Time Line

Earthquake Japan Nuclear Accidents

Alister William Macintyre research notes
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First Visitor (1 Apr 24)

Date at end of table of contents topic means when I last updated that section. Some text other than date, is a pointer to what other notes document the content which used to be there, has moved to.

If this is your first time looking at my research notes, I suggest:

- Get my separate documents focused on
    - Japan Nuclear Glossary of Terminology and Acronyms
    - Japan Navigation Guide to Info from the Horse's Mouth, instead of the other end of the horse (the news media).
- I suggest you check the section on Primary Sources for urls you may wish to visit. I will be adding more there in later editions.

As I explain in other notes documents, the news media often seems to delight in painting any disaster as worst ever, sky is falling, distorting reality, not fomenting coherent cooperation and rescue. My primary sources are a start at getting at latest facts.

You may also wish to visit my overall Nuclear notes document, which includes links to what I consider to be credible science sources, which explain what's going on, what's at risk, without the news media hype. I am in the process of breaking that down into different focus areas.

For a variety of reasons, I began to fall behind on keeping these notes current, so early in April I shifted focus to getting Time Line current, then revert to more of the big picture. Thus some of my other notes may have gaps in detail.

Introduction (1 May 12)

I split this info from my larger collections of Japan and nuclear notes, so it would be easier to copy & paste, as I saw more info which maybe belonged in the time line. I never got caught up on digesting the tsunami of additional information, then other crises, around the world, sucked my attention span away from being here as often.

Japan notes documents (1 Apr 24)

Sometimes when I add new info one place, another section of my notes has an older story.

- Acronyms Glossary for Haiti – many of the acronyms are relevant to many disasters.
- EOJ = naming convention for my Earthquake Japan documents, to distinguish them from Haiti notes.
- EOJ Japan Overview = non-nuclear focus … earthquake and tsunami recovery.[1]
- EOJ Nuclear News = make sense of what's going on with the nuclear power plants. – many topics which I am splitting into more focused notes areas
- EOJ Nuclear Time Line = visualize progression of events and trends, to help make sense without the distortion of the many news media actors with an agenda.
- EOJ SitReps = Japan Situation Reports[2]
- Japan Nuclear Accidents Glossary of Terminology and Acronyms = Try to explain specialized geek language associated with the Japan nuclear disaster, and related recovery. A person working with any of my EOJ documents also ought to get a copy of this.
- Japan Nuclear Info Navigation Guide = Identifying "The Horse's Mouth" for people who have been overly dependent on the other end of the horse (the news media), and are starving for better information.
- Lessons Japan Disasters for the whole world = what we should have learned from Japan's disasters, to apply to rest of world to mitigate risk of something similar happening some place else.
- Map Directory includes Haiti & Japan disasters, other disasters, Democracy foothold in Middle East, how to use some mapping resources.
- I have also downloaded some OFFICIAL documents, named them with a mixture of EOJ, what they are about (e.g. Map), date vintage and organizational source.

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[1] Info on Mapping sources got moved into Maps Directory document so in one place are where to find Maps about Haiti, Japan, other disasters, and also regarding Democracy seeking a foothold in the Middle East.
[2] Mainly non-nuclear, what I consider to be the bigger disaster for the people more due to tsunami than earthquake.

Version sharing (1 Mar 26)

I periodically upload my research notes documents to various public sites where my friends and contacts may freely cherry pick which of my efforts to download copies for themselves. These include:

- Box net on Linked In
- E-mail to some contacts (Macwheel99 is a play on my surname)
- Facebook = I am Alister Wm Macintyre there
- Haiti Rewired[3] / For other than Haiti, see group = Current Events
- Japanese Resilience (I am user AlMac99)[4]
- Linked In / my profile = Al Macintyre / my box net files / folders by general topics[5]
- Plan Haiti has some of my early Haiti research[6]
- Prizm – so far mainly Haiti research
- Scribd (I am user AlMac99)[7]
- Yahoo HDRR – only Haiti here, and disaster relief in general, where it applies to Haiti[8]

After sharing, I usually increment version # to make it easy for people to see which latest version in later uploads. But you can also see by verifying table of contents up-to-date, then date in parentheses at ends of headings to see which got most recently updated.

Document Structure (1 Mar 16)

Topic sub-titles end in a date signifying when that info last updated, so by viewing table of contents, we see where most recent input to these research notes, especially aiding people with copy of an earlier version. Digit 1 in front of month means 2011.

Version numbers are incremented, with this document periodically uploaded various places for convenience of other people who can then pick and choose which of my research efforts they wish to download.

Users of my research hold Alister Wm. Macintyre harmless, and also the places I upload my research to, and agree that my copyright is reserved and that the information is available for

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[3] http://haitirewired.wired.com/profile/AlisterWmMacintyre
[4] http://japan.resiliencesystem.org/nuclear-engineering-issues
[5] Outside the folders are documents which cross topics, such as Maps Directory of sources relevant to Haiti, Japan, Middle East, and more.
[6] http://sites.google.com/site/planhaiti/home
[7] http://www.scribd.com/explore
[8] http://groups.yahoo.com/group/HaitiDisasterRecoveryResearch/

the intended purpose of helping in the recovery of Haiti and Japan. Some of my research content is direct quotes from other sources. I try to give credit every time I do this.

Primary Sources (1 Apr 25)

Thanks to major problems with news media coverage, many people are asking similar questions. So we need to go to primary sources for clarification. As I add to this collection, my priority will be to place the info in my **Japan Nuclear Info Navigation Guide**.

- Info from Gov of Japan http://www.kantei.go.jp/foreign/index-e.html in English.
- IAEA updates on evolving situation in Japan. http://www.iaea.org/newscenter/news/tsunamiupdate01.html
- Nuclear Reactors in Japan http://japan.resiliencesystem.org/map-nuclear-reactors-japan
- http://upload.wikimedia.org/wikipedia/commons/2/2f/Fukushima7.png = Radiation over time period.
- Recent radiation readings http://eq.wide.ad.jp/index_en.html in English, with comparison of what is normal daily life.
- Radiation + Wind = go where? http://japan.resiliencesystem.org/winds-japan-power-plants-should-send-radiation-out-sea
- Stay informed on Japan nuclear accident situation, forget usual media outlets, consult websites[9] in this section, and links from them to related articles. http://mitnse.com/
- World Health Organization (WHO) info on health risks associated with various levels of radiation, with some FAQ on Japan situation. http://www.who.int/hac/crises/jpn/faqs/en/index.html
- OCHA = UN agency in charge of coordination of humanitarian relief. Their Relief Web hosts regular updates from many humanitarian efforts at http://www.reliefweb.int/rw/dbc.nsf including the Japan crises.

IEDM evaluation (1 Apr 25)

See my **Maps Directory** section on Japan disasters, where I give info about the **Kyoto University** evaluation[10] March 25, 2 weeks after the Earthquake Tsunami and start of Nuclear crisis.[11]

Downloads from NIST (1 Mar 21)

March 20 I renamed downloads I have collected so far,[12] to make easier to read vintage when I upload them other places:

- INES 18 Mar GoJ

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[9] https://morgsatlarge.wordpress.com/2011/03/13/why-i-am-not-worried-about-japans-nuclear-reactors/
[10] http://japan.resiliencesystem.org/2-week-report-kyoto-university-synthesis-and-initial-observations
[11] I downloaded a copy, naming it **IEDM 25 March Japan**.
[12] My notes elsewhere, at time of original capture, may have had slightly different naming. But from the clues, hopefully I can find again if someone is seeking a copy of one of these.

- NISA 13 Mar Sitrep
- NISA 14 Mar 7.30 am Sitrep
- NISA 14 Mar 7.30 pm Sitrep
- NISA 15 Mar 11 am Sitrep
- NISA 15 Mar 11.30 pm Sitrep
- NISA 17 Mar 5.30 am Sitrep
- Radiation 15 Mar Explanation

Terminology Concepts (Nuclear Glossary)

I was maintaining this directory of terminology and acronyms in my research notes document "**EOJ Nuke News**" and periodically copying the latest contents to "**EOJ Nuke Time Line**" document, typically shortly before sharing the latter with some upload place(s). But 2011 March 25, I switched to new notes document "**Japan Nuclear Glossary**" as a repository of this info, with the other documents referring to it.

Time Line 2011 March (1 May 10)

I am getting info for this time line from multiple sources. (Horse's mouth and other end.) Clarity of details with each time stamp are obviously very varied. Also my attention wanders to other crises from time to time, so there are gaps in my attention to this story.

Also the details raise more questions … what is significance of Articles 10 and 15?

http://www.bbc.co.uk/news/science-environment-12722719

http://en.wikipedia.org/wiki/Fukushima_II_Nuclear_Power_Plant

- Times = local time Japan, JST = Japan Standard Time

When I refer to various sources, where I got the info, unless I state otherwise, that is all within the following research documents:

- **EOJ Nuclear News** = Japan info, focused on nuclear issues, as opposed to what I consider to be the larger disaster of hundreds of thousands of Japanese people in the path of Tsunami.
- **EOJ SitReps** = Japan Situation Reports[13]
- **Japan Nuclear Info Navigation Guide** = Identifying "The Horse's Mouth" for people who have been overly dependent on the other end of the horse (the news media), and are starving for better information

[13] Mainly non-nuclear, what I consider to be the bigger disaster for the people more due to tsunami than earthquake.

At the end of many time line entries I identify official outfit from which I got info. For what the acronyms mean, see my **Japan Nuclear Accidents Glossary of Terminology and Acronyms**.

Other people are attempting to construct other time lines.
http://en.wikipedia.org/wiki/Timeline_of_relief_efforts_after_the_2010_Haiti_earthquake

Events prior to latest Chaos (1 Mar 22)

2010 Aug 14: Fukushima Dai-ichi unit 6 was shut down for routine planned maintenance. Its fuel is in its reactor. (IAEA confirmed)

2010 Nov 30: Fukushima Dai-ichi unit 4 was shut down for routine planned maintenance, and all fuel from the reactor was transferred to spent fuel pool. (IAEA confirmed)

2011 Jan 3: Fukushima Dai-ichi unit 5 was shut down for routine planned maintenance. Its fuel is in its reactor. (IAEA confirmed)

According to March 20 3.30 EDT status update by MIT NSE[14]

The Fukushima power plants were required by regulators to withstand a certain height of tsunami. At the Dai-ichi plant the design basis was 5.7 metres and at Dai-ni this was 5.2 metres.

Tepco has now released tentative assessments of the scale of the tsunami putting it at over 10 metres at Dai-ichi and over 12 metres at Dai-nii.

11 March Time Line (1 Apr 24)

JACT = Acronym I added to make some of the content more readable for me. It means some Japan actions are implemented per their legal check list of what to do when situation reaches some stage of severity. Later I hope to learn more about these various stages, and add them to my Nuclear Glossary, as opposed to tracking down all relevant references here, and in my other notes.

- JACT-10 = Article 10 of the Act on Special Measures Concerning Nuclear Emergency Preparedness. JACT-10 includes: "loss of power." (JAIF 09 April)
- JACT-15 = Article 15 of the Act on Special Measures Concerning Nuclear Emergency Preparedness. I interpret multiple sources to mean JACT-15 includes: "loss of water cooling function."
- JACT-15-3 = Article 15, Paragraph-3, of the Act on Special Measures Concerning Nuclear Emergency Preparedness.

[14] http://mitnse.com/2011/03/20/status-update-32011-at-330-pm-edt/

- JACT-64-3 = Article 64, Paragraph-3, of the Act on Special Measures Concerning Nuclear Emergency Preparedness.

Japan's nuclear agency says all external power lines at Higashidori nuclear power plant in Aomori Prefecture were knocked out in March 11's quake. The plant switched to emergency diesel power generators for some hours, but power was later restored.[15]

March 11 quake shut down 3 of the 4 external power lines at Onagawa nuclear power plant in Miyagi Prefecture. Onagawa plant also suffered water leaks at 8 locations, including water that spilled from spent fuel storage pools at each of its 3 reactors. A device to control pressure inside a turbine building was also damaged.[16]

In addition, the March 11 quake disabled all external power lines at a nuclear fuel reprocessing plant in Aomori Prefecture. The cooling systems there were running on emergency diesel power.[17]

At the same time that the nuclear power plants were having a crisis, the tsunami also caused chaos all over the area. (IEDM 25 March) This impeded effective rescue of people in the areas most affected by the earthquake.

March 11th, several fires resulted from powerful earthquake and tsunami triggered near the east coast of Honshu, the largest and main island of Japan. (IEDM 25 March)

March 11th, a fire broke out at Cosmo Oil Company refinery in Ichihara city and continued till 14 March. (IEDM 25 March)

11 March Times Events (1 Apr 27)

11 March Friday … problems with cooling, start evacuations

- Prior to the earthquake and tsunami, IAEA has confirmed:
  - Fukushima Daiichi units 4 5 6 were shut down for routine planned maintenance.
  - Unit 4 fuel had been transferred to spent fuel pool.
  - Unit 5 and 6 fuel is fully loaded in their reactors.
- 14.46 earthquake (9.0 magnitude) and tsunami. After the earthquake and tsunami, control rods have been inserted immediately in the 11 reactors which were in operation in 3 nuclear power plants in Miyagi, Fukushima and Ibaragi Prefectures, automatically suspending power generation.[18] Onagawa unit 2 achieved cold shutdown almost immediately (said NISA). Subsequently the tsunami flooded

[15] http://japan.resiliencesystem.org/aftershock-batters-nuclear-plants#comment-448
[16] http://japan.resiliencesystem.org/aftershock-batters-nuclear-plants#comment-448
http://www.jaif.or.jp/english/news_images/pdf/ENGNEWS01_1302261533P.pdf

[17] http://japan.resiliencesystem.org/aftershock-batters-nuclear-plants#comment-448
[18] See info from Gov of Japan 9 am Mar 16

diesel generators which ran the pumps for water cooling at **Fukushima I Daiichi**, causing reactor core to heat up.

- 14:46 Set up of NISA Emergency Preparedness Headquarters (Tokyo) immediately after the earthquake, and started processing information from the various nuclear power plants, and other utilities in trouble.
- 15.41 Emergency diesel electrical power died at Fukushima Dai-ichi, thanks to tsunami in excess of 14 meters.[19] Other nuclear power plants still had external power supplies.
- 15:42 TEPCO reported to NISA that Fukushima Dai-ichi, Units 1,2 and 3 at JACT-10.[20] The loss of both internal and external electrical power, at Fukushima Dai-ichi, constitutes a **Station Blackout Accident**. This makes cooling control, and situation monitoring inoperable. However, there were stories of batteries with 4-9 hours life in them. We don't know if they were damaged by the tsunami.
- 1600 national response by Japan's Nuclear and Industrial Safety Agency (NISA)
- 16:36 TEPCO says Fukushima Dai-ichi, Units 1 and 2 at JACT-15 = Loss of Cooling function. JAIF says JACT-15 here means "Incapability of water injection by core cooling function"
- 16:45 TEPCO reported latest Fukushima Dai-ichi, Units 1 and 2 JACT-15 info to NISA
- 18:08 Unit 1 of Fukushima Dai-ni notified NISA they at JACT-10
- 18:33 Units 1,2 and 4 of Fukushima Dai-ni notified NISA they at JACT-10
- 19:03 Government declared the state of nuclear emergency (Establishment of Government Nuclear Emergency Response Headquarters and Local Emergency Response Headquarters)

- 1930 "nuclear emergency status" declared, standard precaution they say
- 2045 IAEA News[21] overall includes Onagawa fire extinguished
- 2050 Fukushima prefecture's emergency preparedness headquarters - issued a directive regarding the accident occurred at Fukushima-Dai-ichi Nuclear Power Station, TEPCO that the
    - residents living in the area of 2km radius from Unit 1 of the Nuclear Power Station must evacuate.(The population of this area is 1,864)
- 2100
    - residents within a 3km radius of the power station are told to leave their homes, while
    - those within a 10km radius are told to stay at home in case it is necessary to extend the evacuation area.

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[19] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf https://netfiles.uiuc.edu/mragheb/www/NPRE%20402%20ME%20405%20Nuclear%20Power%20Engineering/Fukushima%20Earthquake%20and%20Tsunami%20Station%20Blackout%20Accident.pdf

[20] See JAIF 09 April. JACT-10 includes "loss of power."

[21] See Official Primary.

- 21:23 Directives from Prime Minister to Governor of Fukushima, Mayor of Ookuma and Mayor of Futaba were issued regarding the accident occurred at Fukushima-Dai-ichi Nuclear Power Station, TEPCO, at JACT-15-3 as follows:
    - Residents living in the area of 3km radius from Unit 1 of the Nuclear Power Station must evacuate.
    - Residents living in the area of 10km radius from the Unit 1 must take sheltering.
- 22.55 Fire Smoke, on the first basement of the Turbine Building of Onagawa, was confirmed extinguished (says NISA).
- 24:00: Mr. Ikeda, Vice Minister of METI, arrived at the Local Emergency Response Headquarters.

11 Mar results[22] for **Fukushima I Dai-ichi unit 1**:
Under operation, Automatic shutdown by the earthquake.
Loss of A/C power.
Loss of water injection function.
It was not learned until later, but the tsunami had also rendered some cooling and electrical equipment inoperable, or functioning incorrectly.

11 Mar results[23] for **Fukushima I Dai-ichi unit 2**:
Under operation, Automatic shutdown by the earthquake,
Loss of A/C power.
Loss of water injection function.

11 Mar results[24] for **Fukushima I Dai-ichi unit 3**:
Under operation, Automatic shutdown by the earthquake.
Loss of A/C power.

11 Mar actions[25] by **Gov**ernment of **Japan**:
14:46 Set up of the NISA Emergency Preparedness Headquarters (Tokyo) immediately after the earthquake.
19:03 Government declared state of nuclear emergency.
(Establishment of Government Nuclear Emergency Response Headquarters and Local Emergency Response Headquarters)
21:23 Directives from Prime Minister to the Governor of Fukushima Prefecture and heads of towns were issued regarding the event occurred at Fukushima Dai-ichi NPS, TEPCO, in accordance with the Action Special Measures Concerning Nuclear Emergency Preparedness as follows:
Residents within 3km radius from Unit 1 to evacuate.

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[22] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[23] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[24] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[25] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf

Residents within 10km radius from Unit 1 to stay in-house.
24:00 Vice Minister of Economy, Trade and Industry, Ikeda arrived at the Local Emergency Response Headquarters.

12 March Time Line (1 Apr 24)

International rescue efforts joined Japan efforts. (IEDM 25 March)

12 March Saturday … a large spectrum of different events

- 00.49 Unit 1 of Fukushima Dai-ni at JACT-15 = "Abnormal rise of CV[26] pressure" (JAIF 9 Apr)
- 00.58 Onagawa Unit 1 gets from automatic shutdown to cold shutdown (says NISA), which I think is good news for that unit.
- 01.17 Onagawa Unit 3 gets from automatic shutdown to cold shutdown (says NISA), which I think is good news for that unit. This is now all 3 units of that NPS in that condition.
- 0155 IAEA News[27] of initial evacuation
- 0450 IAEA News[28] of diesel challenges and other conditions
- 05:22 Unit 1 of Fukushima Dai-ni notified NISA they at JACT-15 = Loss of pressure suppression function
- 0530 vent some steam
- 5:32 Unit 2 of Fukushima Dai-ni notified NISA they at JACT-15 = Loss of pressure suppression function
- 05:44 Residents living in the area of 10km radius from unit 1 of the Nuclear Power Station must evacuate by the Prime Minister Direction. (see 11th 21.23 for previous instructions to residents near Fukushima Dai-ichi NPS).
- 06:07 Regarding Units 1,2 and 4 of Fukushima Dai-ni NPS, TEPCO reported NISA at JACT-15 = Loss of pressure suppression function
- 0610 IAEA News[29] of Fukushima Dai-Ichi plant I unit 2, mobile electric attempt, need to vent unit 1.
- 6:50 Due to JACT-64-3, government order to control the internal pressure in Fukushima-daiichi unit No. 1 and 2
- 7:45 Directives from Prime Minister to Governor of Fukushima, Mayors of Hirono, Naraha, Tomioka, Ookuma and Futaba were issued regarding the accident occurred at Fukushima-Dai-ni Nuclear Power Station, TEPCO, due to JACT-15-3 as follows:
    - Residents living in the area of 3km radius from Fukushima-Dai-ni Nuclear Power Station must evacuate.
    - Residents living in the area of 10km radius from Fukushima-Dai-ni NPS must take sheltering
- 0819 alarm about a control rod

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[26] CV = Containment Vessel
[27] See Official Primary.
[28] See Official Primary.
[29] See Official Primary.

- 1009 vent some more
- 1043 control rod problems solved
- 1058 vent more
- 12.15 **Fukushima Dai-ni Unit 3** gets from automatic shutdown to **cold shut down** (says NISA). I think this is good news for that unit. This is the first of four units reaching that point.
- 14.30 Fukushima-Dai-ichi Unit 1 venting started (JAIF 9 Apr)
- 15:29 radiation monitor for Fukushima Dai-ichi I was 1015 micro sievert per hour, attributed to earlier venting

12 Mar 15.36 F Dai-ichi unit 1 explosion explained (1 Mar 20)

- 15.36 **hydrogen explosion** at Fukushima Dai-ichi I unit 1 explained by Gov of Japan next day 10 am briefing, and clarified in subsequent briefings.[30]
    - The roof of unit 1 reactor building had blown off.
    - The cause, of this explosion:
        - The tsunami had wiped out diesel generators, so the pumps could not supply cold water to the core's fuel rods;
        - The water level dropped;
        - Reacted water and metal created hydrogen, which built up and leaked (or was vented) outside the containment vessel;
        - Hydrogen is highly flammable, it exploded;
        - This blew the roof off outer concrete building.

    - **Cesium and Iodine** were detected, it is believed that a part of nuclear fuel was damaged and a small amount of radioactive material leaked into core cooling water. At this point, and for several days after, the probability of radiation leakage, due to this incident, was extremely low. Later incidents could change expectations.
    - **Containment was not breached**, although initially there was some uncertainty. This was very similar to what happened 11.01 of March 14 with unit 3 of the same nuclear plant. In no way can this be called a "melt down" as was misreported by some news media. There is no risk of a hydrogen explosion in the containment vessel because there is no oxygen in it.

12 March continues (1 Apr 27)

- 17:00 JACT-15 Notification since the radiation level exceeded the acceptable level of Fukushima Dai-ichi Nuclear Power Station.(NPS).
    - 17:39 Prime Minister directed evacuation of the residents living within the 10 km radius from the Fukushima-Dai-ni NPS
    - 18:25 Prime Minister directed evacuation of the residents living within the 20km radius from the Fukushima Dai-ichi NPS

[30] Also see NIST 11.30 pm March 15.

- 18:55 radiation monitor for Fukushima Dai-ichi I was 70.5 micro sievert per hour
- 19:55 Directives from Prime Minister was issued regarding sea water injection to Unit No.1 of Fukushima Dai-ichi NPS.
- 20.00 official story, steel containment still intact after explosion # 1
- 20:05 Due to JACT-64-3 and directives from Prime Minister, government ordered to inject sea water Unit No.1 of Fukushima Dai-ichi NPS.
- 20.20 at the Fukushima Dai-ichi Power Plant Unit 1, GOJ began measures to lower the temperature of fuel in the reactor pressure vessel by injecting sea water, and to restrain further nuclear fissions of fuel by mixing some boron into sea water.
- 20.41 Start Venting at Fukushima Dai-ichi Unit 3 (JAIF 9 Apr)
- 21.07 sea water to be used in cooling
- 22.15 after shock interrupted sea water solution

12 Mar results[31] for **Fukushima I Dai-ichi unit 1**:

Unusual increase of PCV pressure
Started to vent.
Sound of explosion.
Started of injection of seawater and borated water to the core.

12 Mar actions[32] by **Gov**ernment of **Japan**:

05:44 Residents within 10km radius from Unit 1 of Fukushima Dai-ichi NPS shall evacuate by the Prime Minister Direction.
07:45 Directives from Prime Minister to the Governor of Fukushima Prefecture and heads of towns were issued regarding the event occurred at Fukushima Dai-ni NPS, TEPCO, pursuant to Act on Special Measures Concerning Nuclear Emergency Preparedness as follows:
Residents within 3km radius from Fukushima Dai-ni NPS to evacuate.
Residents within 10km radius from Fukushima Dai-ni NPS stay in house.
17:39 Prime Minister directed evacuation of the residents within the 10 km radius from Fukushima Dai-ni NPS.
18:25 Prime Minister directed evacuation of the residents within the 20km radius from Fukushima Dai-ichi NPS.
20:05 Considering the Directives from Prime Minister and pursuant to the Nuclear Regulation Act, the order was issued to inject seawater to Unit 1 of Fukushima Dai-ichi and so on.

13 March Time Line (1 Apr 27)

13 March Sunday – cooling challenges

- 01.17 Fukushima accident declared to be a level 4 on the INES scale
- 05:38 Unit 3 of Fukushima-Dai-ichi notified NISA of JACT-15 at the specific emergency stage under the loss of all of the coolant injection function. TEPCO is

[31] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[32] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf

on the progress of the recovering of both of the power source and coolant injection function, and on vent for reducing of the pressure of RPV = Reactor Pressure Vessel.

- 08.41 Start Venting at Fukushima Dai-ichi Unit 3 (JAIF 9 Apr)
- 09.01 TEPCO told NISA of JACT-15 for Fukushima-Dai-ichi because Unusual increase of radiation dose at the site boundary
- 09:08 Pressure suppression in the Containment Vessel and fresh water injection started at Unit 3 of Fukushima Daii-chi NPS. (says NISA)
- 09:20 Opening of Pressure vent valve of Unit 3 of Fukushima Dai-ichi NPS. (says NISA) (Also see primary source info from IAEA and Japanese briefings).
- 09:30 NISA directed the Governor of Fukushima Prefecture, the Mayers of Ookuma-machi, Futaba-machi, Tomioka-machi and Namie-machi based on the Act for Special Measures Concerning Nuclear Emergency Preparedness on radioactivity decontamination screening. (says NISA)
- 09:38 TEPCO notified NISA that Unit 1 of Fukushima Dai-ichi NPS reached JACT-15. (says NISA)
- 11.00 Start venting Fukushima Dai-Ichi unit 2 (JAIF 9 Apr)
- 11.00 Japan Chief Cabinet Secretary[33] briefs news media with lots of info regarding Fukushima Dai-Ichi plant I unit 3.
- 11:55 Unit 1 of Fukushima-Dai-ichi gets Sea water injected to the Primary Containment Vessel PCV via the Fire Extinguishing System Line (says NISA), which continues until March 14 01:10
- 11:55 Unit 3 of Fukushima-Dai-ichi = Fresh water is being injected to the PCV via Fire Extinguishing System Line (FESL) (says NISA)
- 13:09 Tohoku Electric notified NISA that Onagawa now JACT-10 (Unit not identified, but Al is guessing Unit 2 which did NOT achieve cold shut-down on 12 March) (info from NISA)
- 13.12 Unit 3 of Fukushima-Dai-ichi = Sea water is being injected to the Primary Containment Vessel (PCV) via Fire Extinguishing System Line (FESL) (says NISA and JAIF)
- 14:00 Unit 2 of Fukushima-Dai-ichi = Water Injection Function has been sustained (says NISA)
- 14:25 TEPCO notified NISA that Fukushima Dai-ichi NPS reached JACT-15. (says NISA)
- 14.36 TEPCO notified NISA that Fukushima Dai-ichi NPS reached JACT-15 = Unusual increase of radiation dose at the site boundary

13 Mar results[34] for **Fukushima I Dai-ichi unit 3**:

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[33] See Official Primary.

Loss of water injection function.
Started to vent.

13 Mar actions[35] by **Gov**ernment of **Japan**:
Directive was issued for the Governor of Fukushima Prefecture and heads of towns in accordance with the Act on Special Measures Concerning Nuclear Emergency Preparedness screening, on the contents of radioactivity decontamination.

14 March Time Line (1 Apr 23)

I am not sure when this started exactly, but NISA told IAEA about increasing temperatures in the spent fuel ponds at Fukushima-Dai-ichi Units 5 and 6 since 14 March.

- 01:10 Unit 1 and Unit 3 of Fukushima-Dai-ichi = Injection of Sea water injection into PCV is interrupted because of the lack of sea water in pit. (says NISA)
- 01:24 Unit 1 of Fukushima Dai-ni = Due to Recovery of Residual Heat Removal System (RHR), water in suppression pool is started to cool for cold shut down. restarted (says NISA)
- 03:20 Fukushima-Dai-ichi = Injection of Sea water into PCV is restarted (says NISA)
- 04.08 Fukushima-Dai-ichi unit 4 Spent Fuel Storage Pool water temperature had increased to 84 C. (NISA 5.30 pm March 17, IAEA 6.10 UTC March 18, and JAIF 9 Apr)
- 04:24 TEPCO notified NISA that Fukushima Dai-ichi NPS reached JACT-15
- 04.40 TEPCO notified NISA that Fukushima Dai-ichi NPS reached JACT-15 = Unusual increase of radiation dose at the site boundary
- 05.20 Start Venting at Fukushima Dai-ichi Unit 3 (JAIF 9 Apr)
- 05.38 TEPCO notified NISA that Fukushima Dai-ichi NPS reached JACT-15 = Unusual increase of radiation dose at the site boundary
- 07.52 TEPCO notified NISA that Fukushima Dai-ichi NPS reached JACT-15 = Unusual rise of the pressure in PCV
- 07.53 TEPCO notified NISA that Fukushima Dai-ichi NPS reached JACT-15.

14 Mar 11.01 F Dai-ichi unit 3 explosion explained (1 Mar 20)

- 11:01 **hydrogen explosion** at Fukushima Dai-ichi unit 3, as reported to IAEA by Japanese authorities,[36] and also mentioned in multiple briefings from Gov of Japan. 6 workers got injured.
    - According to NIST 11.30 pm Mar 15
    - What happened here was same process as 15.36 Mar 12 with unit 1

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[34] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[35] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[36] Also see briefings by Japanese Cabinet Secretary in other primary sources.

        - The tsunami had wiped out diesel generators, so the pumps could not supply cold water to the core's fuel rods;
        - The water level dropped;
        - Reacted water and metal created hydrogen, which built up and leaked (or was vented) outside the containment vessel;
        - Hydrogen is highly flammable, it exploded;
        - This blew the roof off outer concrete building.
    - The primary containment vessel is not damaged, and the control room remains operational.
    - The pressure of the unit's containment vessel fluctuated, but it is becoming stable.
    - In no way is this a melt down, as was misreported by some news media.
    - This event does not threaten radiation leaks, while other events may.
- 11:13 Fukushima Dai-ichi unit 3 condition of containment vessel remains sound, according to 380kPa pressure inside reading.
- 11:30 Fukushima Dai-ichi unit 3 condition of containment vessel remains sound, so presumption is no major release of radioactive materials. They expect a possible increase in radiation levels similar to what followed the hydrogen explosion that occurred in the Unit 1 reactor. Accordingly, instructions have been given to the very small number (500) of people who were in the process of evacuating from a 20km zone around the power station that they should take refuge indoors immediately as a precautionary measure.[37]
- 11:37 Fukushima Dai-ichi unit 3 radiation reading of 50μSv/h was taken in the service hall inside the power station. Conclusion from multiple readings is that there is no radiation leakage due to the recent explosion.
- 11:44 Fukushima Dai-ichi unit 3 radiation reading of 20μSv/h was recorded at the main entrance. Conclusion from multiple readings is that there is no radiation leakage due to the recent explosion.
- 11:55 Fukushima Dai-ichi unit 3 condition of containment vessel remains sound, according to 360kPa pressure inside reading.
- 12:36 Fukushima Dai-ichi unit 3 radiation reading of 1μSv/h at an off-site center roughly 5 kilometers from the station. This is approximately the same figure as was recorded the previous day.
- 13.25 TEPCO told NISA that Fukushima Dai-ichi Unit 2 reached JACT-15 = Loss of cooling function
- 14.12 The indoors safety precaution was lifted for residents around Fukushima Dai-ichi and their evacuation has resumed.

[37] See briefing by Japanese Cabinet Secretary March 14, near 11 am.

14 March continues (1 Apr 27)

- 15.30 Fire Dept reports[38] the fire, at Tohoku Electric Power Company's Haramachi Thermal Power Station, started when a crane inside the power station collapsed and the crane's fuel ignited.
- 16.34 Seawater injection to Reactor Pressure Vessel (RPV) of Fukushima Dai-ni unit 2 (JAIF 9 Apr)
- 17.00 Fukushima Dai-ni unit 1 reaches cold shutdown (per NISA), the second to get there (unit 3 got there 12.15 March 12).
- 18.00 Fukushima Dai-ni unit 2 reaches cold shutdown (per NISA), third to get there.
- 20.00 just after this time Fukushima Dai-ichi units 1 2 3 water injection resumed, after debris from explosion had got cleared away. Earlier, pumping for unit 2 had been interrupted because they ran out of fuel, and getting more had taken longer than expected, during this delay there was a short period of time when the fuel rods were exposed above the water surface. Operations are now properly cooling the reactors again. (per Gov of Japan briefings)
- 22.13 TEPCO told NISA that Fukushima Dai-ni reached JACT-10
- 22.14 TEPCO evaluated that core damage of Fukushima Dai-ichi Unit 2 is "less than 5%" (per NISA Sitrep 11 am 2011 Mar 15)
- 22.35 TEPCO told NISA that Fukushima Dai-ichi reached JACT-15 = Unusual increase of radiation dose at the site boundary
- 22.50 Water level in RPV (Reactor Pressure Vessel) in Fukushima Dai-ichi Unit 2 is decreasing. (per NISA Sitrep 11 am 2011 Mar 15)

14 Mar results[39] for **Fukushima I Dai-ichi unit 2**:
Loss of water cooling function.

Unusual increase in PCV (Primary Containment Vessel) pressure.

14 Mar results[40] for **Fukushima I Dai-ichi unit 3**:
Unusual increase in PCV (Primary Containment Vessel) pressure.

Sound of explosion.

14 Mar results[41] for **Fukushima I Dai-ichi unit 4**:

Water temperature in the SFP (Spent Fuel Pool), 84 degrees.

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[38] See briefing by Japanese Cabinet Secretary March 14, near 4 pm.
[39] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[40] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[41] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf

15 March Time Line (1 Apr 23)

I don't have the time of this March 15 update from Government of Japan but here are the latest evacuation instructions[42] to residents near Fukushima power plants, as of March 15.

Areas in which counter-emergency measures should be taken:

Residents staying within a 20-kilometer radius from the Fukushima Dai-ichi Nuclear Power Station, Tokyo Electric Power Co.,Inc. (TEPCO) (continuation)

Residents staying in the area from 20-kilometre to 30-kilometer radius from the Fukushima Dai-ichi Nuclear Power Station, Tokyo Electric Power Co.,Inc. (TEPCO) (NEW)

Direction:

Residents staying within a 20-kilometer radius from the Fukushima Dai-ichi Nuclear Power Station, Tokyo Electric Power Co.,Inc. (TEPCO) shall be evacuated.(continuation)

Residents staying in the area from 20-kilometre to 30-kilometer radius from the Fukushima Dai-ichi Nuclear Power Station, Tokyo Electric Power Co.,Inc. (TEPCO) shall stay inside the houses or buildings. (NEW)

Observe directions by the relevant authorities if such directions are given.

Kashiwazaki-Kariwa is a nuclear power plant close to one of the aftershocks, shown on map (NW coast of Japan), of aftershocks Swarm (MAP) Japan: Earthquakes Swarm (15 Mar 2011) from United Nations World Food Programme (WFP) summary link[43] to detail PDF[44] which I downloaded with name "**EOJ Map 2011 Mar 15 WFP Aftershocks**." Aftershock circles are sized according to magnitude of the earthquakes, along with locations of nuclear power plants, in the North, where most of the damage has been, so far.

15 March Times Events (1 Apr 23)

15 March Tuesday

- 00.00 NISA accepted experts on NPS damage from IAEA.
- 00.00 NISA accepted experts dispatched from NRC.
- 00.02 Start Venting Fukushima Dai-ni Unit 2 (JAIF 9 Apr)
- 00.40 Cold Shutdown of Tokai Dai-ni NPS confirmed. (per NISA Sitrep 11 am 2011 Mar 15) I believe any cold shutdown is a good thing.

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[42] http://www.reliefweb.int/rw/rwb.nsf/db900sid/MUMA-8EZ4DA?OpenDocument&rc=3&cc=jpn from OCHA Relief Web

[43] http://www.reliefweb.int/rw/rwb.nsf/db900sid/RKRR-8EZLQD?OpenDocument&rc=3&cc=jpn OCHA Relief Web

[44] http://www.reliefweb.int/rw/fullmaps_sa.nsf/luFullMap/DAFF3E05B66C08E7852578550057F51B/$File/map.pdf?OpenElement OCHA Relief Web

- 02.00 Continue to remove residual heat by Residual Heat Removal System (RHR) in Fukushima Dai-ni Unit 1, 2, 3 and 4. (per NISA Sitrep 11 am 2011 Mar 15)
- 05.06 JST March 15 = 21.05 CET March 14 = when Japan notified IAEA that Fukushima Dai-ni reactor units 1, 2 and 3 are all in cold shutdown. This means that the pressure of the water coolant is at around atmospheric level and the temperature is below 100 degrees Celsius. Under these conditions, the reactors are considered to be safely under control. Tepco still working to bring unit 4 to same condition.
    - However, as we have seen with the spent fuel pools, news media panic, urban legend pranks, and other incidents, there's more that needs to be under control, than the reactors. By Al Mac count, there are a total of FIVE nuclear power plants in trouble, and at least one non-nuclear power plant with lesser chaos.

15 Mar 6.10 F Dai-ichi unit 2 explosion explained (1 Apr 23)

- 06.10 Explosion # 2 noticed or reported by news media, but I think counts are off. JAIF 9 Apr report says initial suspicion included Fukushima Dai-ichi unit 2 Suppression Pool damage.
- 06.14 may now be official time of explosion at Fukushima Dai-ichi unit 2.
    - While earlier explosions with units 1 and 3 did not breach the primary containment, integrity of Unit 2 primary containment vessel is now in doubt.
    - **All 3 explosions** (so far) **were hydrogen**. (IAEA)
- 06.14 Part of wall in operation area of Fukushima Dai-ichi unit 4 was damaged. (NISA Sitrep 5.30 pm March 17)
- 06.20 Sound of explosion heard in Fukushima Dai-ichi unit 2. As the pressure in Suppression Chamber decreased, there was possibility that an incident occurred in this Chamber. (per NISA Sitrep 11 am JST Mar 15, and IAEA 6.15 CET Mar 15)
    - Understanding (per NIST Sitrep 11.30 pm JST Mar 15)
    - Automatic shutdown was initiated immediately after the earthquake and tsunami, with efforts to supply water to cool the fuel rods, but the water level dropped.
    - As stated above, the loss of pressure in Suppression Chamber led to belief that it has been damaged.

15 March continues (1 Apr 27)

- 07.00 Radiation readings of Onagawa NPS monitoring post indicate 6.1 micro Sv/h. (per NISA Sitrep 11 am 2011 Mar 15)
- 07.15 Cold Shutdown of Fukushima Dai-ni Unit 4 confirmed. (per NISA Sitrep 11 am 2011 Mar 15) I believe any cold shutdown is a good thing, and now all 4 units of this NPS got here.
- 07.21 TEPCO told NISA that Fukushima Dai-ichi reached JACT-15 = Unusual increase of radiation dose at the site boundary
- 07.24 Incorporated Administration Agency, Japan Atomic Energy Agency (JAEA) told NISA that Nuclear Fuel Cycle Engineering Laboratories, Tokai Research and Development Centre reached JACT-10
- 07.44 JAEA told NISA that Nuclear Science Research Institute reached JACT-10
- 08.25 White smoke seen coming from Fukushima Dai-ichi unit 2 (JAIF 9 Apr)

- 08.54 Fukushima Dai-ichi unit 4 had a fire which lasted approx 2 hours before it got put out (per Gov of Japan briefings).
- 08.54 TEPCO told NISA that Fukushima Dai-ichi reached JACT-15 = Unusual increase of radiation dose at the site boundary
- 09:16 Plant operators were considering the removal of panels from Fukushima Dai-ichi Units 5 and 6 reactor buildings to prevent a possible build-up of hydrogen in the future. It was a build-up of hydrogen at Units 1, 2 and 3 that led to explosions at the Dai-ichi facilities in recent days. (IAEA info)
- 10.22 Fukushima Dai-ichi unit 3 radiation up to 400mSV per hour (JAIF 9 Apr)
- 10.30 According to the Nuclear Regulation Act, Minister of Economy, Trade and Industry issued directives:
    - For Unit 4: To extinguish fire and to prevent occurrence of re-criticality
    - For Unit 2: To inject water to reactor vessel promptly and to vent Drywell.
- 10.59 Function of Local Emergency Response Headquarters moved to the Fukushima Prefectural Office.
- 11.00 Fukushima Dai-ichi unit 4 fire confirmed out.[45] The temperature of the Spent Fuel Storage Pool has increased.[46]
- 11.00 Prime Minister extended from 20 to 30 km, around the Fukushima power plants, the area for residents to stay indoors. (Previous instructions to residents in the area was on the 12th when those within 10 km of F-I Dai-ichi were evacuated, and those within 20 km of F-II Dai-ni were to remain indoors)
- 12.20 JST = 4.20 CET = when Japan informed IAEA that Fukushima Dai-ichi unit 4 spent fuel storage pond is on fire, and radioactivity is being released directly into the atmosphere. Dose rates of up to 400 millisievert per hour have been reported at the site. The Japanese authorities are saying that there is a possibility that the fire was caused by a hydrogen explosion.[47]
- 16.00 Fukushima Dai-ichi unit 5 water level had decreased to 241 cm above the top of the fuel.
- 16.30 TEPCO told NISA that Fukushima Dai-ichi reached JACT-15 = Unusual increase of radiation dose at the site boundary
- 21.00 Fukushima Dai-ichi unit 5 water level had decreased to 201 cm above the top of the fuel. Officials planning to use an operational diesel generator in unit 6 to supply water to unit 5.

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[45] See IAEA for details … hopefully I translated the time zones correctly.
[46] NIST 15 Mar 11.30 pm Sitrep.
[47] http://www.reliefweb.int/rw/rwb.nsf/db900SID/KKAA-8EYA5D?OpenDocument OCHA Relief Web

- 22.00 According to the Nuclear Regulation Act, Minister of Economy, Trade and Industry issued the following directive:
    - For Unit 4: implement injection of water to Spent Fuel Storage Pool.
- 22.31 Eastern Honshu, Japan experienced a 6.1 quake. Hamaoka nuclear power plant is an estimated 100 kilometres from the epicentre. That plant continues to operate safely. (IAEA confirmed this with Japan.) Units 1 and 2 are decommissioned, Unit 3 is under inspection and not operational, and Units 4 and 5 remain in safe operational status after the 6.1 aftershock.
- 23.10 All units at the Fukushima Daini, Onagawa, and Tokai nuclear power plants are in a safe and stable condition (i.e. cold shutdown).[48]
    - Fukushima Dai-ichi nuclear power plant has most authorities concerned, where sea water injections to cool the reactors in Units 1, 2 and 3 are continuing. Attempts to return power to the entire Daiichi site are also continuing.
    - After explosions at both Units 1 and 3, the primary containment vessels of both Units are reported to be intact. However, the explosion that occurred at 06:14 UTC on 15 March at the Fukushima Dai-ichi Unit 2 may have affected the integrity of its primary containment vessel. All three explosions were due to an accumulation of hydrogen gas.
    - There was a fire at Fukushima Dai-ichi unit 4 which lasted 2 hours.
    - Evacuation and indoors zone has been increased from 20 to 30 kilometers. Ditto no-fly zone. The Japan Coast Guard established evacuation warnings within 10 kilometres of Fukushima Daiichi and 3 kilometres of Fukushima Daini.
- 23.46 TEPCO told NISA that Fukushima Dai-ichi reached JACT-15 = Unusual increase of radiation dose at the site boundary

15 Mar results[49] for **Fukushima I Dai-ichi unit 2**:
Sound of explosion.
Possible damage of the suppression chamber.

15 Mar results[50] for **Fukushima I Dai-ichi unit 4**:
Damage of wall in the 4th floor confirmed.
Fire occurred in the 3rd floor (12:25 extinguished).

15 Mar actions[51] by **Gov**ernment of **Japan**:
05:30 Prime Minister, Kan expressed to establish The Joint Headquarters to Fukushima Dai-ichi NPS accident

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[48] Info via IAEA.
[49] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[50] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[51] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf

10:30 According to the Nuclear Regulation Act, Minister of Economy, Trade and Industry issued the directions as follows.
For Unit 4: To extinguish fire and to prevent the occurrence of re-criticality
For Unit 2: To inject water to reactor vessel promptly and to vent Drywell
11:00 Prime Minister directed the in-house stay area.
In-house stay was additionally directed to the residents in the area from 20 km to 30 km radius from Fukushima Dai-ichi NPS considering reactor situation
22:00 According to the Nuclear Regulation Act, Minister of Economy, Trade and Industry issued the following direction.
For Unit 4: To implement the injection of water to the Spent Fuel Pool.

16 March Time Line (1 Mar 20)

Per Japan: Nuclear and Industrial Safety Agency Tohoku Pacific Earthquake and the seismic damage to the NPSs (As of 23:30 March 15, 2011) of the Government of Japan (NISA info as of 11.30 pm JST) summary link[52] to 6 page detail PDF,[53] including map showing where relevant nuclear plants located, which I downloaded as "**NISA 15 Mar 11.30 pm Sitrep**" (intending to share via my Linked In profile / my box.net files / Japan / official):

The Tohoku Pacific Earthquake of magnitude 9.0 struck the northeastern part of Japan at 2:46 pm on March 11th, 2011.

Reactors count (1 Mar 21)

The earthquake and tsunami affected 4 nuclear power plants, with 14 reactors:
Onagawa = 3 reactors
Fukushima I = 6 reactors
Fukushima II = 4 reactors
Tokai II = 1 reactor

While 3 reactors (Fukushima Dai-ichi (I) Unit 4,5,6) were under periodic inspection, 11 reactors (Onagawa Unit 1,2,3; Fukushima Dai-ichi (I) 1,2,3; Fukushima-Dai-ni (II) Unit 1,2,3,4; and Tokai Dai-ni (II)) were automatically shut-down.
After the automatic shut-down, the Unit 1-3 at Onagawa Nuclear Power Station, the Unit 1-4 at Fukushima II Nuclear Power Station, and the Unit at Tokai II Nuclear Power Station have been cold shut down safely.

[52] http://www.reliefweb.int/rw/rwb.nsf/db900sid/ADGO-8EZLNU?OpenDocument&rc=3&cc=jpn OCHA Relief Web
[53] http://www.reliefweb.int/rw/RWFiles2011.nsf/FilesByRWDocUnidFilename/ADGO-8EZLNU-full_report.pdf/$File/full_report.pdf OCHA Relief Web

16 March Wed continued (1 Apr 27)

- 07.30 Evacuation of population from the 20-kilometre zone around Fukushima Dai-ichi has been successfully completed.
- 08.30 Japan is investigating source of white smoke detected at Fukushima Dai-ichi unit 3. Japan is also examining to see whether there is a direct connection-the radiation levels near the main entrance are changing considerably from moment to moment, and overall, we understand they remain within a range that would impact the human body. At one point last night, a radiation level of 1,000 μSv/h was detected, and as of this morning it had fallen to the 600-800 μSv/h range.[54]
- 09.38 Fire occurred, and extinguished spontaneously in Fukushima Dai-ichi Unit 4 (JAIF 9 Apr)
- 10.00 (just after) radiation levels near Fukushima Dai-ichi unit 3 main entrance jumped rapidly, reaching the mSv/h range. For this reason, reflecting this situation, the minimum necessary personnel on hand temporarily evacuated to a safe area.
- 10.45 workers evacuated from shared control room for Fukushima Dai-ichi units 3 and 4, until it was certain safe to return.
- 10.54 radiation levels began to fall at Fukushima Dai-ichi unit 3. Experts are hard at work analyzing the situation, but at present, we have not confirmed anything, in the reports shared so far.
    - The most probable case is that vapor is being released from part of the containment vessel, as took place in the Unit 2 reactor, and this is appearing as white smoke. As this is vapor which has been absorbing the contained radiation, this may be the reason for the temporary rise in measured radiation levels. This is the situation judged to be most likely according to the analysis at this time. People are monitoring the radiation levels, and confirming conditions such as whether water is actually continuing to flow, with the end goal of swiftly analyzing this situation and deciding measures to take in response.
- 11.30 workers returned to shared control room for Fukushima Dai-ichi units 3 and 4, restarted water injection.

16 Mar results[55] for **Fukushima I Dai-ichi unit 3**:

White smoke generated.

16 Mar results[56] for **Fukushima I Dai-ichi unit 4**:

Fire occurred. TEPCO couldn't confirm any fire on the ground.

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[54] http://www.reliefweb.int/rw/rwb.nsf/db900sid/ADGO-8EZLBA?OpenDocument&rc=3&cc=jpn OCHA Relief Web

[55] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf

[56] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf

17 March Time Line (1 Apr 23)

At least since the 17th, and for many days thereafter, water gets sprayed on Fukushima Dai-ichi unit 3 spent fuel pond. (JAIF 9 Apr)

According to 17 March 3.30 pm EST by MIT NSE:[57]

The high levels of radiation braved by workers at the scene in Fukushima Dai-ichi appear to have reduced after the expansion of the workforce and announcements of infrastructure improvements to come.

In recent days emergency managers were faced with an extremely complicated task to prioritize jobs across all four struggling reactor units in the main part of the site, while a skeleton operating crew maintained the status of units 5 and 6 about two hundred meters away.

There have been about 50 staff engaged in pumping seawater into the reactor cores and primary containment vessels of units 1, 2 and 3. From time to time these need to vent steam, which causes radiation to rise across the site and required the workers to move to a safer location.

Another 130 were also on site, according to reports, including soldiers from the Japan Self Defense Force.

17 March Thursday

Emergency Diesel Generator (1 unit) for Fukushima Dai-ichi Unit 6 operable. Supplying electricity to Unit 5 and 6. Water injection to Spent Fuel Pool through the Make up Water Condensate System (MUWC) progressing. Schedule to inject water to the Reactor Pressure Vessel (RPV) after the recovery of external power source.

Water was delivered to Fukushima Dai-ichi by Self-Defense Force helicopters; Self-Defense Force ground forces; Japan riot police; Japan fire department.

17 March Times Events (1 Apr 27)

- 05.30 Fukushima Dai-ichi unit 2 is getting external grid power line cable installed. (IAEA) They plan to reconnect power to Unit 2 once the spraying of water on the Unit 3 reactor building is completed.
- 09:48 Fukushima Dai-ichi unit 3 received sea water via Self-Defense Force helicopters. (NISA)

[57] http://mitnse.com/2011/03/17/progress-update-at-fukushima-daiichi-31711-330-pm-est/

- 09:52 Fukushima Dai-ichi unit 3 received sea water via Self-Defense Force helicopters.
- 09:58 Fukushima Dai-ichi unit 3 received sea water via Self-Defense Force helicopters.
- 10.01 Fukushima Dai-ichi unit 3 received sea water via Self-Defense Force helicopters.
- 10.15 IAEA reported about people with radioactive contamination detected on them when they were monitored. IAEA later pointed out it was incorrect for news media to say that IAEA had said anything about people sickened by radiation. So far (as of noon March 18 Central European time), IAEA has received ZERO reports about anyone sickened by radiation in Japan.
- 12.00 Fukushima Dai-ichi unit 5 spent nuclear fuel pool water temperature had increased to 64.2 °C (IAEA 6.10 UTC March 18)
- 12.00 Fukushima Dai-ichi unit 6 spent nuclear fuel pool water temperature had increased to 62.5 °C (IAEA 6.10 UTC March 18)
- 16.01 Fukushima Dai-ichi unit 3 arrival of riot police for grand discharge.
- 17.30 Fukushima Dai-ichi unit 2 gets cable installation to receive electricity from the transmission line of Tohoku Electric Power Company. To be connected after completion of discharge work at unit 3. (NISA)
- 17.30 Sea water now going into Fukushima Dai-ichi units 1 2 3.
- 17.30 Water stopped into Fukushima Dai-ichi unit 4.
- 19.05 to 19.30 Fukushima Dai-ichi NPS received water spray from the ground by the riot police of National Police Agency. (NISA)
- 19.35 Fukushima Dai-ichi NPS received water spray car-1 from the ground by the Self-Defense Force. (NISA)
- 19.45 Fukushima Dai-ichi NPS received water spray car-2 from the ground by the Self-Defense Force. (NISA)
- 19.53 Fukushima Dai-ichi NPS received water spray car-3 from the ground by the Self-Defense Force. (NISA)
- 20.00 Fukushima Dai-ichi NPS received water spray car-4 from the ground by the Self-Defense Force. (NISA)
- 20.07 Fukushima Dai-ichi NPS received water spray car-5 from the ground by the Self-Defense Force. (NISA)
- 20.09 Spraying water on Fukushima Dai-ichi unit 3 temporarily interrupted. (IAEA)

17 Mar results[58] for **Fukushima I Dai-ichi unit 3**:

Water discharge by helicopters of Self Defense Force (4 times).
Water spray from the ground by High pressure water cannon trucks (Police: once, Self Defense Force: 5 times)

[58] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf

18 March Time Line (1 Mar 24)

March 18, the International Civil Aviation Organization announced that there are NO restrictions for travel to Japan, related to the nuclear accidents, excluding air ports and sea ports damaged by the tsunami.[59] For more info see World Health Organization: http://www.who.int/en/ and http://www2.icao.int/en/newsroom/default.aspx

March 18, Japanese authorities informed IAEA that they have altered INES ratings as follows:[60]

New INES ratings have been issued for some of the events relating to the nuclear emergency at the Fukushima Dai-ichi and Dai-ni nuclear power plants.[61]

Japanese authorities have assessed that the core damage at the Fukushima Daiichi 2 and 3 reactor units caused by loss of all cooling function has been rated as 5 on the INES scale.

Japanese authorities have assessed that the loss of cooling and water supplying functions in the spent fuel pool of the unit 4 reactor has been rated as 3.[62]

Japanese authorities have assessed that the loss of cooling functions in the reactor units 1, 2 and 4 of the Fukushima Dai-ni nuclear power plant has also been rated as 3. All reactor units at Fukushima Dai-ni nuclear power plant are now in a cold shut down condition.

18 March Times Events (1 Apr 27)

18 March Friday

- 03.00 Fukushima Dai-ichi unit 5 spent nuclear fuel pool water temperature had increased to 65.5 °C (IAEA 6.10 UTC March 18)
- 03.00 Fukushima Dai-ichi unit 6 spent nuclear fuel pool water temperature had increased to 62.0 °C (IAEA 6.10 UTC March 18)
- 06.00 NISA confirmed that the water level of spent fuel storage pool was maintained full. I think this referring to Fukushima Dai-ichi units 5 and 6, thanks to electric power line now connecting the two, so they both can benefit from the diesel electric generator working at unit 6.
- 06.30 Fukushima Dai-ichi water spray by Tokyo Fire Department being confirmed by TEPCO, the Tokyo Fire Department and Futaba Fire fighting Headquarters. (NISA)
- 06.30 Operations for recovery of external power supply to Fukushima Dai-ichi Units 1 to 4 (Power supply from electric transmission grid of Tohoku Electric Power

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[59] http://www.reliefweb.int/rw/rwb.nsf/db900sid/KHII-8F59ZL?OpenDocument&rc=3&cc=jpn OCHA Relief Web

[60] Info supplied 18 March 19.15 JST by Japan Earthquake Update (18 March 2011, 12:25 UTC) on OCHA Relief Web.

[61] On March 24 I updated INES in Acronyms of my general "**Nuclear news and updates**" notes, which periodically get copied here.

[62] I wish we always had clarity Dai-ichi vs, Dai-ni.

Co., and from the route via transformer sub-station of TEPCO) being confirmed. (NISA)

- 11.19 Shared Spent Fuel Pool is 55 C at Fukushima Dai-ichi. (NISA)
- 13:00 Ministry of Education, Culture, Sports, Science and Technology decided to reinforce the nation-wide monitoring survey in the emergency of Fukushima Dai-ichi and Dai-ni NPS. (NISA)
- 14.00 to 14.38 Six fire engines (6 tons of water per car) delivered by Self-Defense Force to Fukushima Dai-ichi.[63] (NISA)
- 14.45 US military fire engine finished delivery water to Fukushima Dai-ichi. (NISA)
- 14.45 Thirty Hyper Rescue carloads of water arrived at J village for delivery to Fukushima Dai-ichi. (NISA)
- 15.00 Seawater is going into Fukushima Dai-ichi Units 1 2. (NISA)
- 15.00 White smoke continues to come from Blow-out Panels of Fukushima Dai-ichi Units 2 3. (NISA)
- 15.55 TEPCO reported to NISA about JACT-62-3 with Fukushima Dai-ichi Units 1 2 3 4. (Leakage of the radioactive materials inside of the reactor building to non-controlled area.)
- 16.48 JAPCO reported to NISA about JACT-62-3 with **Tokai** Unit 2. (Failure of the seawater pump motor of the emergency diesel generator 2C.)
- 18.30 Because of Shroud of RPV[64] replacement work, no fuel[65] was inside the PRV of Fukushima Dai-ichi (I think)[66] Unit 4. (NISA)[67]
- 23.00 Work is on-going to get electricity restored to each and every nuclear unit of Fukushima Dai-ichi. (NISA)
- 23.30 Hyper Rescue of Tokyo Fire Department arrived at Fukushima Dai-ichi Main Gate and started an entrance procedure for the preparation of water spray. (NISA)

18 Mar results[68] for **Fukushima I Dai-ichi unit 3**:

Water spray from the ground by same trucks (Self Defense Force: 6 times).
Water spray from the ground by US water cannon trucks

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[63] Looks like this went to all nuclear units, but maybe it was 1 fire engine for each of the nuclear reactor buildings. (Some trivia is unclear so far. – My main interest here is tracking time line of what exactly is happening, since the picture is very different from what is painted by news media.)

[64] RPV = Reactor Pressure Vessel

[65] I suspect a mis-print or mis-statement, or me earlier transcription error, because on 2010 Nov 30 unit 4 got shut down for routine maintenance and ALL fuel got transferred to the spent fuel pool, then during this crisis its water level dropped and we got a fire there. I suspect they meant to say a continuing problem with the water level there. I am constantly trying to correlate these various time line statements significance.

[66] Sometimes context a little unclear.

[67] http://www.reliefweb.int/rw/RWFiles2011.nsf/FilesByRWDocUnidFilename/JARR-8F3DL6-full_report.pdf/$File/full_report.pdf OCHA Relief Web

[68] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf

(US armed force:1 time).

19 March Time Line (1 Apr 01)

IAEA's radiation monitoring team, which has been measuring radiation levels in Japan since Saturday, 19 March 2011, took readings as close as 16 km away from the nuclear facility and found high levels of radioactivity.[69]

Official Japanese measurements showed radioactivity in drinking water, food and milk at a number of locations in excess of accepted regulatory limits.

It is difficult for IAEA here in Vienna to imagine the conditions in which they are working. The site has been seriously damaged by flood water and is littered with debris. Buildings have been damaged by explosions. There has, for the most part, been no electric power. Radiation levels are elevated. It is no exaggeration to describe the work of the emergency teams as heroic.

10 am EDT March 19 status update by MIT NSE[70]

At a March 19 news conference, Japan's Chief Cabinet Secretary Yukio Edano said that sea water injection is continuing at reactors 1, 2 and 3 at the Fukushima Dai-ichi nuclear power plant.

Preparations were being made to spray water into the used fuel pool at reactor 4, and an unmanned vehicle sprayed more than 1,500 gallons of water over seven hours into the used fuel pool at reactor 3, Edano said. He also said he believed that the situation at the reactor 3 fuel pool is stabilizing.

Some reactor cooling capacity has been restored at reactors 5 and 6 after the installation of generators at those reactors, Edano added.

Edano said that progress had been made on "a fundamental solution" to restore power at the Fukushima Dai-ichi nuclear power plant, with electricity expected to be restored at reactors 1 and 2 today and reactor 3 as early as Sunday.

Edano said that additional equipment was being transported to the site and that other means of providing cooling water to the pool is be examined.

Radiation dose at the west gate of the Fukushima Daiichi was 83 millirem per hour on March 18 at 7:10 p.m. EDT and dropped to 36 millirem per hour by 8 p.m. EDT, Edano said. Radiation levels have decreased since March 16. Although they are higher than

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[69] Japan: IAEA Board Discusses Fukushima Nuclear Accident with a video.
[70] http://mitnse.com/2011/03/19/status-update-3192011-at-1000-am-edt/
http://nei.cachefly.net/newsandevents/information-on-the-japanese-earthquake-and-reactors-in-that-region/

normal, radiation levels near the reactors are within the range that allows workers to continue on-site recovery measures, the International Atomic Energy Agency said.

According to the IAEA, radiation dose rates in Tokyo and other areas outside the 30-kilometer zone remain far below levels which would require any protective action by the public.

All reactors at the Fukushima Daini nuclear power plant are in cold shutdown (See the Japan Atomic Industrial Forum website).

Radiation levels have increased above the (Japan) federal government's level in some food products from the Fukushima Prefecture and nearby areas. These levels were detected in samples of milk in Fukushima Prefecture and six samples of spinach in neighboring Ibaraki Prefecture, according to the Japan Atomic Industrial Forum. (Japan Cabinet Secretary) Edano said that if these products are consumed for a year, the total radiation dose would be equivalent to one CT scan.

International Atomic Energy Agency (IAEA) via OCHA Relief Web[71] provides Japan Earthquake Update (19 March 2011, 4:30 UTC) with an update[72] on conditions at Fukushima Dai-ichi nuclear power plant.[73] I am only including here that which is new info, or clarified info, not included real close elsewhere in these notes.

Fukushima Dai-ichi Units 1 2 3

Coolant within Unit 1 is covering about half of the fuel rods in the reactor.

Efforts to pump seawater into the reactor core are continuing.

Fukushima Dai-ichi Unit 3

Of additional concern at Unit 3 is the condition of the spent fuel pool in the building.[74] There are indications that there is an inadequate cooling water level in the pool, and Japanese authorities have addressed the problem by dropping water from helicopters into the building and spraying water from trucks.

This tells us that the containment between outside of the building (where this water is coming from) and where the spent fuel pool located, has now been breached, so there will be continuing risk of radiation leakage from here, until a new containment can be built,

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[71] http://www.reliefweb.int/rw/rwb.nsf/db900sid/MUMA-8F48KJ?OpenDocument&rc=3&cc=jpn
[72] 4.30 am UTC + 9 hours = 13.30 JST = 1.30 pm.
[73] Reproduction or redistribution of this text, in whole, part or in any form, requires the prior consent of the original source. (IAEA) Al Mac just copies, does not ask permission.
[74] I remember seeing multiple reports on unit 4 spent fuel, where never clear WHICH power plant that was about, but here we know it is Dai-ichi.

like was done at Chernobyl (that containment's life span has expired), or until the spent fuel can be moved somewhere whose containment is still secure, like USA trying to do with controversial Yucca mountain.

Fukushima Dai-ichi Unit 4

A portion of the building's outer shell was damaged by the explosion at Unit 3 on 14 March, and there have been two reported fires - possibly including one in the spent fuel pool on 15 March -- that extinguished spontaneously, although smoke remained visible on 18 March.

Fukushima Dai-ichi Units 5 6

Officials have configured two[75] diesel generators at Unit 6 to power water circulation in the spent fuel pools and cores of Units 5 and 6.

Workers have opened holes in the roofs of both buildings to prevent the possible accumulation of hydrogen, which is suspected of causing explosions at other units.[76]

19 March Times (1 Apr 27)

19 March Saturday

- 00.30 to 01.10 Hyper Rescue Unit of Tokyo Fire Department carried out water spray (60 ton) at Fukushima Dai-ichi. (NISA)
- 04.22 Electric generation for pumping water to both core and spent pool for Fukushima Dai-ichi units 5 6 went from 1 to 2 diesel generators at unit 6. (NISA)
- 05.00 Pump for Residual Heat Removal (RHR) for Unit 5 started up and cooling of Spent Fuel Storage Pool has started. (Power supply: Emergency Diesel Generator for Unit 6) at Fukushima Dai-ichi. (NISA)
- 12.00 Sea water being injected to Fukushima Dai-ichi unit 1 2. (NISA)
- 12.00 Tokyo Electric Power Co. took sample of dust in the air, for the first time, using a monitoring car in front of the main building in Fukushima Dai-ichi Nuclear Power Station and carried out Radioactive Nuclide Analysis. The result of the analysis was reported on 20 March. It showed that the radioactive nuclides of Iodine, Cesium and so on were detected
  - Iodine-131 was the only nuclide among detected that exceeded the allowable criteria of concentration.[77]
  - Workers currently wear Full Face-piece Respirator with charcoal filter, TYVEK Suit and so on, which are effective radiation protection equipments. There is also an examination of their situation when they exit the danger working zones.

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[75] **This also is new**. The last I read it was ONE generator providing electricity to TWO nuclear units.
[76] Yes but, somewhere else I read that the spent fuel pools are located close to the top floor of the buildings, without as much containment protection as the reactor. I hope future designs find a more constructive way to dispose of hydrogen.
[77] See details of them all in PDF, which I downloaded naming "**Radiation 20 Mar 2011 GoJ**".

- 14.10 – 24.30 Hyper Rescue Unit of Tokyo Fire Department scheduled to carry out water spray at Fukushima Dai-ichi. (NISA)
- 14.10 to wee hours next morning March 20 water spray implemented. (NISA)
- 22.14 pump for Residual Heat Removal (RHP) (B) for Fukushima Dai-ichi Unit 6 has recovered and started full operation. (NISA)

19 Mar results[78] for **Fukushima I Dai-ichi unit 3**:

Water spray from the ground by High pressure water cannon trucks by Hyper Rescue Unit of Tokyo Fire Department.

20 March Time Line (1 Apr 23)

At least since the 20th and for many days thereafter, water gets sprayed on Fukushima Dai-ichi units 2, 3, 4 spent fuel ponds. (JAIF 9 Apr)

Here is the status of Fukushima Dai-ichi 6 nuclear units as of 20 March 11 pm JST, thanks to International Atomic Energy Agency (IAEA) via OCHA Relief Web[79] providing Japan: IAEA Briefing on Fukushima Nuclear Emergency (19 March 2011, 14:00 UTC). UTC+9 hours = JST.

It is hoped that power will be restored to Unit 2 within 1 day, which will then act as a hub for restoring power to Unit 1. However, we do not know if the water pumps have been damaged and if they will work when power is restored.[80]

Seawater is still being injected into the reactor pressure vessels of Units 1 and 2 and additional fire trucks have arrived, reinforcing the operation to spray water into the Unit 3 reactor building.

We still lack reliable validated data on water levels and temperatures at the spent fuel pools at Units 3 and 4.

Temperatures at the spent fuel pools in Units 5 and 6 have risen in the past few days but this does not give rise to immediate concern. Water continues to be circulated within the reactor pressure vessels and the spent fuel ponds at both units.

Spent fuel removed from a nuclear reactor is highly radioactive and generates intense heat. This fuel needs to be actively cooled for one to three years[81] in pools that cool the fuel, shield the radioactivity, and keep the fuel in the proper position to avoid fission reactions. If the cooling is lost, the water can boil and fuel rods can be exposed to the air, possibly leading to severe damage and a large release of radiation.

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[78] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf

[79] http://www.reliefweb.int/rw/rwb.nsf/db900sid/KKAA-8F55W9?OpenDocument&rc=3&cc=jpn OCHA Relief Web

[80] A previous effort failed thanks to incorrect connection plugs.

[81] After these 3 years, they can move to other storage arrangements for hundreds of years, which protect humans from radioactivity, but do not require same level of water cooling.

The concern about the spent fuel pools at Fukushima Dai-ichi is that sources of power to cool the pools have been compromised.

In addition to pools in each of the plant's reactor buildings, there is another facility -- the Common Use Spent Fuel Pool -- where spent fuel is stored after cooling at least 18 months in the reactor buildings. This fuel is much cooler than the assemblies stored in the reactor buildings. Japanese authorities have confirmed that fuel assemblies there are fully covered by water, and the temperature was 57 °C as of 20 March, 00:00 UTC.[82]

A second diesel generator is providing power for cooling at Units 5 and 6. We have been informed that holes have been made in the roof of the reactor building at Units 5 and 6 to avoid the risk of a hydrogen explosion.

Radiation levels in major Japanese cities have not changed significantly since yesterday.

The IAEA radiation monitoring team took measurements at seven different locations in Tokyo and in the Kanagawa and Chiba Prefectures. Dose rates were well below those which are dangerous to human health.

The monitoring team are now on their way to Aizu Wakamatsu City, which is 97 km west of the Fukushima nuclear power plant. They have just provided initial measurements from three additional locations.

Measurements made by Japan in a number of locations have shown the presence of radionuclides – ie isotopes such as Iodine-131 and Caesium-137 – on the ground. This has implications for food and agriculture in affected areas. The IAEA and the UN Food and Agriculture Organization (FAO) are consulting with the Japanese authorities on measures being taken in these areas related to food and agriculture.

The Japanese Ministry of Health, Labour and Welfare has announced that radiation levels that exceeded legal limits had been detected in milk produced in the Fukushima area and in certain vegetables in Ibaraki. They have requested the Bureau of Sanitation at the Fukishima Prefectural Office, after conducting an investigation of the relevant information, to take necessary measures, such as identifying the provider of these samples and places where the same lots were distributed and banning sales based on the Food Hygiene Law.

We now have continuous online access to data from CTBTO radionuclide monitoring stations, which is being evaluated by Agency dosimetry specialists.

As far as the Fukushima Dai-ni nuclear power plant is concerned, there is no record of any incidents or radiation releases at the site. Present elevated radiation levels at the Dai-ni site are attributed by Japan to events at the Dai-ichi nuclear power plant.

→ Watch video : View Presentation

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[82] Japan Earthquake Update (20 March 2011, 16:20 UTC)

3.30 EDT status update by MIT NSE[83]

20 March 2011
FIRST PUBLISHED 2.05pm GMT
UPDATE 1: 2.56pm GMT Units 5 and 6 in cold shutdown, tsunami heights
UPDATE 2: 3.30pm GMT IAEA graph of fuel pond temperatures

Workers on site have succeeded in increasing the stability of the Fukushima Dai-ichi reactor units with units 5 and 6 now in cold shutdown. Pressure built up within unit 3 but a more significant venting does not seem necessary now.

External power has now been connected to unit 5 and 6, allowing them to use their residual heat removal systems and transfer heat to the sea. This has been used to cool the fuel ponds and bring the units to cold shutdown status, meaning that water in the reactor system is at less than 100ºC.

An extended operation to refill the fuel pond took place at unit 3, with the Hyper Rescue crew spraying for over 13 hours. Radiation levels 500 metres north of the reactor showed a decrease from 3.44 millisieverts per hour to 2.75 millisieverts per hour, indicating a measure of success in refilling the pond. A similar operation is planned for later today at unit 4 and the surface temperatures of the buildings appear to be below 100ºC.

At units 1 and 2, external power has been restored. Tokyo Electric Power Company (Tepco) said it would restore functions in the central control room shared by the units so that accurate readings could again be taken from the reactor system. Next, workers will check the condition of the water supply systems to the reactor and the used fuel pond. With luck these will be able to go back into operation as they had been immediately after the earthquake on 11 March.[84]

External power for units 3 and 4 should be in place 'in a few days time', said Tepco.

20 March Times Events (1 Apr 27)

20 March Sunday

- 03.40 finished the water spray which started 14.10 previous day (see above).
- 11.00 pressure in the Primary Containment Vessel (PCV) of Fukishima Dai-ichi Unit 3 rose to 320 kPa. (NISA)
- 11.00 to 16.00 Workers[85] did a survey to figure out how and where to install electric supply cable for Fukishima Dai-ichi nuclear building units 3 and 4.[86] (NISA)

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[83] http://mitnse.com/2011/03/20/status-update-32011-at-330-pm-edt/
[84] Other articles had indicated that sea water is corrosive, meaning damage assessments would be needed, followed by repairs, before resume operations.
[85] I hope the workers were properly protected from radiation, while doing this.
[86] The plan is to implement this March 21.

- 14.30 Workers successfully placed Fukishima Dai-ichi reactor Unit 5 into **cold shutdown**. (NISA and IAEA)
- 15.00 40t of Seawater to Fukishima Dai-ichi Spent Fuel Pool of Unit 2 was started. (NISA)
- 15.46 Fukishima Dai-ichi reactor Unit 2 is now receiving electricity and the integrity of each load is under confirmation testing. (NISA)
- 18.30 to 19.46 water spray[87] over Fukishima Dai-ichi Spent Fuel Pool of Unit 4 by Self-Defence Force. (NISA)
- 19.27 Workers successfully placed Fukishima Dai-ichi reactor Unit 6 into **cold shutdown**. (IAEA)[88]
- 19.52 Receiving electricity reached to the transformer of starter for Fukishima Dai-ichi Units 5 and 6. (NISA)
- 20.39 thru wee hours of 21 March water spray over Fukishima Dai-ichi Spent Fuel Pool of Unit 3 by Hyper Rescue Unit of Tokyo Fire Department. (NISA)
- 22.00 pressure monitoring 225 kPa of Primary Containment Vessel (PCV) of Fukishima Dai-ichi Unit 3. (NISA)

20 Mar results[89] for **Fukushima I Dai-ichi unit 2**:
Injection of about 40 tons of seawater into SFP through fire extinguishing system.
Injection of seawater to the Spent Fuel Pool (SFP).

20 Mar results[90] for **Fukushima I Dai-ichi unit 3**:
Sprayed by Hyper Rescue Unit of Tokyo Fire Department.

20 Mar results[91] for **Fukushima I Dai-ichi unit 4**:
Water spray over SFP (spent fuel pool) by Self Defense Force.

20 Mar results[92] for **Fukushima I Dai-ichi units 5 and 6**:
Units 5 and 6 under cold shutdown. (Water temperature of reactor water is less than 100 degrees.)

20 Mar actions[93] by **Gov**ernment of **Japan**:

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[87] This contains risk of radiation and other spillage from the spent fuel pool, but fire department delivery of water to a busted radiation containment building, means a downstream concern about the build up of radioactive water.
[88] Eight other reactors at the Fukushima Daini, Onagawa, and Tokai nuclear power plants were shut down automatically after the earthquake and all are now in cold shutdown.
[89] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[90] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[91] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[92] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[93] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf

23:30 Directive from Local Emergency Response Headquarters to the Prefectural Governor and the heads of cities, towns and villages was issued regarding the change of the reference value for the screening level for decontamination of radioactivity.

21 March Time Line (1 Apr 01)

Here is the status of Fukushima Dai-ichi 6 nuclear units as of 21 March 6 am JST.[94]

Dai-ichi Unit 1

Coolant within Unit 1 is covering about half of the fuel rods in the reactor, and Japanese authorities believe the core has been damaged. High pressure within the reactor's containment led operators to vent gas from the containment. Later, an explosion destroyed the outer shell of the reactor building above the containment on 12 March.

There are no indications of problems with either the reactor pressure vessel or the primary containment vessel. Efforts to pump seawater into the reactor core are continuing. No precise information has been available on the status of the spent fuel pool.

On 18 March, Japan assigned an INES rating of 5 to this unit.

On 19 March, the containment vessel pressure indication was restored.

Dai-ichi Unit 2

Coolant within Unit 2 is covering about half of the fuel rods in the reactor, and Japanese authorities believe the core has been damaged. Following an explosion on 15 March, Japanese officials expressed concerns that the reactor's containment may not be fully intact. As of 19 March, 11:30 UTC, officials could no longer confirm seeing white smoke coming from the building. Smoke had been observed emerging from the reactor earlier.

Efforts to pump seawater into the reactor core are continuing. No precise information has been available on the status of the spent fuel pool. On 20 March, workers began pumping 40 tonnes of seawater into the spent fuel pool.

On 18 March, Japan assigned an INES rating of 5 to this unit.

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[94] Japan Earthquake Update (20 March 2011, 21:00 UTC) (+ 9 hours to get JST) http://www.iaea.org/newscenter/news/tsunamiupdate01.html from International Atomic Energy Agency (IAEA).

Dai-ichi Unit 3

Coolant within Unit 3 is covering about half of the fuel rods in the reactor, and Japanese authorities believe the core has been damaged. High pressure within the reactor's containment led operators to vent gas from the containment. Later, an explosion destroyed the outer shell of the reactor building above the containment on 14 March.

Following the explosion, Japanese officials expressed concerns that the reactor's containment may not be fully intact. White smoke has been seen emerging from the reactor, but on 19 March it appeared to be less intense than in previous days.

Efforts to pump seawater into the reactor core are continuing.

Of additional concern at Unit 3 is the condition of the spent fuel pool in the building. There are indications that there is inadequate cooling water level in the pool, and Japanese authorities have addressed the problem by dropping water from helicopters into the building and spraying water from trucks. Spraying from trucks continued on 20 March. There is no data on the temperature of the water in the pool.

On 18 March, Japan assigned an INES rating of 5 to this unit.

Dai-ichi Unit 4

All fuel from Unit 4 had been removed from the reactor core for routine maintenance before the earthquake and placed into the spent fuel pool. The building's outer shell was damaged on 14 March, and there have been two reported fires ' possibly including one in the area of the spent fuel pool on 15 March -- that were extinguished spontaneously.

Authorities remain concerned about the condition of the spent fuel pool, and Japanese Self Defence Forces began spraying water into the building on 20 March.

On 18 March, Japan assigned an INES rating of 3 to this site.

Dai-ichi Units 5 and 6

Shut down for routine maintenance before the earthquake, both reactors achieved cold shutdown on 20 March. The reactors are now in a safe mode, with cooling systems stable and under control, and with low temperature and pressure within the reactor.

Instrumentation from both spent fuel pools had shown gradually increasing temperatures over the past few days. Officials configured two diesel generators at Unit 6 to power cooling and fresh-water replenishment systems in the spent fuel pools and cores of Units 5 and 6. As of 20 March, temperatures in both pools had decreased significantly.

Workers have opened holes in the roofs of both buildings to prevent the possible accumulation of hydrogen, which is suspected of causing explosions at other units.

Dai-ichi Electric Grid work

Progress has been achieved in restoring external power to the Fukushima Dai-ichi nuclear power plant, although it remains uncertain when full power will be available to all reactors. Off-site electrical power has been connected to an auxiliary transformer and distribution panels at Unit 2. Work continues toward energizing specific equipment within Unit 2.

Fukushima Dai-ichi Evacuation

Japanese authorities have informed the IAEA that the evacuation of the population from the 20-kilometre zone around Fukushima Daiichi has been successfully completed. Japanese authorities have also advised people living within 30 kilometres of the plant to remain inside.

Iodine

On 16 March, Japan's Nuclear Safety Commission recommended local authorities to instruct evacuees leaving the 20-kilometre area to ingest stable (not radioactive) iodine. The pills and syrup (for children) had been pre-positioned at evacuation centers. The order recommended taking a single dose, with an amount dependent on age:

Baby 12.5 mg

1 mo.-3 yrs. 25mg

3-13 yrs. 38mg

13-40 yrs. 76mg

40+ yrs. Not necessary

Fukushima Dai-ichi Radiation Measurements

Radiation levels near Fukushima Dai-ichi and beyond have elevated since the reactor damage began. However, dose rates in Tokyo and other areas outside the 30-kilometre zone remain below levels which would require any protective action. In other words they are not dangerous to human health.

Dose rates have been provided by Ministry of Education, Culture, Sport, Science and Technology for 47 cities and town representing a comprehensive nationwide monitoring network. The data set covers the period from 15 March 08:00 UTC to 20 March 17:00

UTC with an hourly sampling frequency. No significant changes of dose rates have been observed if compared to previous day data.

At the Fukushima Daiichi nuclear plant, radiation levels spiked three times since the earthquake, but have stabilized since 16 March at levels which are, although significantly higher than the normal levels, within the range that allows workers to continue onsite recovery measures. Two new on-site environmental monitoring locations have been added to the monitoring network.

Radionuclides in Foodstuffs and Water

The IAEA has received information from the Japanese Ministry of Health, Labor and Welfare regarding the presence of Iodine-131 in three milk samples tested in the town of Kawamata. The concentration is reported to be above allowed levels. Cesium-137 was detected in one sample, though in concentration below allowed levels.

In the Ibaraki prefecture, Iodine-131 and Cesium-137 have been detected in leaf vegetables such as spring onions and spinach. Some of the samples have been reported to be above the levels allowed by the Japanese food hygiene law for emergency monitoring criteria for intake of vegetables.

According to the Nuclear Safety Division, Ministry of Education, Culture, Sports, Science and Technology (MEXT) analysis for Iodine-131 and Cesium-137 in tap water from 46 locations yielded the majority of samples as non-detects. Only six out of 46 exhibited any iodine-131, though the concentration was reported to be below levels allowed by the Japanese food hygiene law for emergency monitoring criteria for drinking water.

21 March Times Events (1 Apr 27)

21 March Monday

- 03.58 finished water spray which started 21.39 the previous evening. (NISA)
- 04.00 pressure monitoring 140 kPa of Primary Containment Vessel (PCV) of Fukishima Dai-ichi Unit 3. (NISA)
- 06.37 to 08.41 water spray over **Fukishima Dai-ichi** Unit 4 Spent Fuel Pool by Self-Defence Force (13 fire engines). (NISA)
- 10.37 water spray started over **Fukishima Dai-ichi** Common Spent Fuel Pool. (NISA and IAEA)
- 11.36 Power supply for **Fukishima Dai-ichi** Unit 5 was switched from Emergency Diesel Generator to External Power Supply. (NISA)
- 12.15 pressure monitoring 120 kPa of Primary Containment Vessel (PCV) of Fukishima Dai-ichi Unit 3. (NISA)
- 15.00 finished laying electricity cable to Power Center of **Fukishima Dai-ichi** Unit 4. (NISA)

- 15.55 Grayish smoke from **Fukishima Dai-ichi** Unit 3. (NISA) This led to evacuation of workers from units 1-4. (IAEA) This gray smoke ended 18.02 (JAIF 9 Apr)
- 17.55 Smoke seemed to have died down. (NISA and IAEA)
- 18.22 White smoke from **Fukishima Dai-ichi** Unit 2. (NISA, IAEA and JAIF)

At 23:00 March 20th, the directive of the screening level for decontamination of radioactivity, and at 7:45 March 21st, the directive of the administration of stable Iodine were issued to the Prefectural Governor and the heads of cities, towns and villages (Tomioka Town, Hutaba Town, Okuma Town, Namie Town, Kawauchi Village, Naraha Town, Minamisouma City, Tamura City, Kazurao Village, Hirono Town, Iwaki City and Iidate Village). (NISA)

21 Mar results[95] for **Fukushima I Dai-ichi unit 2**:
White smoke generated.

21 Mar results[96] for **Fukushima I Dai-ichi unit 4**:
Water spray over SFP (spent fuel pool) by Self Defense Force.

21 Mar results[97] for **Fukushima I Dai-ichi units 5 and 6**:
Water spray over the Common Spent Fuel Pool started.

21 Mar actions[98] by **Gov**ernment of **Japan**:
07.45 Directive titled as "Administration of the stable Iodine" was issued from Local Emergency Response Headquarters to the Prefectural Governor and the heads of cities, towns and villages.
16:45 Directive titled as "Ventilation for using heating equipments within the in-house evacuation zone" was issued from the Head of Local Emergency Response Headquarters to the Prefectural Governor and the heads of cities, towns and villages.
17:50 Directive from the Head of Government Nuclear Emergency Response Headquarters to the Prefectural Governors of Fukushima, Ibaraki, Tochigi and Gunma was issued, which directs the above mentioned governors to issue a request to relevant businesses and people to suspend shipment of spinach, Kakina (a green vegetable) and raw milk for the time being.

22 March Time Line (1 Apr 23)

Here is Fukushima Dai-ichi situation as of midnite 21-22 March JST, as known to IAEA:[99]

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[95] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[96] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[97] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[98] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf

- Offsite power is getting restored.
- Seawater is getting injected into reactor pressure vessel.
- Water is being sprayed onto the spent fuel pools.
- Pressure falling again.
- Some info is still uncertain.

Concerned by possible loss of water in Fukushima Dai-ichi Unit 3 spent fuel pool, authorities began spraying water into the building in an effort to replenish water levels. First, helicopters dropped seawater on 17 March, and every day since then, **including 21 March, emergency workers have sprayed water from fire trucks and other vehicles, so far spraying at least 3,742 tonnes.**[100]

IAEA radiation monitoring team took measurements at distances from 56 to 200 km from the Fukushima nuclear power plant. At two locations in Fukushima Prefecture gamma dose rate and beta-gamma contamination measurements have been repeated. These measurements showed high beta-gamma contamination levels. Measurements by the IAEA and the Japanese authorities were taken at the same time and locations. The Japanese and independent IAEA measurements gave comparable results.

Measurement of gamma dose rate and beta-gamma contamination were taken on 20 March at more locations. The dose-rate results ranged from 2-160 microsieverts per hour, which compares to a typical natural background level of around 0.1 microsieverts per hour. High levels of beta-gamma contamination have been measured between 16-58 km from the plant. Available results show contamination ranging from 0.2-0.9 MBq per square metre.

Further measurements are needed to assess possible contamination beyond the area currently monitored - both closer to the facility and further way. We have no contamination measurements showing that that contamination levels are high at greater distances than 58 km from the plant, but this cannot be excluded.

Additional radiation monitoring is planned for greater distances from the nuclear power plant.

Some results on the monitoring of foodstuffs have been made available by Japan to the IAEA and FAO. Results provided recently by the Japanese authorities range up to 55 000 Bq per kg of I-131 in samples of Spinach taken in in the Ibaraki Prefecture. These high values are significantly above Japanese limits for restricting food consumption (i.e. 2 000 Bq/kg). I understand that the Japanese Government is actively considering relevant precautionary measures and has instructed four Prefectures (Ibaraki, Totigi, Gunma, Fukushima) to refrain,

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[99] http://www.reliefweb.int/rw/rwb.nsf/db900sid/MUMA-8F749C?OpenDocument&rc=3&cc=jpn OCHA Relief Web

[100] IAEA report from OCHA Relief Web http://www.reliefweb.int/rw/RWFiles2011.nsf/FilesByRWDocUnidFilename/EGUA-8F7RNF-full_report.pdf/$File/full_report.pdf

for the time being, from distributing two types of vegetables (spinach and kakina) from these Prefectures and milk from Fukshima.

Thanks to Japan Resilience for link[101] to CNN story,[102] attributed to non-profit Japan Atomic Industrial Forum and Tokyo Electric Power Co, on the status of Fukushima Dai-ichi six reactors. Much of this content has obviously gone through the usual media spin.

- Unit 1 containment is still intact, various aspects of interior damaged. Workers have been pumping a mix of seawater and boron into the reactor to prevent further core damage until coolant systems can be brought back on line.
- Unit 2 containment suspected of being damaged (how many days has this been an unresolved question?). Lots more unresolved.
- Unit 3 also lots unresolved. A pool containing spent fuel rods is a chief concern.
- Unit 4 more speculations. The reactor does not contain any fuel rods, but the pool that houses the spent fuel rods is a chief concern.
- Units 5 and 6 Workers created vent holes in the building's roof to avoid a hydrogen explosion. The cooling system is working and powered by a generator. That controls the temperature of the reactor, which is in cold shutdown, and the pool containing spent fuel rods.

22 March Times Events (1 Apr 27)

22 March Tuesday

- 02.33 Sea water injection, in addition to fire extinguisher line, started at **Fukishima Dai-ichi** Unit 1 (JAIF 9 Apr)
- 08.00 49 °C Spent Fuel Temperature **Fukishima Dai-ichi** Unit 2. (IAEA)
- 11.20 Reactor Pressure Vessel (RPV) temperature increased at **Fukishima Dai-ichi** Unit 1 (JAIF 9 Apr)
- 14.25 50 °C Spent Fuel Temperature **Fukishima Dai-ichi** Unit 2. (IAEA)
- 15.10 to 15.59 Water spray over **Fukishima Dai-ichi** Unit 3 by Hyper Rescue Unit of Tokyo Fire Department. (NISA)
- 16.07 to 17.01 Seawater delivered to Spent Fuel Pool of **Fukishima Dai-ichi** Unit 2. (NISA)
- 17.10 – 20.09 Water spray over **Fukishima Dai-ichi** Unit 4 using a Concrete Pump Truck (50t/h). (NISA)
- 19.41 All power supply switched to external power for **Fukishima Dai-ichi** Units 5 and 6 (JAIF 9 Apr)
- 22.46 Lights back on in main control room of **Fukishima Dai-ichi** Unit 3 (JAIF 9 Apr)

22 Mar results[103] for **Fukushima I Dai-ichi unit 1:**

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[101] http://japan.resiliencesystem.org/status-six-reactors-fukushima-daiichi-nuclear-plant
[102] http://www.cnn.com/2011/WORLD/asiapcf/03/22/japan.reactors.status/
[103] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf

Rise of reactor temperature (383 degrees) → Drop (26th 05:00 144.3 degrees)

22 Mar results[104] for **Fukushima I Dai-ichi unit 2**:
Injection of seawater to the Spent Fuel Pool (SFP).

22 Mar results[105] for **Fukushima I Dai-ichi unit 3**:
Lighting in the Central Control Room was recovered.

22 Mar results[106] for **Fukushima I Dai-ichi unit 4**:
Water spray (Concrete Pump Truck).

22 Mar results[107] for **Fukushima I Dai-ichi units 5 and 6**:
Recovering power supply of unit 5 and 6 is completed.

23 March Time Line (1 Apr 27)

Japanese authorities have reported that the Tokyo Electric Power Company has detected radioactive materials in seawater at one location near the Southern discharge canal at the Fukushima Daiichi nuclear power plant. Samples taken included levels of iodine-131, cesium-134, and cesium-137.

To study a larger area of the marine environment, the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) plans to measure radioactivity around Fukushima Dai-ichi from 22-23 March. Seawater will be collected from eight locations, and the Japan Atomic Energy Agency plans to analyze the samples and release results on 24 March. The analysis will include radionuclide concentrations found in sea water and dose rate in the air.

23 March Wednesday

- 06.20 51 °C Spent Fuel Temperature **Fukishima Dai-ichi** Unit 2. (IAEA)
- 11.20 53 °C Spent Fuel Temperature **Fukishima Dai-ichi** Unit 2. (IAEA)
- 15.30 50 °C Spent Fuel Temperature **Fukishima Dai-ichi** Unit 2. (IAEA)

23 Mar results[108] for **Fukushima I Dai-ichi unit 1:**
Water supply line in addition to the Fire Extinguisher line, Switched to water supply line only. (Flow rate: 7m3/h)

23 Mar results[109] for **Fukushima I Dai-ichi unit 3**:

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[104] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[105] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[106] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[107] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[108] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[109] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf

Injection of seawater to the Spent Fuel Pool (SFP).

23 Mar results[110] for **Fukushima I Dai-ichi unit 4**:
Water spray (Concrete Pump Truck).

24 March Time Line (1 Apr 27)

Dai-ichi Unit 3

Control room lights turned back on.[111]
Suspicion of a breach occurred when workers, trying to hook up electrical power, stepped in some water found to be much more radioactive than anticipated. All three of them were hospitalized, then released March 28.

24 March Thursday

- 11.30 main control room lights back on Dai-ichi Unit 1 (JAIF 9 Apr)

24 Mar results[112] for **Fukushima I Dai-ichi unit 1:**
Lighting in the Central Control Room was recovered.

24 Mar results[113] for **Fukushima I Dai-ichi unit 3**:
Injection of seawater to the Spent Fuel Pool (SFP).

24 Mar results[114] for **Fukushima I Dai-ichi unit 4**:
Water spray (Concrete Pump Truck).

24 Mar results[115] for **Fukushima I Dai-ichi units 5 and 6**:
The power was started to be supplied. Cooling also started.

25 March Time Line (1 Apr 23)

Fresh water replaced sea water at **Fukushima Dai-ichi**.

Dai-ichi Unit 1

Control room lights turned back on.
Radioactivity was found in the water of Fukushima Dai-ichi unit 1 turbine hall, which was pumped to storage tanks to allow the radioactivity to decay.[116]

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[110] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[111] https://netfiles.uiuc.edu/mragheb/www/NPRE%20402%20ME%20405%20Nuclear%20Power%20Engineering/Fukushima%20Earthquake%20and%20Tsunami%20Station%20Blackout%20Accident.pdf
[112] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[113] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[114] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[115] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf

25 March Times Events (1 Apr 27)

25 March Friday

- Residents within 20-30 km of **Fukushima Dai-ichi** were asked to voluntarily evacuate. (JAIF 9 Apr)
- 15.37 Fresh water replaced sea water into **Fukushima Dai-ichi** unit 1 (JAIF 9 Apr)
- 18.02 Fresh water replaced sea water into **Fukushima Dai-ichi** unit 3 (JAIF 9 Apr)

25 Mar results[117] for **Fukushima I Dai-ichi unit 1:**
Started fresh water injection.

25 Mar results[118] for **Fukushima I Dai-ichi unit 2**:
Injection of seawater to the Spent Fuel Pool (SFP).

25 Mar results[119] for **Fukushima I Dai-ichi unit 3**:
Water spray (Emergency fire support team).
Started fresh water injection.

25 Mar results[120] for **Fukushima I Dai-ichi unit 4**:
Injection of seawater to SFP (Spent Fuel Ponds) via the Fuel Pool Cooling Line (FPC).
Water spray (Concrete Pump Truck).

25 Mar actions[121] by **Gov**ernment of **Japan**:
NISA directed orally to the TEPCO regarding the exposure of workers at the turbine building of Unit 3 of Fukushima Dai-ichi Nuclear Power Station occurred on March 24th, to review immediately and to improve its radiation control measures from the viewpoint of preventing a recurrence.

Since there was a mistake in the evaluation regarding the concentration measurement of radioactive materials, NISA directed TEPCO orally to prevent the recurrence of such a mistake

13:50 Receiving the suggestion by the special meeting of Nuclear Safety Commission, NISA directed TEPCO orally to add the sea water monitoring points and carry out the groundwater monitoring.

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116 https://netfiles.uiuc.edu/mragheb/www/NPRE%20402%20ME%20405%20Nuclear%20Power%20Engineering/Fukushima%20Earthquake%20and%20Tsunami%20Station%20Blackout%20Accident.pdf
117 http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
118 http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
119 http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
120 http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
121 http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf

Regarding the delay in the reporting of the water confirmed outside of the turbine buildings, NISA directed TEPCO to accomplish the communication in the company on significant information in a timely manner and to report it in a timely and appropriate manner.

26 March Time Line (1 Apr 27)

Dai-ichi Unit 2

Control room lights turned back on.[122]

26 March Saturday

- 10.10 Freshwater injection started into **Fukushima Dai-ichi** unit 2 (JAIF 9 Apr)
- 16.46 Lights available in main control room of **Fukushima Dai-ichi** unit 2 (JAIF 9 Apr)

26 Mar results[123] for **Fukushima I Dai-ichi unit 2**:
Lighting in the Central Control Room was recovered.

27 March Time Line (1 Apr 27)

27 March Sunday

- 08.30 continuing to transfer water in the basement of **Fukushima Dai-ichi** unit 1 turbine building (JAIF 9 Apr)

27 Mar results[124] for **Fukushima I Dai-ichi unit 2**:
Switched water injection to the core using a temporary motor-driven pump.

27 Mar results[125] for **Fukushima I Dai-ichi unit 3**:
Water spray by Concrete Pump Truck.

27 Mar results[126] for **Fukushima I Dai-ichi unit 4**:
Water spray (Concrete Pump Truck).

28 March Time Line (1 Apr 27)

28 March Monday

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122 https://netfiles.uiuc.edu/mragheb/www/NPRE%20402%20ME%20405%20Nuclear%20Power%20Engineering/Fukushima%20Earthquake%20and%20Tsunami%20Station%20Blackout%20Accident.pdf
123 http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
124 http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
125 http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
126 http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf

- 17.40 Start to transfer water from CST to the surge tank of **Fukushima Dai-ichi** unit 3 (JAIF 9 Apr)

28 Mar results[127] for **Fukushima I Dai-ichi unit 3**:
Switched to the water injection to the core using a temporary Motor driven pump.
In order to prepare for transfer the stagnant water on the basement floor of turbine building to the Condenser, the water in the Condensate Storage Tank is being transferred to the Surge Tank of Suppression Pool Water.

29 March Time Line (1 Apr 27)

29 March Tuesday

- 11.50 Lights on again in main control room of **Fukushima Dai-ichi** unit 4 (JAIF 9 Apr)
- 16.45 Start to transfer water from CST to the surge tank of **Fukushima Dai-ichi** unit 2 (JAIF 9 Apr)

29 Mar results[128] for **Fukushima I Dai-ichi unit 1:**
Switched to water injection to the core using a temporary motor operated pump.

29 Mar results[129] for **Fukushima I Dai-ichi unit 2**:
Seawater injection to Spent Fuel Pool (SFP) using the Fire Pump.
Truck was switched to fresh water injection using temporary Motor-driven pump.
In order to prepare for transferring stagnant water on the basement floor of turbine building to the Condenser, water in the Condensate Storage Tank is being transferred to the Surge Tank of Suppression Pool Water.

29 Mar results[130] for **Fukushima I Dai-ichi unit 3**:
Started to spray freshwater by Concrete Pump Truck.

29 Mar results[131] for **Fukushima I Dai-ichi unit 4**:
Lighting in the Central Control Room was recovered.

29 Mar actions[132] by **Gov**ernment of **Japan**:

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[127] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[128] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[129] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[130] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[131] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[132] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf

In order to strengthen the system to assist the nuclear accident sufferers, the "Team to Assist the Lives of the Nuclear Accident Sufferer" headed by the Minister of Economy, Trade, and Industry, was established.

30 March Time Line (1 Apr 27)

30 March Wednesday

30 Mar results[133] for **Fukushima I Dai-ichi unit 2**:

The injection pump was switched to the Fire Pump Truck. However, because cracks were confirmed in the hose (12:47 and 13:10 March 30th), the injection was suspended. Injection of fresh water resumed at 19:05 March 30th.

30 Mar results[134] for **Fukushima I Dai-ichi unit 4**:

White smoke was confirmed to generate continuously.
Spray of fresh water (Around 140t) over SFP (Spent Fuel Pool) using Concrete Pump Truck (50t/h).
Fresh water is being injected to the spent fuel pool.

30 Mar results[135] for **Fukushima I Dai-ichi units 5 and 6**:

Back up power of Unit 6 is in working condition, and external power was supplied to Unit 5 as of March 30th.

30 Mar actions[136] by **Gov**ernment of **Japan**:

Directions as to implement the emergency safety measures for the other power stations considering the accident of Fukushima Dai-ichi and Dai-ni NPSs in 2011 was issued and handed to each electric power company and the relevant organization.

31 March Time Line (1 Apr 27)

31 March Thursday

- 09.20 to 11.15 work to remove water from **Fukushima Dai-ichi** unit 1 trench (JAIF 9 Apr)
- 12.00 Start to transfer water from CST to the surge tank of **Fukushima Dai-ichi** unit 1 (JAIF 9 Apr) … this got completed April 2.
- 13.03 Start water injection to Spent Fuel Pools (SFP) of **Fukushima Dai-ichi** unit 1 (JAIF 9 Apr)

31 Mar results[137] for **Fukushima I Dai-ichi unit 1:**

White smoke was confirmed to generate continuously.
Freshwater is being injected into the RPV (Reactor Pressure Vessel).

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[133] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[134] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[135] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[136] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[137] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf

31 Mar results[138] for **Fukushima I Dai-ichi unit 2**:
White smoke was confirmed to generate continuously.
Fresh water is being injected to the SFP (Spent Fuel Pool) and the RPV (Reactor Pressure Vessel).

31 Mar results[139] for **Fukushima I Dai-ichi unit 3**:
White smoke was confirmed to generate continuously.
Fresh water is being injected to the spent fuel pool and the RPV (Reactor Pressure Vessel).

Time Line 2011 April (1 Apr 23)

Extra heading inserted to make it easier to navigate from Table of Contents.

01 April Time Line (1 Apr 23)

01 April Friday

- 13.40 Start transferring pooled water from **Fukushima Dai-ichi** unit 6 radioactive waste processing facility to **Fukushima Dai-ichi** unit 5 condenser (JAIF 9 Apr)

02 April Time Line (1 Apr 23)

02 Apr Saturday

- 16.25 Start injecting concrete into **Fukushima Dai-ichi** unit 2 to stop water leakage from the pit near the intake (JAIF 9 Apr)
- 17.10 Start transferring water from **Fukushima Dai-ichi** unit 2 condenser to the CST (JAIF 9 Apr)

03 April Time Line (1 Apr 23)

03 Apr Sunday

- 12.18 switch power supply for water injection pumps to the Reactor Pressure Vessel (RPV) **Fukushima Dai-ichi** units 1 2 3 4 from power supply vehicles to (now repaired) originally equipped external power source (JAIF 9 Apr)

04 Apr Monday

[138] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf
[139] http://japan.resiliencesystem.org/sites/default/files/Fukushima_Report.pdf

05 April Time Line (1 Apr 23)

05 Apr Tuesday

- 15.07 Hardening agent was injected into **Fukushima Dai-ichi** unit 2 hole dug around pit at discharge outlet, to put a stop to leakage. (JAIF 9 Apr)

06 April Time Line (1 Apr 23)

06 Apr Wednesday

- 05.38 It was confirmed that the highly radioactive water was no longer flowing from **Fukushima Dai-ichi** unit 2 pit at discharge outlet. (JAIF 9 Apr)

07 April Time Line (1 Apr 23)

07 Apr Thursday

- 01.31 Injection of Nitrogen gas started after opening all valves through line to **Fukushima Dai-ichi** unit 1 (JAIF 9 Apr)

08 April Friday

09 April Time Line (1 Apr 23)

09 April Saturday

I downloaded a document, calling it "**JAIF 9 April Fukushima Sitrep**" which is a situation report on Japan nuclear crisis thru April 9, from JAIF = Japan Atomic Industrial Forum.[140] I uploaded it to my Linked In[141] full profile box net files / folder – Japan / sub-folder "official".[142]

10 April Sunday

11 April Time Line (1 Apr 24)

11 April Monday

APRIL 11th, the Japanese authorities announced that they had reassessed the severity of the ongoing crisis at the Fukushima Dai-ichi nuclear plant. Having previously categorized the incidents at reactors 1, 2 and 3 in the plant as three different accidents classified as level 5 on the International Nuclear Event Scale (INES) they were now going to treat them all together as a level seven accident.[143]

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[140] http://www.jaif.or.jp/english/
[141] http://www.linkedin.com/in/almacintyre
[142] "Official" sub-folder is for documents from official sources, as opposed to my research like this one.
[143] http://japan.resiliencesystem.org/fukushima-daiichi-power-plant-accident-raised-crisis-level-5-7

The Nuclear and Industrial Safety Agency (NISA) says the damaged facilities have been releasing a massive amount of radioactive substances, which are posing a threat to human health and the environment over a wide area. The discharged radioactive materials (so far) are approx 10% of what came from Chernobyl. I downloaded NISA press release on this topic, labeling it "**NISA 12 Apr INES**."

According to the International Atomic Energy Agency (IAEA) the fire in a spent-fuel pool at reactor number 4 is still classified independently at level 3 on the INES scale, making it an "incident", not an "accident".[144]

12 April Tuesday
13
14
15 April Friday
16
17 April Sunday

18 April Time Line (1 Apr 24)

As reported in MPHISE Japan Resilience Radiation Medicine group:[145] AP - AOL News reported:[146] robots visited Unit 1 and Unit 3 at the tsunami-flooded **Fukushima Dai-ichi** plant, and found the radiation there to be too high for humans to go in.

18 April Monday
19 April Tuesday
20
21
22 April Friday
23
24
25 April Monday
26
27
28
29 April Friday
30

Time Line 2011 May (1 May 17)

Extra heading inserted to make it easier to navigate from Table of Contents.

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[144] http://www.economist.com/blogs/babbage/2011/04/japans_nuclear_crisis
[145] http://japan.resiliencesystem.org/robot-japanese-reactors-detects-high-radiation
[146] http://www.aolnews.com/2011/04/18/robot-in-japanese-reactors-detects-high-radiation/

01 May
02 May Monday
03
04
05 May Thursday

06 May Time Line (1 May 10)

As reported in MPHISE Japan Resilience groups,[147] CBS News reported[148] that the Japanese government asked Chubu Electric to shut down Hamaoka nuclear plant, which is 100 metres off the Pacific coast in central Japan, for 2 years while a seawall and other structures are built to ensure a major earthquake or tsunami does not cause a second radiation crisis. This request came Friday May-6, during a government safety review of all of Japan's 54 nuclear reactors.

Earthquake experts' have forecast a 90 per cent probability of a quake with magnitude of 8.0, or higher, striking central Japan within 30 years. Previously they had made similar prediction exactly where the latest disaster struck.

06 May Friday
07 May Saturday
08
09 May Monday

10 May Time Line (1 May 12)

Tap Water restriction, outside of Fukushima, has been lifted.[149]
10 May Tuesday

11 May Wednesday
12 May Thursday
13 May Friday
14
15 May Sunday

16 May Time Line (1 May 17)

Here are results of testing different kinds of food for radiation content.[150]
Raw tea is the only food with a problem, out of those tested.

16 May Monday
17 May Tuesday
18

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[147] http://japan.resiliencesystem.org/japan-wants-3-reactors-shut-until-seawall-built
[148] http://www.cbc.ca/news/world/story/2011/05/06/japan-reactor-closing.html?ref=rss
[149] http://www.world-nuclear-news.org/RS_Water_poses_questions_for_Tepco_1205111.html
[150] http://www.mhlw.go.jp/english/topics/2011eq/level_ma16.html

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20

Lessons (Lessons Japan)

This section was moved to a separate document April 24, 2011. The new document is initially called "**Lessons Japan disaster for whole world**." The events occurred in Japan, but the entire world needs to learn from them.

Planning before Disaster (Lessons Japan)

This was moved to "**Lessons Japan disaster for whole world**" April 24, 2011

Worst earthquakes in history (Lessons Japan)

This was moved to "**Lessons Japan disaster for whole world**" April 24, 2011

Earthquake Tsunami Risks (Lessons Japan)

This was moved to "**Lessons Japan disaster for whole world**" April 24, 2011

Nuclear Accident Risks (Lessons Japan)

This was moved to "**Lessons Japan disaster for whole world**" April 24, 2011

Rethinking Risks (Lessons Japan)

This was moved to "**Lessons Japan disaster for whole world**" April 24, 2011

Managing Design Risks (Lessons Japan)

This was moved to "**Lessons Japan disaster for whole world**" April 24, 2011

Stop ignoring recommendations (Lessons Japan)

This was moved to "**Lessons Japan disaster for whole world**" April 24, 2011