SC vent valve opened.	—	—	—	06 d 05 h 52 min
18 March 2011						
2011-03-18 05:30	06 d 14 h 44 min	SC vent valve found closed.	—	—	—	06 d 13 h 52 min
2011-03-18 05:30	06 d 14 h 44 min	SC vent valve opened.	—	—	—	06 d 13 h 52 min
19 March 2011						
2011-03-19 11:30	07 d 20 h 44 min	SC vent valve found closed.	—	—	—	07 d 19 h 52 min
20 March 2011						
2011-03-20 11:25	08 d 20 h 39 min	SC vent valve opened.	—	—	—	08 d 19 h 47 min
2011-03-20	—	480 V emergency low voltage switchboard (power centre 4D) energized.	—	—	—	—
21 March 2011						
2011-03-21 15:55	10 d 01 h 08 min	Grey smoke observed coming from the roof of the reactor building.	—	—	—	10 d 00 h 17 min
22 March 2011						
2011-03-22 10:45	10 d 19 h 58 min	Units 3 and 4 CR lighting restored.	—	—	—	10 d 19 h 07 min
23 March 2011						
2011-03-23 16:20	12 d 01 h 33 min	Grey smoke observed coming from the roof of the reactor building.	—	—	The smoke continued until the next day and then stopped.	12 d 00 h 42 min
24 March 2011						
25 March 2011						
2011-03-25 06:02	13 d 15 h 15 min	Reactor injection changed from sea water to fresh water.	—	—	—	13 d 14 h 24 min
26 March 2011						
2011-03-26	14 + d	Temporary Unit 3 off-site power restored.	—	—	Establishment of support to fundamental safety functions.	14 d 08 h 22 min
27 March 2011						
28 March 2011						
2011-03-28 08:30	16 d 17 h 43 min	Freshwater injection to the reactor from fire trucks transferred to electrical pumps powered by a diesel generator.	—	—	—	16 d 16 h 52 min

[1] Time may be approximate, especially during the first two minutes of the main event, due to data recording frequency, chart recorder scale or delays in the operator reports and logs.