Nelson, Robert

From: Nelson, Robert
Sent: Thursday, March 24, 2011 2:14 PM
To: Williams, Shawn
Subject: FW: Answers in our FAQs

Lease respond to Holly & cc me.

NELSON

From: Harrington, Holly
Sent: Thursday, March 24, 2011 2:12 PM
To: Nelson, Robert; Williams, Shawn
Subject: Answers in our FAQs

I'm stepping into this discussion because Scott is extremely tied up right now on other issues. If I understand the concern, the answer to the first Q pasted below could give the wrong impression and you prefer the wording in the second Q pasted below. From our standpoint, however, the answer to the second Q is much too complicated for the purposes of the FAQS that contain the first question. In other words, the first document is a very layman's high-level look at the disaster, while Annie's document is a much more detailed and specific one.

So I've used Annie's language in a layman's way to try and meet your concern. See my version in red below and let me know if that addresses your concern.

Can the Japanese nuclear crisis happen here in the United States?
The events that have occurred in Japan are the result of a combination of highly unlikely natural disasters. These include the fifth largest earthquake in recorded history and the resulting devastating tsunami. It is highly unlikely that a similar event could occur in the United States.

1) Can an earthquake and tsunami as large as happened in Japan also happen here?
This earthquake occurred on a "subduction zone", which is the type of tectonic region that produces earthquakes of the largest magnitude. A subduction zone is a tectonic plate boundary where one tectonic plate is pushed under another plate. Subduction zone earthquakes are also required to produce the kind of massive tsunami seen in Japan. In the continental US, the only subduction zone is the Cascadia subduction zone which lies off the coast of northern California, Oregon and Washington. So, a continental earthquake and tsunami as large as in Japan could only happen there. The only nuclear plant near the Cascadia subduction zone is the Columbia Generating Station. This plant is located a large distance from the coast (approximately 225 miles) and the subduction zone (approximately 300 miles), so the ground motions estimated at the plant are far lower than those seen at the Fukushima plants. This distance also precludes the possibility of a tsunami affecting the plant. Outside of the Cascadia subduction zone, earthquakes are not expected to exceed a magnitude of approximatly 8. Magnitude is measured on a log scale and so a magnitude 9 earthquake is approximately 32 times larger than a magnitude 8 earthquake.

Can the Japanese nuclear crisis happen here in the United States?
The events that have occurred in Japan are the result of a combination of an extremely large earthquake followed by a massive tsunami. Based on the geology of the U.S., this combination of extreme events could only occur in one area of the U.S., and the single plant in that location is far inland and subject to significantly lower ground motion that that see at the Fukushima plants. For these reasons, it is highly unlikely that a similar event could occur in the United States.

w/301

Cheok, Michael

From: Leeds, Eric JRR
Sent: Thursday, March 24, 2011 5:50 PM
To: Grobe, Jack; Boger, Bruce
Cc: Bahadur, Sher; Blount, Tom; Brown, Frederick; Cheok, Michael; Evans, Michele; Galloway, Melanie; Giitter, Joseph; Givvines, Mary; Hiland, Patrick; Holian, Brian; Howe, Allen; Lee, Samson; Lubinski, John; McGinty, Tim; Nelson, Robert; Quay, Theodore; Ruland, William; Skeen, David
Subject: FYI: WENRA Statement Regarding Japan

Eric J. Leeds, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
301-415-1270

R

From: Doane, Margaret
Sent: Thursday, March 24, 2011 5:15 PM
To: Borchardt, Bill
Cc: Mamish, Nader; Holahan, Gary; Leeds, Eric; Johnson, Michael; Miller, Charles; Weber, Michael; Virgilio, Martin
Subject: WENRA Statement Regarding Japan

This is just a heads up. The Chairman has a phone call with Mike Weightman, UK head regulator, tomorrow. I will be providing to the Chairman for background the Western European Nuclear Regulators Association's discussion of a lessons learned initiative in light of the events in Japan. WENRA refers to the initiative as performing "stress tests." Pasted below are two documents. One is a press release giving the background for WENRA undertaking this initiative. The other is the details of what should be undertaken in these stress tests. For purposes of the phone call, we've included a talking point that asks Mr. Weightman his views on the initiative. Also, if you're interested in going directly to the WENRA website for the documents go to http://www.wenra.org/extra/news

WENRA statement on the Fukushima NPP accident

The Heads of the nuclear regulatory bodies of European nations with nuclear power plants met in Helsinki on the 22 and 23 March 2011. During the meeting WENRA discussed the tragic events in Japan, and in particular the role of nuclear safety regulators in understanding the circumstances.

WENRA wishes to express its utmost sympathy for the plight of the Japanese people, its admiration of the dedication of those personnel in responding to the event on the site, and its desire to offer what ever help it could to assist in the response and learning from the event.

At the present time the event is still in progress and much difficult work is required to bring the plant under full control. Furthermore, continued vigilance will be required for weeks if not months to come and the management of the consequences may take decades.

WENRA recognises that, despite the high levels of safety for European nuclear plants, it is important to learn any immediate lessons from the Fukushima accident and to aim for the highest levels of safety in line with the fundamental principle of nuclear safety – continuous improvement.

W/302

To this end, in addition to national level initiatives, and in response to discussions at the Council of the European Union for Energy held on 21st March, a WENRA task force is working to provide urgently an independent regulatory technical definition of a "stress test" and how it should be applied to nuclear facilities across Europe. This will take account of the detailed work which WENRA has done for existing reactors (safety reference levels) and for new reactors (safety objectives for new nuclear power plants). A proposal for this work has been prepared.

The aim of the work is to see what improvements to nuclear safety may be appropriate in light of the Fukushima nuclear accident, as far as it is understood. It will be given to European Nuclear Safety Regulators' Group (ENSREG) to assist in its response to requests for advice from the Council of the European Union and European Commission.

Additionally, WENRA members will be offering to the IAEA to send nuclear experts to their response centre to assist them in responding to the ongoing event, and possible future events, to understand the circumstances and lessons to be learnt, and to provide real time authoritative information to regulatory bodies.

Published: 2011-03-23 20:38

News archive

First proposal about European "stress tests" on nuclear power plants

Definition and objective

We define a "stress test" as a targeted reassessment of the safety margins of NPPs in the light of the events which occurred in Fukushima.

This reassessment will be based on the existing safety studies and engineering judgement to evaluate the behaviour of a nuclear power plant when facing a set of challenging situations (those envisaged under the following section "technical scope").

For a given plant, the reassessment will report on the behaviour of the plant (most probable behaviour, with mention of potential cliff-edge effect) for each of the considered situations.

The results of the reassessment may indicate a need for additional safety provisions being technical or organisational (such as procedures, human resources, emergency response organisation, use of external resources).

It remains a national responsibility to take any appropriate measures resulting from the reassessment.

Technical scope

The scope takes into account the issues that have been directly highlighted by the events that occurred in

Fukushima and the possibility for combination of initiating events. The following situations will be envisaged:

Initiating events
1. Earthquake exceeding the design basis
2. Flooding exceeding the design basis
3. Other extreme external conditions challenging the specific site

Consequential loss of safety functions
4. Prolonged total loss of electrical power
5. Prolonged loss of the ultimate heat sink

Accident management issues
6. Core melt accident, including consequential effects such as hydrogen accumulation
7. Degraded conditions in the spent fuel storage, including consequential effects such as the loss of shielding of radiation

Consideration should be given to:
- automatic actions,
- operators actions specified in emergency operating procedures,
- any other planned measures of prevention, recovery and mitigation of accidents, - the situation outside the plant
- the possibility of several units being affected at the same time.

Given the tight timeframe of the exercise, very clear guidance for each selected scenario will be developed by WENRA.

Methodology and timeframe

The licensee has the prime responsibility for safety. Hence, it is up to the licensees to perform the reassessments, and to the regulatory bodies to independently review them.

A task force of WENRA should conduct discussions with the European nuclear industry and bring its proposal to the European Nuclear Safety Regulators Group (ENSREG) meeting scheduled on the 12th of May. This proposal will then be presented and further discussed at the European level.

Timeframe needs further consideration, taking into account the available resources for daily focus on safety. The following figures are just indications.

The licensees could be given 6 months to perform the reassessments as described above and to send the results and related documentation to their national regulator.

The regulator then would perform a review of the licensees' submissions. Interactions between European regulators will be necessary and could be managed through WENRA or ENSREG. Regulators will perform, within 3 months, the review and produce a report which should be published.

Results of the reviews could be discussed in a public seminar, to which other experts (from non nuclear field, from NGOs, etc) should be invited.

Published: 2011-03-23 20:16

Nelson, Robert

From: Nelson, Robert INRR
Sent: Friday, March 25, 2011 8:11 AM
To: Markley, Michael; Oesterle, Eric
Subject: Heads-Up: Emailing: boardfile.htm
Attachments: image001.png

NELSON

From: Nelson, Robert INRR
Sent: Friday, March 25, 2011 8:10 AM
To: McGinty, Tim; LIA06 Hoc
Cc: LIA08 Hoc; PMT09 Hoc; ET07 Hoc; RST01 Hoc; Ross-Lee, MaryJane; Giitter, Joseph; Westreich, Barry; Kobetz, Timothy; ET05 Hoc; Zimmerman, Jacob
Subject: RE: Emailing: boardfile.htm

If the Ops Center provides the answers to 1 – 3 (my team has no way to interact with the NRC-Japan team), my comm. team can get the answer to Item 4 and prepare a consolidated response for OPA review.

NELSON

From: McGinty, Tim INRR
Sent: Friday, March 25, 2011 2:18 AM
To: LIA06 Hoc; Nelson, Robert
Cc: LIA08 Hoc; PMT09 Hoc; McGinty, Tim; ET07 Hoc; RST01 Hoc; Ross-Lee, MaryJane; Giitter, Joseph; Westreich, Barry; Kobetz, Timothy; ET05 Hoc; Zimmerman, Jacob
Subject: FW: Emailing: boardfile.htm

Jake – for the call this evening with the in-country team, we discussed that the NRC-Japan team may be the best source of information to address questions 1 and 2 below, and may also have insights on question 3. Please see what insights we can get from the team so we can pass them along to the line organization (Nelson is the focal point for comms).

For Question 4, I think the best response would come from DIRS on day shift, regarding the information that is in the TI being developed.

Nelson – the midnight shift ET wanted to get this tasker out of the Operations Center and into the line organization. The Protective Measures Team has a number of other higher priorities that we want them to be able to focus on. Can you respond to this email accepting the tasking so I can get it out of the Ops Center task tracker? Thanks, Tim

---

From: McGinty, Tim
Sent: Friday, March 25, 2011 12:47 AM
To: McGinty, Tim
Subject: Emailing: boardfile.htm

From: OST02 HOC
Sent: Thursday, March 24, 2011 7:03 PM
To: ET05 Hoc
Subject: FW: Congressional call Today

W/303

From: HOO Hoc
Sent: Thursday, March 24, 2011 5:46 PM
To: LIA07 Hoc; OST01 HOC; OST02 HOC; OST03 HOC
Subject: FW: Congressional call Today

Headquarters Operations Officer
U.S. Nuclear Regulatory Commission
Phone: 301-816-5100
Fax: 301-816-5151
email: hoo.hoc@nrc.gov
secure e-mail: hoo1@nrc.sgov.gov

From: Sheron, Brian
Sent: Thursday, March 24, 2011 3:40 PM
To: HOO Hoc
Subject: Congressional call Today

I received the following questions from congressional staff which I could not readily answer. Can you please ask the ET, RST and/or the PMT if they have any information that can address these questions?

1.) Two workers were reported to have been hospitalized due to radiation exposure. Have there been any more workers hospitalized, and do we know how they were exposed?

2.) Three workers were reported to have received radiation burns to their feet by spending too much time walking in contaminated water. Do we have any more information on this?

3.) It was reported that the Iodine levels in the Tokyo drinking water went down below allowable limits. Do we know what this is attributable to? Was it due to a shift in wind direction? Did the releases from the plant go down"?

4.) What action is the NRC taking regarding licensee plans to walk down their plants to confirm systems, procedures, etc., are in place to deal with natural phenomena? Are the resident inspectors going to accompany the licenses during the walkdowns?

Thanks.

Thompson, John

From: Garmon, David NRR
Sent: Friday, March 25, 2011 6:52 AM
To: NRR_DIRS_IOEB Distribution
Subject: Japan Status Updates for ET Briefers

Rather than everyone contacting the HOO to obtain the status updates, I have developed a folder on the G drive(G:\ADRO\DIRS\IOEB\Subject Folders\JAPAN EARTHQUAKE 11 MARCH 2011\HOO Status Updates) that contains all of them. I will update this folder daily (especially before the ET brief).

Please note that these documents are not to be widely distributed.

Regards,
Dave

R

David Garmon
NRR/DIRS/IOEB
(301) 415-3512
Office: O-7C20
Mail Stop OWFN-7C02A

W/304

Nelson, Robert

From: Nelson, Robert NRR
Sent: Friday, March 25, 2011 8:35 AM
To: Markley, Michael; Oesterle, Eric
Subject: FYI: Suggestions on 3/11/11 FAQs

Please read but no action unless you deem necessary.

NELSON

From: Ellmers, Glenn EDO
Sent: Thursday, March 24, 2011 4:51 PM
To: Nelson, Robert
Subject: FW: Suggestions on 3/11/11 FAQs

FYI. These suggestions seem highly technical, and I don't know how helpful they would be to most people, but I pass it along.

From: Borchardt, Bill EDO
Sent: Thursday, March 24, 2011 3:34 PM
To: Brenner, Eliot; Ellmers, Glenn; Zimmerman, Roy
Subject: FW: Suggestions on 3/11/11 FAQs

From: William E. Burchill [mailto:burchill@ne.tamu.edu]
Sent: Thursday, March 24, 2011 2:13 PM
To: Borchardt, Bill
Subject: Suggestions on 3/11/11 FAQs

Bill,

Please pass along the following suggestions for consideration relative to the FAQs on the 3/11/11 Japanese Earthquake and Tsunami posted on the NRC website:

#1 The last sentence explains "magnitude is measured on a log scale and so a magnitude 9 earthquake is approximately 32 times larger than a magnitude 8 earthquake." To the reader familiar with a log scale, this would appear to be incorrect since differences by one unit on a log10 scale differ by a factor of 10, by definition. The reason for the discrepancy is that the commonly-reported Richter scale measures amplitude of displacement, and a difference of one unit represents a factor of 10 in amplitude. However, the factor of 32 represents the difference in earthquake energy which is related to the amplitude of displacement by an exponent of (3/2). Thus, a difference of one unit on the Richter scale represents a difference of a factor of 10 in amplitude of displacement and a factor of $10^{3/2} = 31.6 \approx 32$ in energy. Including this clarification would help to avoid confusion and improve credibility.

#2 TEPCO yesterday revised its tsunami estimate to 14 m. I don't know whether this has been validated by NISA. If is has, or if NOAA agrees, this would help to explain the severity of the plant response since it was designed for a 5.7 m tsunami. Including comparison of this design parameter to the actual event would also be useful.

#3 See #2 above.

W/305

#11 The first sentence of the 2nd paragraph lists US modifications "including design changes to control hydrogen and pressure in the containment" and "additional equipment and measures to mitigate damage stemming from large fires and explosions from a beyond-design-basis event ... include providing core and spent fuel pool cooling..." I suggest adding the modifications made in response to the SBO rule since the tsunami-induced SBO is the root cause of most of the Fukushima Daiichi problems.

#14 The last sentence of the first paragraph provides the clarification between amplitude and energy when using the log10 scale (on amplitude), but it does so relative to the Moment Magnitude scale. I suggest adding that the same clarification applies to the Richter scale. I also suggest cross-referencing between answers #1 and #14. The second paragraph implies that the Richter Scale is reported deceptively to the public. I know that isn't what is intended. Perhaps the wording can be improved.

#22 It may be helpful to give examples of some of the plant modifications that were made in response to the SBO rule as listed in NUREG-1776, Appendix B. However, caution should be exerted since some of these modifications, e.g., an additional EGD or new cross-ties, may not provide reduction of risk due to a pervasive common cause such as a tsunami. I presume this will be a significant aspect of the NRC's two-pronged re-evaluation of US NPP safety.

I hope that NRC will continuously update these FAQs and expand their subject coverage. I suggest that the next general topic to be included be maintenance of spent fuel pool cooling since this has occupied center stage in the current drama and is, I assume, the primary source of radiological releases. Although they may be more detailed than you wish to consider, I offer the following possibilities along with their relevant implications and applications for US NPPs. Partial answers to some of these have begun to appear from various sources including TEPCO, NISA, IAEA, NEI, and WNN.

1. How badly were the SFP structures damaged by the earthquake?
2. Was the SFP water drained due to the earthquake? If yes, over what period of time?
3. Are the SFPs structurally sound enough to be refilled with water, a slurry, or sand?
4. What are the SFP loadings (# F/As, weight, heat load, radioactivity)?
5. How much has the cladding in the SFPs been oxidized (perhaps as inferred from the hydrogen released)?
6. What is the degree of fuel melting in the SFPs?
7. Is the fuel in the SFPs in a coolable geometry?
8. What effect has the spraying with water cannons and concrete pumping truck had (fuel cooling, fuel degradation, water accumulation)?
9. What are the options to refill the SPFs with water, i.e., plant systems, external systems, water supplies, heat sink?
10. Will refilling the SFPs with water cause the fuel within to "slump" as occurred at TMI?
11. Will refilling the SFPs with water produce massive amounts of hydrogen? If yes, is it likely to explode before it is vented from the building?
12. Will refilling the SFPs with water produce a potential nuclear criticality?
13. What special precautions and being taken , e.g., shielding being installed around cooling system components to accommodate high levels of contamination in and radiation from the water to be circulated from the SFPs (and reactor assemblies), to ensure worker protection prior to activating installed cooling systems?
14. Is filling the SFPs with a slurry or sand being aggressively evaluated?

I hope these suggestions are useful to you. I fully appreciate the difficulty of your task and that of the agency under these circumstances. I watched your briefing the Commissioners on Monday and was impressed by both your prepared remarks and your answers to questions from the Commissioners. Soon you'll be being compared to Harold Denton.

Best regards,
Bill

William E. Burchill, Ph.D.
Past President
American Nuclear Society
Retired Department Head

Nuclear Engineering
Texas A&M University
129 Zachry Engineering Center
College Station, TX 77843-3133
Phone: (979) 845-1670
FAX: (979) 845-6443
E-mail: burchill@tamu.edu

Nelson, Robert

From: Nelson, Robert NRR
Sent: Friday, March 25, 2011 11:27 AM
To: Regan, Christopher; McGinty, Tim; Blount, Tom; Quay, Theodore
Cc: Astwood, Heather
Subject: RE: Chairman's office inquiry

The front office TAs are responding.

NELSON

From: Regan, Christopher NRR
Sent: Friday, March 25, 2011 10:28 AM
To: McGinty, Tim; Blount, Tom; Quay, Theodore
Cc: Astwood, Heather; Nelson, Robert
Subject: FYI: Chairman's office inquiry

T3,
FYI, Roberta Warren from the Chairman's Office was inquiring about a status sheet/background information regarding the situation in Japan for a meeting he would be attending today (Friday). Given guidance that communications external to NRR on Japan are being coordinated by Bob Nelson I referred her directly to him for current information.
Thanks,
Chris

R

w/306

Nelson, Robert

From: Nelson, Robert
Sent: Friday, March 25, 2011 12:39 PM
To: Meighan, Sean
Subject: RE: AS per Your Request: Visiting of Dr Ishikawa to NRC

Thanks

NELSON

-----Original Message-----
From: Meighan, Sean
Sent: Friday, March 25, 2011 11:30 AM
To: Nelson, Robert
Subject: AS per Your Request: Visiting of Dr Ishikawa to NRC

Nelson:

NRR has not developed any material for the Japan JANTI meeting.

Very Respectfully
Sean

-----Original Message-----
From: Cullingford, Michael
Sent: Friday, March 25, 2011 11:29 AM
To: Pace, Patti
Cc: Schwarz, Sherry; Bloom, Steven; Abrams, Charlotte; Warren, Roberta; Cohen, Shari; Astwood, Heather; Bradford, Anna; Meighan, Sean; Emche, Danielle; Brown, Frederick
Subject: RE: Visiting of Dr Ishikawa to NRC

Patti: We have not prepared any briefing material for this visit. We will be in a listening mode as to: what JANTI does; what is its relationship with the regulatory authority NISA and JNES; and what are JANTI's immediate and long-term goals. Ordinarily NRR does not meet with non regulatory entities from other countries. This meeting has been arranged by OIP.....mc -----Original Message-----
From: Pace, Patti
Sent: Thursday, March 24, 2011 8:10 PM
To: Cullingford, Michael; Emche, Danielle
Cc: Schwarz, Sherry; Bloom, Steven; Abrams, Charlotte; Warren, Roberta; Cohen, Shari; Astwood, Heather; Bradford, Anna
Subject: RE: Visiting of Dr Ishikawa to NRC

Good Evening,

Would it be possible for Chairman Jaczko to receive a copy of any briefing materials that have been prepared for this meeting?

Many thanks,

Patti Pace
Assistant to Chairman Gregory B. Jaczko
U.S. Nuclear Regulatory Commission

W/307

301-415-1820 (office)
301-415-3504 (fax)

-----Original Message----- INRR
From: Cullingford, Michael
Sent: Thursday, March 24, 2011 9:45 AM
To: Emche, Danielle
Cc: Schwarz, Sherry; Bloom, Steven; Abrams, Charlotte; Warren, Roberta; Cohen, Shari; Astwood, Heather; Pace, Patti
Subject: RE: Visiting of Dr Ishikawa to NRC

Danielle: The local NISA/JNES representatives (Mr. Yamachika and Mr. Aono) asked me if and when the meeting has been set. They will be attending the meeting of Dr. Ishikawa with Eric Leeds on Friday at 2:30pm
.....mike -----Original Message-----

From: Emche, Danielle IOIP
Sent: Wednesday, March 23, 2011 4:12 PM
To: Pace, Patti
Cc: Schwarz, Sherry; Cullingford, Michael; Bloom, Steven; Abrams, Charlotte; Warren, Roberta
Subject: RE: Visiting of Dr Ishikawa to NRC

Ok, that is great news. I would like to suggest 2:30, if that is ok with NRR. Can NRR confirm this? Thank you to everyone.

Danielle

-----Original Message-----
From: Pace, Patti IOCM
Sent: Wednesday, March 23, 2011 4:09 PM
To: Emche, Danielle
Cc: Schwarz, Sherry; Cullingford, Michael; Bloom, Steven; Abrams, Charlotte; Warren, Roberta
Subject: RE: Visiting of Dr Ishikawa to NRC

Hi Danielle,

Just had a moment to discuss this request with Chairman Jaczko. He said he would like to stop in at the beginning of the meeting when it is scheduled and would be happy to go to Eric Leeds' office if that is where the meeting will take place.

The best times for the Chairman would be 2:30p or 4:30p on Friday afternoon. Please let us know for when and where this meeting is confirmed and we will be sure Chairman Jaczko comes by.

Thanks!

Patti Pace
Assistant to Chairman Gregory B. Jaczko
U.S. Nuclear Regulatory Commission
301-415-1820 (office)
301-415-3504 (fax)

-----Original Message-----
From: Emche, Danielle
Sent: Wednesday, March 23, 2011 1:24 PM
To: Pace, Patti
Cc: Schwarz, Sherry; Cullingford, Michael; Bloom, Steven; Abrams, Charlotte; Warren, Roberta

Subject: RE: Visiting of Dr Ishikawa to NRC

Hi Patti,

The meeting with JANTI is scheduled for Friday afternoon with Eric Leeds, NRR, and based on the Chairman's schedule, we would like to choose a half an hour within the 2:30 - 5:00 PM timeframe. In order to nail down a time by this afternoon, I will provide in this email some background about The Japan Nuclear Technology Institute (JANTI). It is our understanding that the Chairman may be available for a meet/greet at the end of the scheduled bilateral with NRR. I am leaving on Saturday for Japan, so please keep all on cc, as I will not be in on Friday.

For background about the meeting with JANTI:

Dr. Michio Ishikawa, Chief Advisor and former-president of JANTI, will be visiting the area on the Friday, March 25, and has meetings planned with NEI and most likely INPO. JANTI has requested a meeting with NRC. JANTI is an organization that was closely modeled after INPO. NRC met with them in December 2009 in Tokyo. During that meeting, they explained their initiative to work and coordinate with industry, and the significant strides they have made in recent years. In light of recent events, they will obviously be re-assessing things and will have challenges to confront. It would be beneficial for the Chairman to have an opportunity to become familiar with this very senior representative from JANTI and how JANTI may compare with U.S. entities.

Best regards,
Danielle

-----Original Message-----
From: Cohen, Shari
Sent: Tuesday, March 22, 2011 2:30 PM
To: Astwood, Heather; Emche, Danielle
Cc: Schwarz, Sherry
Subject: RE: Visiting of Dr Ishikawa to NRC

I have confirmed with Sherry Schwarz, Mr. Leeds Administrative Assistant, that Mr. Leeds will be available on Friday from 2:30 - 5:00 p.m. if you wish to schedule an appointment sometime during that time frame. Thank you, Shari Cohen

Shari Cohen, Contract Secretary
Office of Nuclear Reactor Regulation, USNRC Room – O-13H18 / Mail Stop - O13H16M Phone – 301-415-1270 Fax - 301 - 415-8333 Email - shari.cohen@nrc.gov

-----Original Message-----
From: Astwood, Heather
Sent: Tuesday, March 22, 2011 2:06 PM
To: Emche, Danielle
Cc: Leeds, Eric; Doane, Margaret; Abrams, Charlotte; Cullingford, Michael; Regan, Christopher; Cohen, Shari
Subject: RE: Visiting of Dr Ishikawa to NRC

Thanks for the information Danielle,

We are looking at his schedule and will get back to you if he is available.

-----Original Message-----
From: Emche, Danielle
Sent: Tuesday, March 22, 2011 1:22 PM
To: Astwood, Heather

Cc: Leeds, Eric; Doane, Margaret; Abrams, Charlotte
Subject: FW: Visiting of Dr Ishikawa to NRC

Hi Heather,

The Japan Nuclear Technology Institute (JANTI) has requested a meeting with NRC. JANTI is an organization that was closely modeled after INPO. Chairman Klein met with them in December 2009 in Tokyo. During that meeting, they explained their initiative to work and coordinate with industry, and the significant strides they have made in recent years. We'd like to set up a meeting with Eric and Mr. Ishikawa, former president and current chief advisor of JANTI, on March 25th for a half hour, as requested by JANTI (see emails below). At the end of the meeting, we'd like the Chairman to stop in for a meet/greet, and the Chairman agrees with this approach. It is our understanding that while JANTI is in country, they are meeting with NEI and most likely INPO.

Danielle

-----Original Message-----
From: Masaki UOTANI [mailto:uotani.masaki@gengikyo.jp]
Sent: Monday, March 21, 2011 11:26 PM
To: Emche, Danielle; Doane, Margaret; RINCKEL, Jeannie
Cc: 中村 民平; 北村 信行; 永田 匡尚; MARION, Alex; SLIDER, James; MAUER, Andrew; ANDERSON, Victoria; 成瀬 喜代士; 百々 隆; 伊藤 裕之; 大部 悦二; Abrams, Charlotte
Subject: Visiting of Dr Ishikawa to NRC

Dear Ms. Danielle Emche,

I am Masaki Uotani, staff of the Japan Nuclear Technology Institute (JANTI). JANTI develops technical expertise and supports utilities in promoting safety activities, aiming further enhance the safety of nuclear power, similar to INPO in the US. JANTI has examined the status of Fukushima Daiichi NPP after the earthquake, and thinks that the situation is not reported abroad correctly.

Dr. Michio Ishikawa, Chief Advisor and former-president of JANTI, would like to visit NRC Executives personally, especially Chairman Jaczko, in order to present his prospect based on the exact information of the damage. Dr. Ishikawa has been contributed to enhancement of nuclear safety in Japan for a long time.

Could you arrange the visit of Dr. Ishikawa and a few staffs of JANTI to NRC anytime on March 25, if possible for half an hour ?

I would like to say thank you in advance.

Sincerely yours,

Masaki UOTANI
Strategic Planning Office, JANTI

----- Original Message -----
From: "Doane, Margaret" <Margaret.Doane@nrc.gov>
To: "RINCKEL, Jeannie" <jmr@nei.org>; "Masaki UOTANI"
<uotani.masaki@gengikyo.jp>
Cc: "中村 民平" <nakamura.tamihei@gengikyo.jp>; "北村 信行"
<kitamura.nobuyuki@gengikyo.jp>; "永田 匡尚"
<nagata.tadahisa@gengikyo.jp>; "MARION, Alex" <axm@nei.org>; "SLIDER, James" <jes@nei.org>;
"MAUER, Andrew" <anm@nei.org>; "ANDERSON, Victoria" <vka@nei.org>; "成瀬 喜代士"
<naruse.kiyoshi@gengikyo.jp>; "百々
隆" <dodo.takashi@gengikyo.jp>; "Emche, Danielle"
<Danielle.Emche@nrc.gov>; "伊藤 裕之" <ito.hiroyuki@gengikyo.jp>; "大部
悦二" <obu.etsuji@gengikyo.jp>; "Abrams, Charlotte"
<Charlotte.Abrams@nrc.gov>
Sent: Tuesday, March 22, 2011 7:09 AM
Subject: RE: Visiting of Dr Ishikawa (JANTI)

Dear Mr. Uotani,

The NRC would be pleased to meet with you and your team. The Chairman's schedule is full this week, but we will look to see if something can be changed. If not, we would be happy to try and schedule a meeting with our Executives. If you or one of your team would please contact Ms. Danielle Emche she will take care of all of the arrangements. I have copied her on this note. She can be reached at 301-415-2644, or by e-mail at danielle.emche@nrc.gov

As we remember from our visit, your activities may be similar to the activities of our Institute of Nuclear Power Operators (INPO) in the US. I have spoken with NEI and INPO and they would be willing to try to set up a teleconference if time and schedules permit, if you would find that helpful.

With kind regards,
Margie Doane
Office of International Programs, Director US Nuclear Regulatory Commission

-----Original Message-----
From: RINCKEL, Jeannie [mailto:jmr@nei.org]
Sent: Monday, March 21, 2011 1:22 PM
To: Masaki UOTANI; Doane, Margaret
Cc: 中村 民平; 北村 信行; 永田 匡尚; MARION, Alex; SLIDER, James; MAUER, Andrew; ANDERSON, Victoria;
成瀬 喜代士; 百々 隆; 伊藤 裕之; 大部
悦二
Subject: RE: Visiting of Dr Ishikawa (JANTI)

Dear Mr. Uotani,
We will be prepared to meet with JANTI in the NEI offices on Thursday afternoon from 1:30 - 4:30 pm. I will follow up with you with more details in a subsequent email.

Regarding the arrangements with the NRC, Margaret Doane, Director, Office of International Programs, will provide you with further assistance. I spoke with Margaret this morning and she is included on distribution to this email response. She will provide you with the details for arranging a meeting as you requested.

Please let me know if I can be of further assistance.

Sincerely yours,
Jeannie Rinckel

Jeannie M. Rinckel
Regulatory Affairs Executive Director
Nuclear Energy Institute
jmr@nei.org
202-739-8095

-----Original Message-----
From: Masaki UOTANI [mailto:uotani.masaki@gengikyo.jp]
Sent: Sunday, March 20, 2011 1:53 AM
To: RINCKEL, Jeannie
Cc: 中村 民平; 北村 信行; 永田 匡尚; MARION, Alex; SLIDER, James; MAUER, Andrew; ANDERSON, Victoria; 成瀬 喜代士; 百々 隆; 伊藤 裕之; 大部
悦二
Subject: Re: Visiting of Dr Ishikawa (JANTI)

Dear Ms. Rinckel,

Thank you for accepting our proposal to visit NEI and explain the status of the Fukushima Daiichi NPP.

JANTI would like to visit you on March 24, 1:30-4:30 PM.

The visiting members are as follows:
Dr. Michio Ishikawa, Chief Advisor
Mr. Tamihei Nakamura, Director, the General Affairs Division
Mr. Yoshikazu Suzuki, General Manager, Codes and Standards Division
Mr. Nobuyuki Kitamura, General Manager, Strategic Planning Office
Mr. Tadahisa Nagata, General Manager, Strategic Planning Office
Interpreter

JANTI is planning to explain the following topics using PPT slide and video:
(1) Description of Fukushima Daiichi NPP
(2) Sequence of Earthquake and Tsunami damage
(3) Details
Earthquake and Tsunami (Scale, Plant damage)
Core (Situation, Damage estimated by the result of TMI-2 Study)
Spent Fuel Pool (Estimation of fuel cooling)
Dose rate on site and outside
(4) Prospects of settlement of the damaged facility

I would like to ask you to suggest the persons concerned in NRC and INPO to attend the meeting.

In addition, Dr. Ishikawa is hoping to visit NRC Executives personally, especially Chairman Jaczko, on March 25, in order to present his prospect and discuss with them. Could you arrange the visit with NRC Executives, if possible for half an hour ?

After visiting NEI, JANTI's delegation is going to visit WANO Paris Center next week.

Dr. Ishikawa contributed an article on nuclear safety of the Fukushima Daiichi NPP to the Electric Daily News (The Denki Shimbun). I am attaching the article to this Email, translated into English.

Sincerely yours,

Masaki UOTANI

----- Original Message -----
From: "RINCKEL, Jeannie" <jmr@nei.org>
To: "Masaki UOTANI" <uotani.masaki@gengikyo.jp>
Cc: "中村 民平" <nakamura.tamihei@gengikyo.jp>; "北村 信行" <kitamura.nobuyuki@gengikyo.jp>; "永田 匡尚" <nagata.tadahisa@gengikyo.jp>; "MARION, Alex" <axm@nei.org>; "SLIDER, James" <jes@nei.org>; "MAUER, Andrew" <anm@nei.org>; "ANDERSON, Victoria" <vka@nei.org>
Sent: Saturday, March 19, 2011 12:10 AM
Subject: RE: Visiting of Dr Ishikawa (JANTI)

Dear Mr. Uotani,

You and the JANTI folks have been in my thoughts since the devastating events of last week. I hope that you and your family are doing well.
I am sorry to hear the Dr. Ishikawa suffered as a result of the earthquake and hope recovery is going well.

At NEI, we established a emergency response center that has been monitoring the events around the clock in order to assist in providing technical expertise to the communications efforts. We have been following the progress very closely.

I am encouraged by your message and particularly Dr. Ishikawa's interested in visiting NEI to explain the status of the Fukushima NPP.
We are very interested in understanding the details such that we can incorporate lessons learned to every U.S. reactor. We can be available to meet with you whenever convenient.

Additionally, Alex Marion has a new email address: axm@nei.org and is on copy to this email.

Sincerely yours,
Jeannie Rinckel

-----Original Message-----
From: Masaki UOTANI [mailto:uotani.masaki@gengikyo.jp]
Sent: Friday, March 18, 2011 5:50 AM
To: RINCKEL, Jeannie
Cc: 中村 民平; 北村 信行; 永田 匡尚
Subject: Visiting of Dr Ishikawa (JANTI)

Dear Ms. Rinckel,

I sent the following Email to Mr. A. Marion again and again, but the message could not be delivered to Mr. Marion.

Could you please inform Mr. Marion of this message? I will appreciate it if you inform us of Mr. Marion's available day after March 24th for visiting of Dr. Ishikawa.

I would like to say thank you in advance.

Sincerely yours,

M.Uotani

Dear Mr. Marion,

I am most grateful to you for your kind arrangement of NEI-JANTI Meeting last Monday. The meeting was very fruitful for us.

You know Japan was hit by the greatest ever earthquake last Friday, and Fukushima Nuclear Power Plant suffered from large damage. JANTI is now engaged in collecting the information of the impact of the earthquake.

Dr. M. Ishikawa, Chief Advisor and former-president of JANTI, would like to visit you and to explain the status of Fukushima NPP to you directly, if possible for half a day. Could you inform me of your available day after March 24th?

Dr.Ishikawa suffered from the earthquake himself, so he is sorry to contact you late.

Sincerely yours,

Masaki UOTANI
Strategic Planning Office, JANTI

party any transaction or matter addressed herein.

Sent through mail.messaging.microsoft.com

Sent through mail.messaging.microsoft.com

Imboden, Andy

From: Imboden, Andy NRR
Sent: Friday, March 25, 2011 12:45 PM
To: Galloway, Melanie
Subject: RE: Any Nominees for a 3rd team to Japan?

None recommended from RERB. Based on LT discussion last Friday, the overall thought would be to limit the impact on NRR, so if we do recommend people to go on the 3rd team, I recommend we put forward a short list (0, 1, or 2 people max)

Andy

From: Galloway, Melanie NRR
Sent: Friday, March 25, 2011 10:22 AM
To: Hiser, Allen; Lund, Louise; Auluck, Rajender; Dias, Antonio; Imboden, Andy; Pelton, David; Pham, Bo; Wertz, Trent; Wrona, David
Cc: Holian, Brian
Subject: Any Nominees for a 3rd team to Japan?

Do any of your or your staffs have strong backgrounds in the following? If so, would he or she have availability to go to Japan?

a. Severe Accident management knowledge
b. B5b knowledge
c. Accident Recovery knowledge

Please respond by 8 am Monday. Thanks.

R

W308

Nelson, Robert

From: Nelson, Robert
Sent: Friday, March 25, 2011 4:00 PM
To: McDermott, Brian
Subject: FYI: Link we discussed

http://portal.nrc.gov/edo/nrr/default.aspx

All info under "Japan Event Information" is releasable to the public.

NELSON

w/309

Munro, John

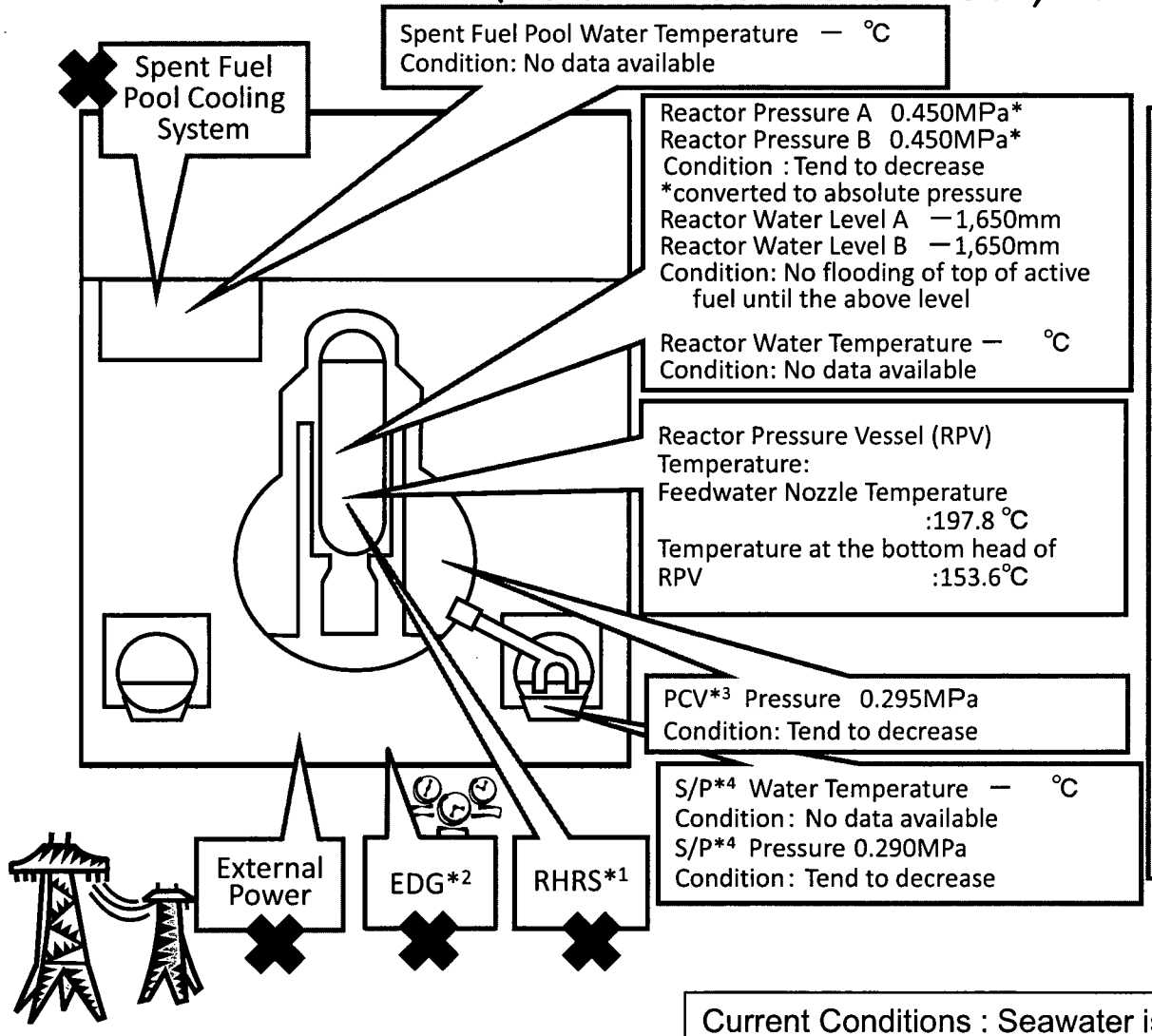
From: Vick, Lawrence | NRR
Sent: Friday, March 25, 2011 9:56 AM
To: Munro, John
Subject: Emailing: en20110325-3-2.pdf
Attachments: en20110325-3-2.pdf

FYI – see NISA web page

Larry

W/310

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 1
(As of 10:00 March 25th, 2011)



Major Events after the earthquake

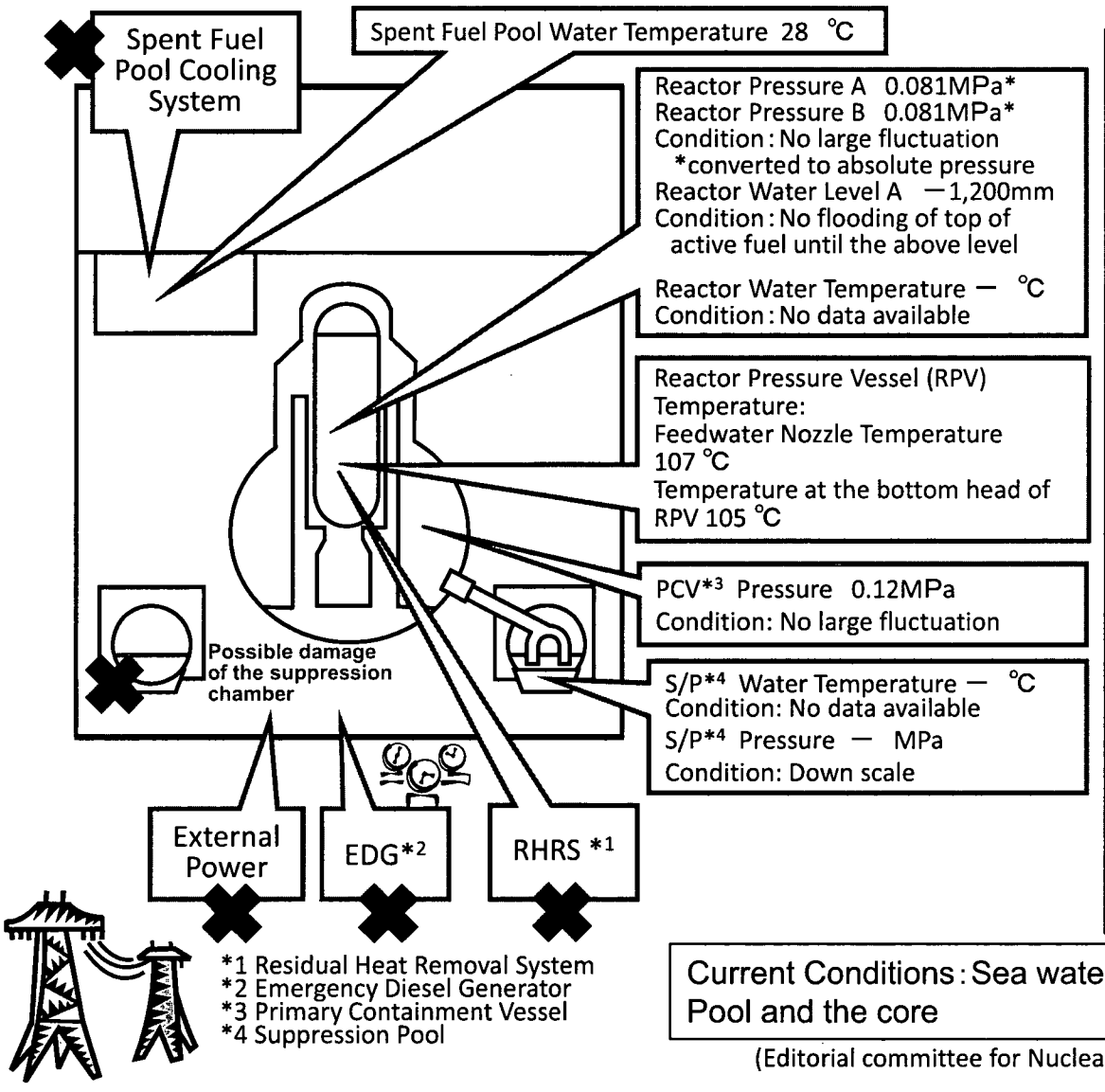
- 11th 14:46 : Under operation, Automatic shutdown by the earthquake
- 11th 15:42 : Report based on the Article 10 (Total loss of A/C power)
- 11th 16:36: Occurrence of the Article 15 event (Inability of water injection of the Emergency Core Cooling System)
- 12th 1:20 Occurrence of the Article 15 event (Unusual rise of the pressure in PCV)
- 12th 10:17 Started to vent
- 12th 15:36 Sound of explosion
- 12th 20:20 Started to inject seawater and borated water to core
- 23rd 02:33 The amount of injected water to the Rector Core was increased utilizing water supply line in addition to the Fire Extinguish line. ($2m^3/h \rightarrow 18m^3/h$)
  09:00 Switched to water supply line only.($18m^3/h \rightarrow 11m^3/h$)
- 24th 11:30 Lightening in the Central Control Room was recovered.

*1 Residual Heat Removal System
*2 Emergency Diesel Generator
*3 Primary Containment Vessel
*4 Suppression Pool

Current Conditions : Seawater is being injected to the core

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 2
(As of 10:00 March 25th, 2011)



Major Events after the earthquake

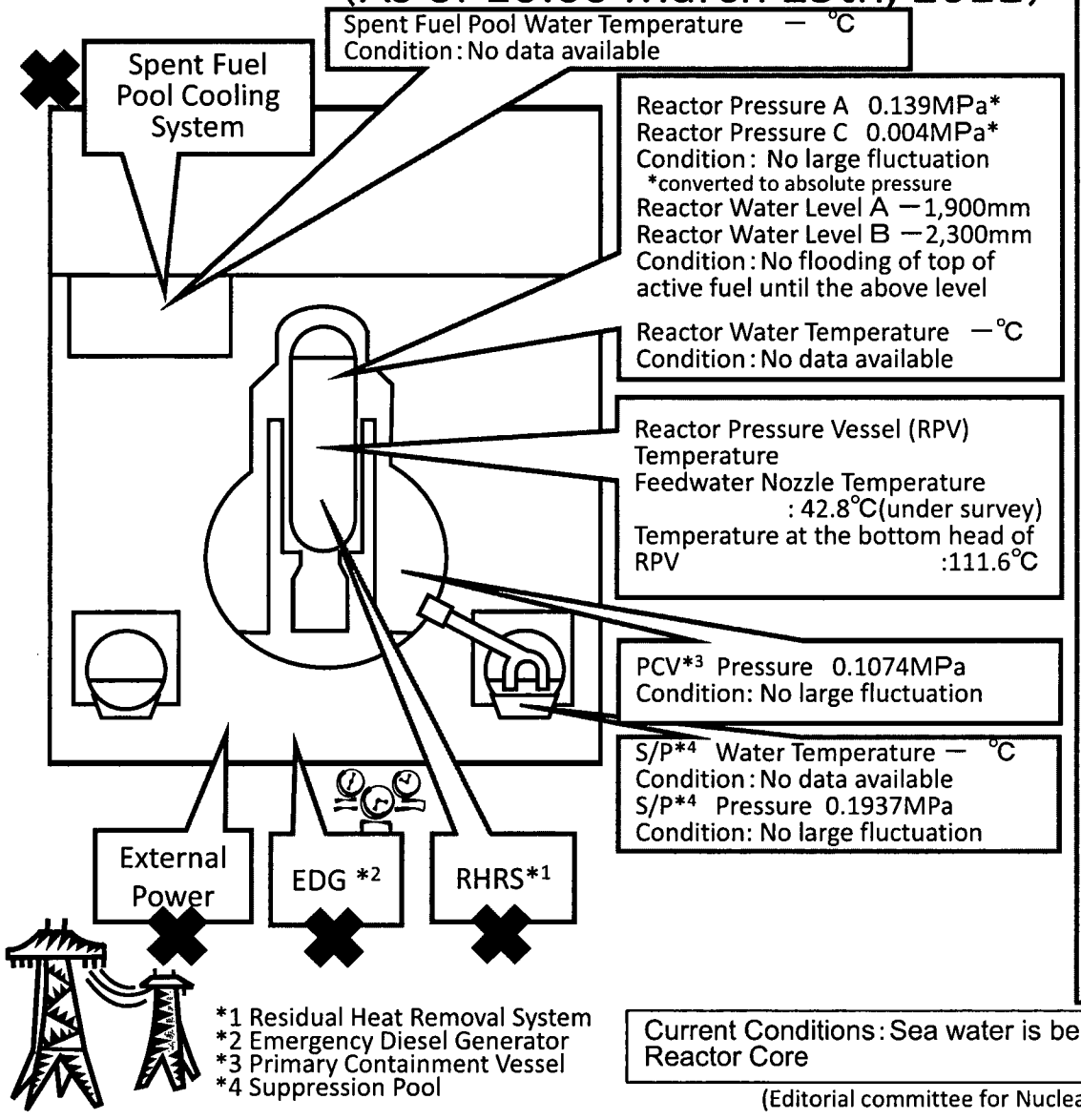
- 11th 14:46 Under operation, Automatic shutdown by the earthquake
- 11th 15:42 Report based on the Article 10 (Total loss of A/C power)
- 11th 16:36 Occurrence of the Article 15 event (Inability of water injection of the Emergency Core Cooling System)
- 13th 11:00 Started to vent
- 14th 13:25 Occurrence of the Article 15 event (Loss of reactor cooling functions)
- 14th 16:34 Started to inject water to the Reactor Core
- 14th 22:50 Occurrence of the Article 15 event (Unusual rise of the pressure in PCV)
- 15th 0:02 Started to vent
- 15th 6:10 Sound of explosion
- 15th around 6:20 Possible damage of the suppression chamber
- 20th 15:05～17:20 Approximately 40 ton seawater injection to the Spent Fuel Pool (SFP) via the Fuel Pool Cooling System (FPC)
- 20th 15:46 Power Center received electricity.
- 21st 18:22 White smoke generated. The smoke died down and almost invisible at 07:11 March 22nd.
- 22nd 16:07 Injection of around 18 tons of seawater to the Spent Fuel Pool
- 25th 10:30~12:19 Seawater injection to SFP via FPC

Current Conditions : Sea water is being injected to Spent Fuel Pool and the core

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 3

(As of 10:00 March 25th, 2011)



*1 Residual Heat Removal System
*2 Emergency Diesel Generator
*3 Primary Containment Vessel
*4 Suppression Pool

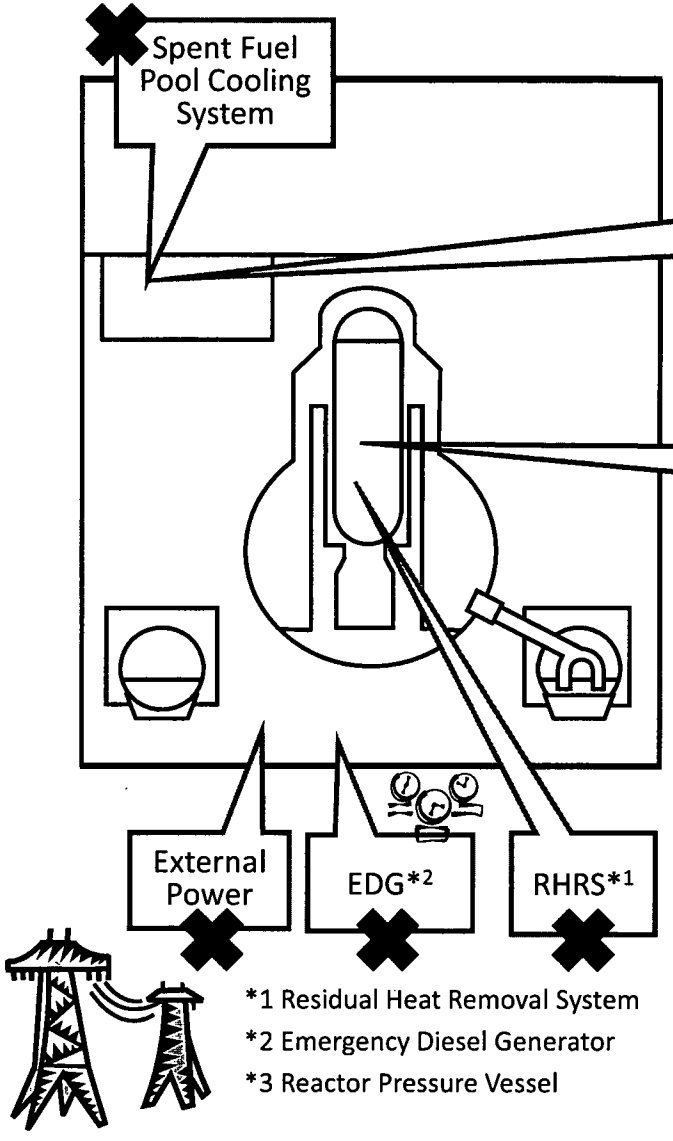
Major Events after the earthquake

11th 14:46 Under operation, Automatic shutdown by the earthquake
11th 5:42 Report based on the Article 10 (Total loss of A/C power)
12th 20:41 Started to vent
13th 5:10 Occurrence of the Article 15 event (Inability of water injection of the Emergency Core Cooling System)
13th 9:20 Started to vent
13th 13:12 Started to inject seawater and borated water to core
14th 5:20 Started to vent
14th 7:44 Occurrence of the Article 15 event (Unusual rise of the pressure in PCV)
14th 11:01 Sound of explosion
16th around 8:30 White smoke generated.
17th 9:48～10:01 Water discharge by the helicopters of Self-Defense Force (4 times)
19:05～20:07 Water spray from the ground by High pressure water-cannon trucks (Police: once, Self-Defense Force: 5 times)
18th before 14:00～14:38 Water spray from the ground by 6 fire engines of Self-Defense Force
~14:45 Water spray from the ground by a fire engine of the US Military
19th 0:30 ～0:50 Water spray by Tokyo Fire Department
19th 14:05 ～ 20th 3:40 Water spray by Tokyo Fire Department
20th 11:00 Pressure of PCV rose(320kPa).Afterward fell.
20th 21:30 ～ 21st 3:58 Water spray by Tokyo Fire Department
21st about 15:55 Grayish smoke generated and was confirmed to be died down at 17:55.
22nd 15:10 ～15:59 Water spray by Tokyo Fire Department
22nd 22:43 Lightening in the Central Control Room was recovered.
23rd 11:03 ～13:20 Injection of about 35ton of sea water to the Spent Fuel Pool (SFP) via the Fuel Pool Cooling System (FPC)
23rd around 16:20 Black smoke generated and was confirmed to died down at around 23:30 and 24th 4:50.
24th 5:35~16:05 Approximately 120 ton sea water injection to SFP via FPC

Current Conditions : Sea water is being injected to Spent Fuel Pool and the Reactor Core

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 4
(As of 10:00 March 25th, 2011)



In periodic inspection outage

Spent Fuel Pool Water Temperature - ℃
Condition: Indication failure

No fuel is inside the reactor core

*1 Residual Heat Removal System
*2 Emergency Diesel Generator
*3 Reactor Pressure Vessel

Major events after the earthquake

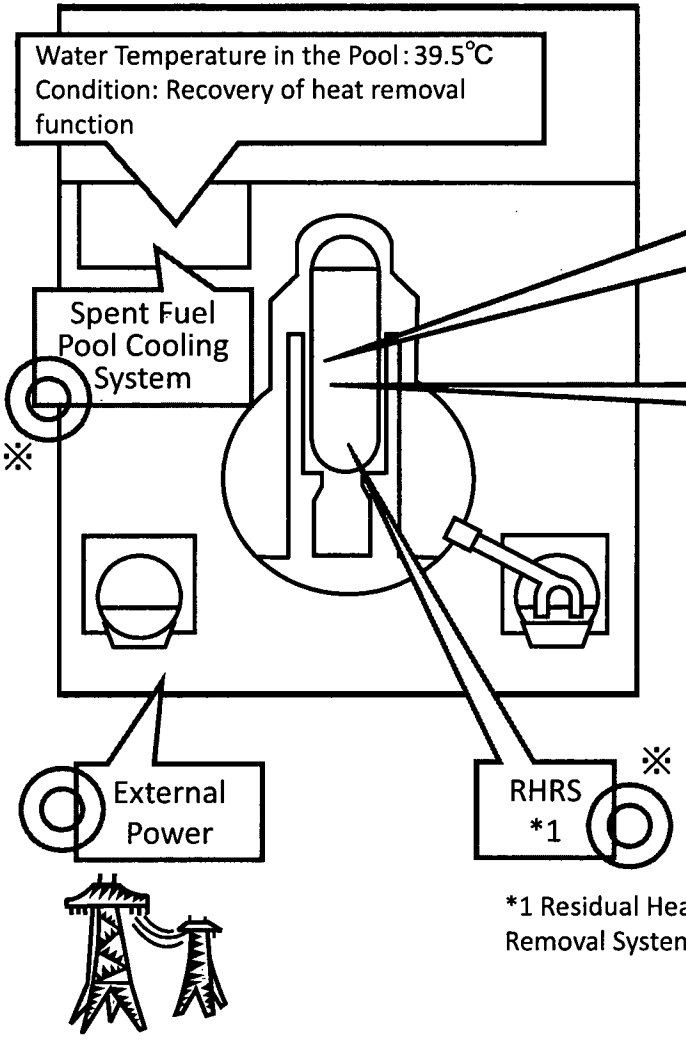
In periodic inspection outage when the earthquake occurred.
11th 15:42 Report based on the Article 10 (Total loss of A/C power)
14th 4:08 Water temperature in the Spent Fuel Pool, 84℃
15th 6:14 Partial damage of wall in the 4th floor confirmed
15th 9:38 Fire occurred in the 3rd floor. (12:25 extinguished)
16th 5:45 Fire occurred. TEPCO couldn't confirm any fire on the ground. (6:15)
20th 8:21~9:40 Water spray over the Spent Fuel Pool (SFP) by Self-Defense Force
20th around 18:30~19:46 Water spray over the Spent Fuel Pool by Self-Defense Force
21st 6:37~8:41 Water spray over the Spent Fuel Pool by Self-Defense Force
21st about 15:00 Work for laying cable to Power Center was completed.
22nd 10:35 Power Center received electricity
22nd 17:17～20:32 Water spray by Concrete Pump Track
23rd 10:00～13:02 Water spray by Concrete Pump Track
24th 14:36～17:30 Water spray by Concrete Pump Track
25th 6:05～10:20 Sea water injection to SFP via the Fuel Pool Cooling System (FPC)

Current Conditions : No fuel is in RPV*3.
Started sea water injection to Spent Fuel Pool.

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 5
(As of 10:00 March 25th, 2011)

In periodic inspection outage



*1 Residual Heat Removal System

Reactor Pressure: 0.113MPa*
Reactor Water Level: 2,497mm
Reactor Water Temperature: 77.0℃
Condition: Pressure is under control.
*converted to absolute pressure

Reactor Pressure Vessel Temperature:
Monitoring by Reactor Water Temperature

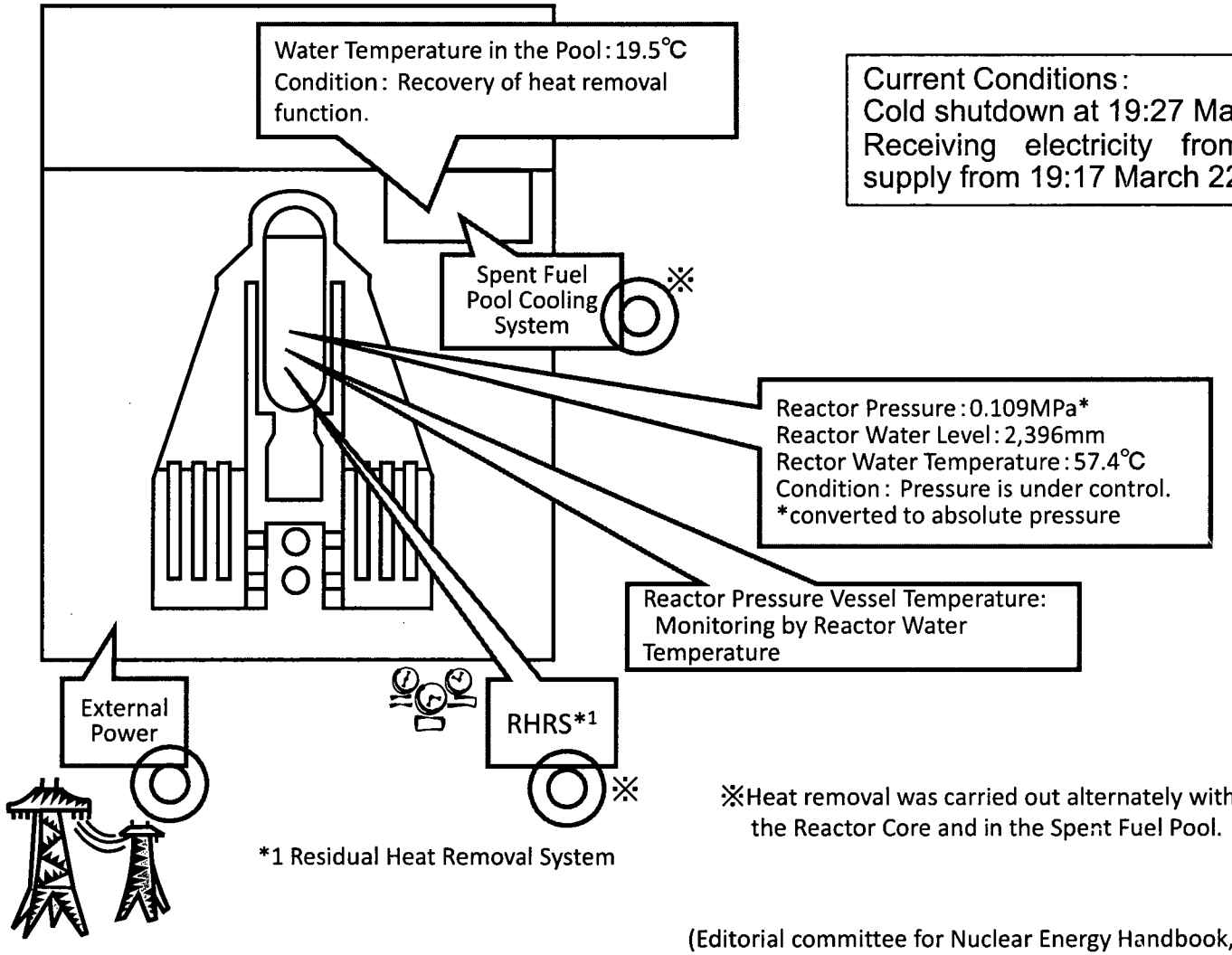
※Heat removal was carried out alternately with the water in the Reactor Core and in the Spent Fuel Pool.

Current Conditions:
Cold shutdown at 14:30 March 20th.
Receiving electricity from external power supply from 11:36 March 21st.
Pump for Residual Heat Removal Seawater System (RHRS) was automatically stopped when the power supply was switched from the temporary to the permanent at 17:24 March 23rd.
Repair of the RHRS pump was completed at 16:14 March 24th.
Cooling started at 16:35 March 24th.

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 6
(As of 10:00 March 25th, 2011)

In periodic inspection outage



Current Conditions:
Cold shutdown at 19:27 March 20th.
Receiving electricity from external power supply from 19:17 March 22nd.

*1 Residual Heat Removal System

※Heat removal was carried out alternately with the water in the Reactor Core and in the Spent Fuel Pool.

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Beasley, Benjamin

From: Beasley, Benjamin
Sent: Friday, March 25, 2011 12:59 PM
To: Kauffman, John
Subject: FW: pls review changes and let me know if we need to revise, thanks Marty
Attachments: GI.199.plan.docx; 199.Memo.pdf; GL GSI-199 Schedule.docx

Importance: High

For review

From: Stutzke, Martin
Sent: Friday, March 25, 2011 12:48 PM
To: Beasley, Benjamin
Subject: FW: pls review changes and let me know if we need to revise, thanks Marty
Importance: High

Ben –

Here's the draft PR and GL schedule.

Marty

From: Khanna, Meena
Sent: Friday, March 25, 2011 11:37 AM
To: Stutzke, Martin
Subject: re: pls review changes and let me know if we need to revise, thanks Marty
Importance: High

GENERIC ISSUE 199, "IMPLICATIONS OF UPDATED PROBABILISTIC SEISMIC HAZARD ESTIMATES IN CENTRAL AND EASTERN UNITED STATES ON EXISTING PLANTS"

Objective of GI-199

Initially, the objective of the GI-199 Safety/Risk Assessment was to perform a conservative, screening-level assessment to evaluate if further investigations of seismic safety for operating reactors was warranted consistent with NRC directives. The initial intent was to focus on 27 plants that met the criteria for further examination of cost justified backfits. In 2005, the staff determined that there was enough conservatisms in the calculations and other approximations to increase the scope to the central and eastern U.S. (CEUS) plants (96 plants). In light of the recent Japanese event, the NRC has determined to expand the scope of the plants to all plants in the U.S (104 plants).

- Results of the GI-199 safety risk assessment are not final estimates of plant-specific seismic risk.
- The seismic hazard data and plant-level fragility assumptions were conservative estimates useful as a screening tool.
- The NRC does not rank plants by seismic risk.

Key Messages:

3/31/11

1. Safety/Risk Assessment for GI-199 was completed in August 2010. It is publically available in ADAMS at ML100270582. That assessment found that plants have adequate safety margin for seismic issues and are within their licensing basis.

2. Overall seismic risk estimates remain small and adequate protection is maintained.

3. Updates to seismic data and models indicate increased seismic hazard estimates for some operating nuclear power plant sites in the Central and Eastern United States.

4. NRC has separate criteria for evaluating whether plant improvements may be imposed through a back-fit.

5. The Safety/Risk Assessment used readily available information and found that for about one-quarter of the currently operating plants, the change in seismic hazard is enough to warrant further NRC review.

6. Action may include obtaining additional, updated information and developing methods to determine if plant improvements to reduce seismic risk are warranted.

Status of Operating Plants and Need for Actions due to Japanese Event:

- Existing plants were designed with considerable margin to be able to withstand the ground motions from the largest earthquake expected in the area around the plant.

- During the mid-to late-1990s, the NRC staff reassessed the margin beyond the design basis as part of the Individual Plant Examination of External Events [IPEEE] program.

- The NRC's safety/risk assessment concluded that the probability of exceeding the design basis ground motion may have increased by a small amount at some plants. Those results also indicate that the probabilities of damage are lower than NRC's guidelines for taking immediate action.

- US plants are designed for appropriate earthquake levels and are safe.

The NRC is conducting a regulatory assessment, which includes reviewing the seismic capacity for plants located in central and eastern United States based on the latest data and analysis techniques.

Timeline for Preparation and Issuance of Generic Letter:

- The NRC is in the process of developing a Generic Letter (GL) that was originally intended to request information from all affected plants (96 plants that are east of the Rockies). However, due to the recent Japanese event, the NRC has determined to expand the scope of the plants to all plants in the U.S.

- An effort is being coordinated with US NRC, Department of Energy, EPRI, and USGS to determine the new consensus seismic hazard estimates, which is scheduled for completion in early 2011. Once this has been completed, the staff will issue the GL to request licensees of all 104 U.S. plants to address specific information n relating to their facilities to enable the staff to complete its regulatory assessment. The information from licensees will likely require 3 to 6 months to complete. Staff's review will commence after receiving licensees' responses. Based on staff's review, a determination can be made regarding whether candidate backfits should be considered for plant improvements to reduce seismic risk and to evaluate their potential cost-justified imposition.

- The GL is planned to be issued in draft form for public comment in the late Spring.

- Processes that are planned for review of the GL include a review by the NRC's Committee to Review Generic Requirements, the Advisory Committee on Reactor Safeguards (ACRS), and the GL will be issued as a draft for public comments (60 days), followed by a second meeting with ACRS.

- GL should be issued by end of 2011, as the new consensus seismic hazard models become available.

- Consensus hazard models are being developed by NRC, DOE, and EPRI. In addition the USGS will review the model.

- Information requested from licensees will likely require 3 to 6 months to prepare. NRC's review will be on-going as information is collected.

- Based on NRC's review, a determination will be made regarding beneficial back-fits.

COMMUNICATION PLAN FOR GENERIC ISSUE 199

March 17, 2011
(ML081850477)

Goal

This plan will guide staff communications and activities with internal and external stakeholders of the United States Nuclear Regulatory Commission (NRC) as they relate to Generic Issue 199 (GI-199), "Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States on Existing Plants."

Key Message Following March 11, 2011, Japanese Earthquake

US plants are designed for appropriate earthquake shaking levels and are safe. Currently the NRC is conducting a program called Generic Issue 199, which is reviewing the adequacy of the earthquake design of US NPPs in central and eastern North America based on the latest data and analysis techniques. The NRC will look closely at all aspects of the response of the plants in Japan to the earthquake and tsunami to determine if any actions need to be taken in US plants and if any changes are necessary to NRC regulations.

Key Messages

The key messages to be communicated to stakeholders based on the GI-199 Safety Risk/Assessment (completed in August 2010) are as follows:

(1) **Operating nuclear power plants are safe:** Plants have adequate safety margin for seismic issues. The NRC's Safety/Risk Assessment confirms that overall *seismic risk* estimates remain small and that adequate protection is maintained.

(2) **Though still small, some seismic hazard estimates have increased:** Updates to seismic data and models indicate increased *seismic hazard* estimates for some operating nuclear power plant sites in the Central and Eastern United States.

(3) **Assessment of GI-199 will continue:** Plants are safe (see key message 1), but the NRC has separate criteria for evaluating whether plant improvements may be imposed. The NRC's Safety/Risk Assessment used readily available information and found that for about one-quarter of the currently operating plants, the estimated *core damage frequency* change is large enough to warrant further attention. Action may include obtaining additional, updated information and developing methods to determine if plant improvements to reduce seismic risk are warranted.

Background

This issue was proposed as a Generic Issue in May 2005 after NRC staff's review of updates to the seismic source and ground motion models provided by applicants in support of early site permits for new reactors. The updated seismic information included new Electric Power Research Institute (EPRI) models to estimate earthquake ground motion and updated models

for earthquake sources in seismic regions such as eastern Tennessee, and around both Charleston, South Carolina and New Madrid, Missouri. The new data and models resulted in increased estimates of the seismic hazards for some plants in the Central and Eastern United States (CEUS). The staff evaluated this new information along with preliminary results from a 2004 U.S. Geological Survey (USGS) letter report regarding seismic hazard estimates. From this review the staff concluded that the likelihood of exceeding the seismic hazard values, used in plant design and in previous evaluations (such as the Individual Plant Examination of External Events (IPEEE) Program), may be higher than previously understood for some currently operating CEUS sites.

The staff compared the new seismic hazard data with the earlier evaluations conducted as a part of the IPEEE Program. From this comparison, the staff determined that the seismic designs of operating plants in the CEUS still provide adequate safety margins. At the same time, the staff also recognized that the new seismic data and models could reduce available safety margins due to increased estimates of the probability associated with seismic hazards at some of the currently operating sites in the CEUS.

The licensing basis for currently operating plants is based on deterministic analysis of design basis loads from the maximum earthquake level determined from historical data. The licensing basis does not include a probabilistic assessment of seismic hazards or probabilistic assessment of their potential impact on plant structures, systems, and components.

To maintain consistency with the performance-based approach for assessing seismic hazards for new reactors, the staff determined that the screening analysis should consider seismic hazard data and models besides those available from the USGS. This determination was based on the staff's ongoing interactions with stakeholders to develop a new performance-based approach for assessing seismic hazards for new reactors, as described in a memorandum to the Commission, "A Performance-Based Approach to Define the Safe Shutdown Earthquake Ground Motion," dated July 26, 2006 (ADAMS Accession No. ML052360044). The NRC staff held a public meeting, in February 2008, to engage external stakeholders. During the meeting, the representative from the Nuclear Energy Institute (NEI) expressed their willingness to support a collaborative approach to GI-199. This led to a Seismic Risk Memorandum of Understanding Addendum between EPRI and NRC.

The staff collected and analyzed seismic hazard information from the USGS and from other sources, and seismic risk information from IPEEE analyses. EPRI reported that they calculated mean seismic hazard results for all nuclear power plant sites in the CEUS and used these results to perform an independent evaluation of the implications of changes in seismic hazard estimates. The staff completed the review and analysis of seismic data in support of the Safety/Risk Assessment in June 2009.

Audience and Stakeholders

Internal

Internal stakeholders include the Commission, Office of the Executive Director for Operations (OEDO), Office of Nuclear Regulatory Research (RES), Office of Nuclear Reactor Regulation (NRR), Office of New Reactors (NRO), Office of Nuclear Material Safety and Safeguards (NMSS), Office of Federal and State Materials and Environmental Management Programs (FSME), Region I, Region II, Region III, Region IV, Office of Public Affairs (OPA), Advisory Committee on Reactor Safeguards (ACRS), Office of International Programs (OIP), Office of Congressional Affairs (OCA). (See the "Communications Team" section for a list of specific Communication Team members.)

External

External stakeholders include licensees, EPRI, Nuclear Energy Institute, Congressional members, public interest groups, media, and the public.

Communication Timeline

Detailed Activities to Support Release of the GI-199 Safety/Risk Assessment Report				
Stakeholder Group	**Specific Audience**	**Tool**	**Lead**	**Date**
Internal	Regional Offices	Brief	RES-Kauffman	May 12, 2010 (c)
	NRR Office Director	Brief	RES-Kauffman	May 12, 2010 (c)
	NRO Office Director	Brief	RES-Beasley	May 19, 2010 (c)
	Region I Management	Brief	RES-Kauffman	June 3, 2010 (c)
	EDO, Deputy EDOs	Brief	RES-Kauffman	June 22, 2010 (c)
	Commission offices	Technical Assistants Brief	RES-Kauffman	July 8, 2010 (c)
	NRC Chairman	Brief	RES-Kauffman	August 23, 2010
	Commission offices	EDO Daily Note (with link to documents)	RES-Killian	T* (September 1, 2010)
	EDO	Issue Safety/Risk Assessment Report (goes public after 5 working days)	RES-Sheron	T
External	General Public	Safety/Risk Assessment Report made public in ADAMS		T + 6 days (September 7, 2010)
	General Public	Press Release	OPA-Burnell	T + 6 days (September 7, 2010)
	Public and Licensees	Information Notice	NRR-Manoly	T + 6 days (September 7, 2010)
	Congressional Members/staff (as appropriate)	Phone Calls	OCA-Riley	T + 6 days (September 7, 2010)
	International contacts (as appropriate)	Phone Calls	OIP	T + 6 days (September 7, 2010)
	State/local governments (as appropriate)	Phone Calls	Regional State Liaison Officers Region I- McNamara/Tifft Region II – Trojanowski Region III – Barker Region IV - Maier	T + 6 days (September 7, 2010)

	USGS	Phone Call	OCA-Riley	T + 6 days (September 7, 2010)
	General Public	Public Meeting	RES-Beasley	T + [1 month]
	General Public	Seismic Fact Sheet Update	RES-Killian OPA-Burnell	August 26, 2010

* *"T"* refers to the time that the Director, RES endorses the Safety/Risk Assessment panel recommendation.

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Additional Communication Tools

The NRC has an internal Generic Issues Program (GIP) website (http://www.internal.nrc.gov/RES/GIP/index.html) and a public GIP website (http://www.nrc.gov/about-nrc/regulatory/gen-issues.html.). These websites include program information and documents, background and historical information, generic issue status information, and links to related programs.

The staff created a Seismic Issue Fact Sheet (http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/fs-seismic-issues.html).

Questions and Answers

Background

Q1. What is the NRC Generic Issues Program?

A1. The Nuclear Regulatory Commission (NRC) Generic Issues Program (GIP) evaluates technical issues that apply to two or more facilities and that may not be covered by existing regulatory processes or criteria. Issues are evaluated for their effect on safety, security, and/or the environment. The GIP is a program by which these issues can be formally assessed to see if they can be dispositioned by existing regulatory processes or if not, to determine their safety and/or risk significance and how best to treat them. Information on the program is available on the public NRC GIP website (http://www.nrc.gov/about-nrc/regulatory/gen-issues.html); information is also available to NRC staff on the NRC internal GIP website (http://www.internal.nrc.gov/RES/projects/GIP/). Management Directive (MD) 6.4, "Generic Issues Program," contains GIP guidance (available at http://www.nrc.gov/about-nrc/regulatory/gen-issues/policy-procedures.html). MD 6.4 was updated in November 2009 to incorporate program changes described in SECY-07-0022 (available at http://www.nrc.gov/reading-rm/doc-collections/commission/secys/2007/).

Q2. What is Generic Issue 199 about?

A2. Generic Issue 199 investigates the safety and risk implications of updated earthquake-related data and models. These data and models suggest that the probability for earthquake ground shaking above the seismic design basis (see answers A8, A9, and A10) for some nuclear power plants in the Central and Eastern United States is still low, but larger than previous estimates (see answer A12).

Q3. Where can I get current information about Generic Issue 199?

A3. The public NRC Generic Issues Program (GIP) website (http://www.nrc.gov/about-nrc/regulatory/gen-issues.html) contains program information and documents, background and historical information, generic issue status information, and links to related programs. The GI-199 section of the NRC internal GIP website (http://www.internal.nrc.gov/RES/projects/GIP/Individual%20GIs/GI-0199.html) contains additional information about Generic Issue 199 (GI-199) and is available to NRC staff. The latest Generic Issue Management Control System quarterly report, which has regularly updated GI-199 information, is publicly available at http://www.nrc.gov/reading-rm/doc-collections/generic-issues/quarterly/index.html. Additionally, the U.S. Geological Survey data is publicly available at http://earthquake.usgs.gov/hazards/products/conterminous/2008/.

Q4. Are all U.S. plants being evaluated as a part of Generic Issue 199?

A4. The scope of the Generic Issue 199 (GI-199) Safety/Risk Assessment is limited to all plants in the Central and Eastern United States. Although plants at the Columbia, Diablo Canyon, Palo Verde, and San Onofre sites are not included in the GI-199 Safety/Risk Assessment, the Information Notice on GI-199 is addressed to all operating power plants in the U.S. (as well as all independent spent fuel storage installation licensees). The staff will also consider inclusion

of operating reactors in the Western U.S. in its future generic communication information requests.

Q5. Does GI-199 affect license renewal?

A5. No. The NRC's regulations for license renewal (10 CFR Part 54) require licensees to manage age-related degradation to ensure that systems, structures, and components (SSCs) will fulfill their safety-related functions, as specified in the current licensing basis, for the period of extended operation. The aging management review conducted by license renewal applicants specifically addresses the impact of age-related degradation on SSC seismic capacity. It should be noted that a plant's licensing basis, including its seismic design basis, is established outside of the license renewal process during initial plant licensing and subsequent license amendments. In addition, the NRC has processes to evaluate the adequacy of plant licensing bases (e.g., the Generic Issues Program) based on new information or operating experience and, if necessary, improve safety (e.g., require plant improvements through the backfit process).

Note: Related to license renewal, the County Executive of Westchester County (New York) and groups from New Jersey submitted a petition for rulemaking on license renewal, including a seismic-related aspect. NRC denied this petition. The petitioners then filed suit in the U.S. Court of Appeals Second Circuit and the court upheld the NRC's position. Details are available on the internal webpage of the Office of General Counsel (under Law Library, Summary of AEC-NRC Litigation, "Spano v. NRC" (2d Cir. 2009): http://www.internal.nrc.gov/ogc/internal/AEC-NRC_Cases.pdf.)

Q6. Are the implications of new seismic hazard estimates being considered for the storage of spent fuel?

A6. Yes, while the GI-199 Safety/Risk Assessment focused solely on operating power reactors in the Central and Eastern U.S., spent fuel storage has been considered by NRC.

The NRC Office of Nuclear Materials Safety and Safeguards (NMSS) was informed of GI-199 and a preliminary screening review was performed in November, 2008 by the NMSS Division of Spent Fuel Storage and Transportation. There is a total of 40 operating independent spent fuel storage installations (ISFSIs) in the Central and Eastern U.S. (CEUS). Except for a wet storage facility at G. E. Morris located in Illinois, the ISFSIs are co-located at the operating and permanently shutdown reactor sites. A review of design earthquakes (DE) used at the existing ISFSI locations in CEUS indicated that the safety margin (defined for ISFSIs as the ratio of DE/SSE, where SSE is the *safe shutdown earthquake* discussed in answer A8) for the cask designs were in the range of 1.20 ~ 3.90. Therefore, NMSS considers that there is significant margin built into the existing designs and has confidence that the ISFSIs can continue to operate safely while the licensees' investigate this issue using their site specific information. Even so, holders of operating license for ISFSIs are included among addressees in the Information Notice on GI-199.

Spent fuel pools (SFPs) were not specifically evaluated as part of GI-199. However, based on their design attributes (as follows), SFPs remain safe. SFPs are constructed of reinforced concrete, several feet thick, with a stainless steel liner to prevent leakage and maintain water quality. Due to their configuration, SFPs are inherently structurally-rugged and are designed to the same seismic requirements as the nuclear plant.

Note: Typically, SFPs are about 40 feet deep and vary in width and length. The fuel is stored in stainless steel racks and submerged with approximately 23 feet of water above the top of the stored fuel. Each plant has a preferred SFP make-up water source (the refueling water storage tank for pressurized water reactors and the condensate storage tank for boiling water reactors). SFPs have alternate means of make-up such as service water systems and the fire water system. SFPs are also typically designed (e.g. with anti-siphon check valves) and instrumented such that leakage is minimized and promptly detected.

Q7. Are the implications of new seismic hazard estimates being considered for fuel cycle facilities?

A7. Yes, while the GI-199 Safety/Risk Assessment focused solely on operating power reactors in the Central and Eastern U.S., fuel cycle facilities have been considered by NRC. Based on preliminary reviews of the updated seismic hazard estimates, NRC staff in the Office of Nuclear Material Safety and Safeguards concluded that, for the fuel cycle facilities within the CEUS, there is no immediate safety concern.

Existing facilities (uranium enrichment, fuel fabrication [high and low enriched]) were mostly built to local building codes. These facilities demonstrate compliance with the performance requirements in 10 CFR 70.61 through their Integrated Safety Analyses (ISAs). 10 CFR Part 70 licensees are required to perform an ISA in which seismic events are addressed (through a combination of design and preventive/mitigative actions). To demonstrate compliance with Part 70, licensees must limit the risk of high and intermediate consequence events, by limiting the likelihood or consequence. It is expected that, in view of this new data, existing facilities will consider the updated information as it relates to the performance requirements and see if additional safety controls are necessary.

In addition to the ISA requirements, new facilities have to meet the even higher baseline design criteria (BDC), which requires the design to provide adequate protection against natural phenomena with consideration of the most severe documented historical events for the site. Three new facilities (LES, USEC ACP, and MOX) are undergoing construction. Conservatism was built into the design of these facilities (i.e., design code factors of safety, elasticity in the structures, and conservatism in the design evaluation) resulting in additional safety margin. All new facilities and new processes at existing facilities are required to meet 10 CFR 70.64(a)(2), which requires adequate protection against natural phenomena.

Note: Regarding some particular facilities, the Paducah Gaseous Diffusion Plant (a 10 CFR Part 76 facility) was designed to meet local building codes at the time of its construction in the early 1950s. Later in the late 1990s, as part of the Certification process, the Paducah plant was evaluated and reinforced to meet a 250 year return earthquake. Honeywell's construction was also consistent with the local building codes when it was built 50 years ago. Later during the 1990s, structural modifications were performed at Honeywell to upgrade the plant so it could withstand a 475-yr recurrence site-specific earthquake.

Q8. How can I learn more about earthquakes?

A8. A fact sheet on seismic issues for existing nuclear power plants is available on the NRC public website at http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/fs-seismic-issues.html. Background information on earthquakes can also be obtained at the U.S. Geological Survey website at http://earthquake.usgs.gov/.

Q9. What do the following terms mean?

- ***Annual exceedance frequency***
- ***Core damage frequency***
- ***Design basis earthquake* or *safe shutdown earthquake***
- ***Ground acceleration***
- ***High confidence of low probability of failure capacity***
- ***Large early release frequency***
- ***Seismic hazard***
- ***Seismic margin***
- ***Seismic risk***

A9. The terms are defined as follows:

- ***Annual exceedance frequency (AEF)*** – Number of times per year that a site's ground motion is expected to exceed a specified acceleration.

- ***Core damage frequency (CDF)*** – Expected number of core damage events per unit of time. *Core damage* refers to the uncovery and heat-up of the reactor core, to the point that prolonged oxidation and severe fuel damage are not only anticipated but also involve enough of the core to result in off-site public health effects if released. *Seismic core damage frequency* refers to the component of total CDF that is due to seismic events.

- ***Design basis earthquake* or *safe shutdown earthquake (SSE)*** – A *design basis earthquake* is a commonly employed term for the *safe shutdown earthquake* (*SSE*); the SSE is the earthquake ground shaking for which certain structures, systems, and components are designed to remain functional. In the past, the SSE has been commonly characterized by a standardized spectral shape associated with a peak *ground acceleration* value.

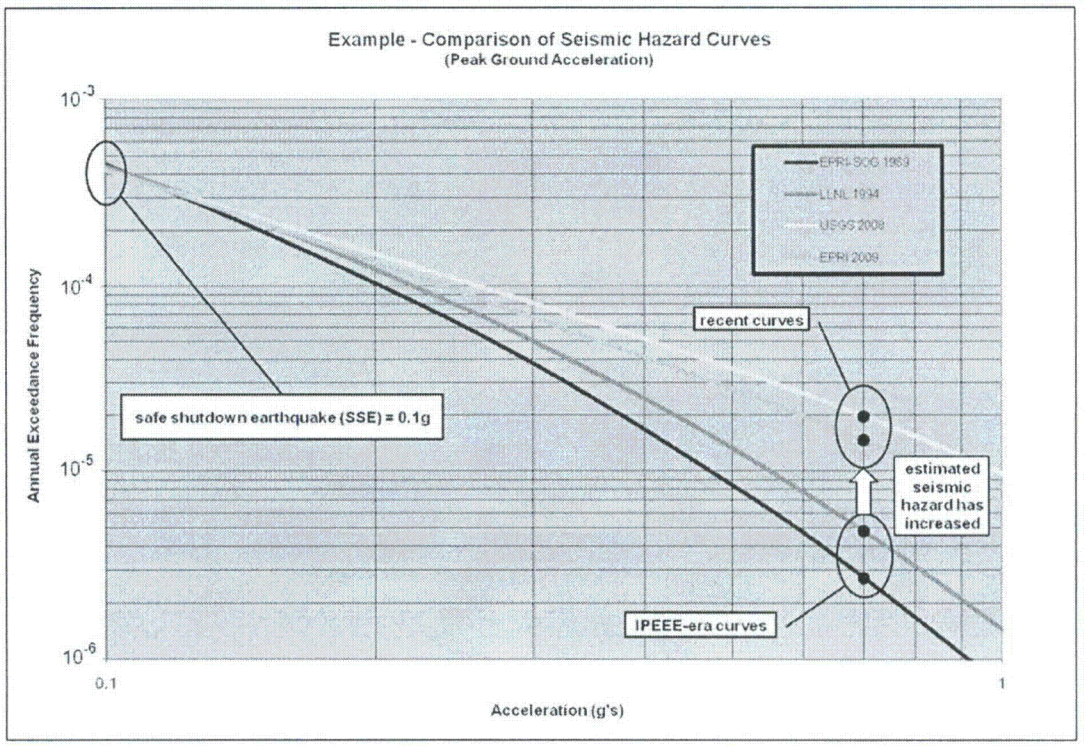
- ***Ground acceleration*** – Acceleration produced at the ground surface by seismic waves, typically expressed in units of *g*, the acceleration of gravity at the earth's surface.

- ***High confidence of low probability of failure (HCLPF) capacity*** – A measure of *seismic margin*. In *seismic risk* assessment, *HCLPF capacity* is defined as the earthquake motion level, at which there is high confidence (95%) of a low probability (at most 5%) of failure of a structure, system, or component.

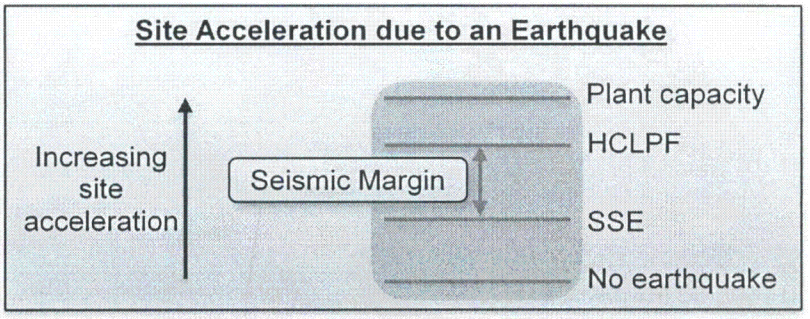
- ***Large early release frequency (LERF)*** – The expected number of large early releases per unit of time. A *large early release* is the rapid, unmitigated release of airborne fission products from the containment building to the environment, occurring before the effective implementation of off-site emergency response and protective actions, such that there is a potential for early health effects. *Seismic large early release frequency* refers to the component of total LERF that is due to seismic events.

- ***Seismic hazard*** – Any physical phenomenon, such as ground motion or ground failure, that is associated with an earthquake and may produce adverse effects on human activities (such as posing a risk to a nuclear facility).

For the representative plant in the chart below, the *annual exceedance frequency* for a 0.7*g* acceleration (e.g., for a large, but highly improbable earthquake) has increased from approximately one in 250,000 years (for IPEEE-era curves) to approximately one in 60,000 years (for recent *seismic hazard* curves). (In other words, the annual exceedance frequency for a 0.7*g* acceleration has increased from about 4 x 10^{-6} (0.000004) per year for IPEEE-era curves to about 1.8 x 10^{-5} (0.000018) per year for recent seismic hazard curves.) Note that the curves in this example are virtually indistinguishable at the SSE (design basis) level, but this is not always the case. Ultimately, GI-199 is about understanding the impact of these seismic hazard changes on reactor risk.



- ***Seismic margin*** – The difference between a plant's *HCLPF* capacity and its seismic design basis (*safe shutdown earthquake, SSE*), as shown in the figure below. (Note that the "plant capacity" label in this figure is the acceleration expected to result in core damage half of the time.) (Also see answer A11.)



- ***Seismic risk*** – The risk (frequency of occurrence multiplied by its consequence) of severe earthquake-initiated accidents at a nuclear power plant. A severe accident is an accident that causes core damage, and, possibly, a subsequent release of radioactive materials into the environment. Several risk metrics may be used to express *seismic risk*, such as seismic *core damage frequency* and seismic *large early release frequency*.

Safety

Q10. How was the seismic design basis for an existing nuclear power plant established?

A10. The seismic ground motion used for the design basis was determined from the evaluation of the maximum historic earthquake within 200 miles of the site, without explicitly considering the time spans between such earthquakes; safety margin was then added beyond this maximum historic earthquake to form a hypothetical *design basis earthquake* (see answer A9). The relevant regulation for currently operating plants is 10 CFR Part 100, Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants" (http://www.nrc.gov/reading-rm/doc-collections/cfr/part100/part100-appa.html).

Q11. Is there margin above the design basis?

A11. Yes, there is margin beyond the design basis (see answer A9). In the mid to late 1990s, NRC staff reviewed the plants' assessments of potential consequences of severe earthquakes (earthquakes well beyond the safety margin included in each plant's design basis), which licensees performed as part of the Individual Plant Examination of External Events program. From this review, the staff determined that seismic designs of operating plants in the Central and Eastern United States have considerable safety margins, for withstanding earthquakes, built into the designs.

Q12. What do you mean by "increased estimates of seismic hazards" at nuclear power plant sites?

A12. *Seismic hazard* (earthquake hazard) represents the chance (or probability) that a specific level of ground shaking could be observed or exceeded at a given location. Our estimates of seismic hazard at some Central and Eastern United States locations have changed based on results from recent research, indicating that earthquakes occurred more often in some locations than previously estimated. Our estimates of seismic hazard have also changed because the models used to predict the level of ground shaking, as caused by a specific magnitude earthquake at a certain distance from a site, changed. The increased estimates of seismic hazard at some locations in the Central and Eastern United States were discussed in a memorandum to the Commission, dated July 26, 2006. (The memorandum is available in the NRC Agencywide Documents Access and Management System [ADAMS] under Accession No. ML052360044).

Q13. What has the Safety/Risk Assessment found and what does it mean for Generic Issue 199?

A13. Results of the Safety/Risk Assessment confirm that currently operating plants have adequate protection against *seismic hazards* (see Safety/Risk Assessment report transmittal

memorandum). However, based on a separate criterion in the Generic Issues Program, the estimated *core damage frequency* change is still large enough to warrant further attention regarding the possible imposition of plant improvements. Action could include obtaining information and developing methods to complete plant-specific value-impact analyses.

RES staff developed a methodology and implemented it to assess the risk associated with this issue. Overall *seismic risk* estimates remain small in an absolute sense. All operating plants in the Central and Eastern United States have seismic core damage frequency (SCDF) less than or equal to 10^{-4} (0.0001) per year, which is considered safe (see answer to A15). The SCDF changes (the difference in SCDFs calculated using the old and new seismic hazard information) for a number of plants lie in the range of 10^{-4} to 10^{-5} (0.0001 to 0.00001) per year, which meets the NRC Generic Issues Program numerical risk threshold for an issue to continue to be evaluated for possible regulatory action.

Q14. Are the plants safe? If you are not sure they are safe, why are they not being shut down? If you are sure they are safe, why are you continuing evaluations related to this generic issue?

A14. Yes, currently operating nuclear plants in the Central and Eastern United States remain safe, with no need for immediate action. This determination is based on NRC staff reviews associated with Early Site Permits, the conclusions of the Generic Issue 199 Screening Panel (comprised of technical experts), and the conclusions of the Safety/Risk Assessment Panel (also comprised of technical experts).

No immediate action is needed because: (1) existing plants were designed to withstand anticipated earthquakes with substantial design margins, as confirmed by the results of the Individual Plant Examination of External Events; (2) the probability of exceeding the *safe shutdown earthquake* ground motion (see answer A9) may have increased at some sites, but only by a relatively small amount; (3) the increased probability is primarily in the high structural response frequencies, so buildings and equipment should not be affected (seismic amplitudes at lower frequencies are the primary contributors to building and equipment damage); and (4) the Safety/Risk Assessment Stage results indicate that the probabilities of seismic core damage are lower than the guidelines for taking immediate action.

Even though the staff has determined that existing plants remain safe, the Generic Issues Program criteria direct staff to continue their analysis to determine whether any cost-justified plant improvements can be identified to make plants even safer.

Q15. How do you know the plants are safe?

A15. The Safety/Risk Assessment results confirm that plants are safe. The relevant risk criterion for GI-199 is total *core damage frequency* (CDF). The threshold for taking immediate regulatory action (found in NRR Office Instruction LIC-504, see below) is a total CDF greater than or on the order of 10^{-3} (0.001) per year. For GI-199, the staff calculated seismic CDFs of 10^{-4} (0.0001) per year and below for nuclear power plants operating in the Central and Eastern U.S. (CEUS) (based on the new U.S. Geological Survey seismic hazard curves). The CDF from internal events (estimated using the staff-developed Standardized Plant Analysis of Risk models) and fires (as reported by licensees during the IPEEE process and documented in NUREG-1742), when added to the seismic CDF estimates results in the total risk for each plant to be, at most, 4×10^{-4} (0.0004) per year or below. This is well below the threshold (a CDF of

10^{-3} [0.001] per year) for taking immediate action. Based on the determination that there is no need for immediate action, and that this issue has not changed the licensing basis for any operating plant, the CEUS operating nuclear power plants are considered safe. In addition, as detailed in the GI-199 Safety/Risk Assessment and answers A13 and A14 above, there are additional, qualitative considerations that provide further support to the conclusion that plants are safe.

Note: The NRC has an integrated, risk-informed decision-making process for emergent reactor issues (NRR Office Instruction LIC-504, ADAMS Accession No. ML100541776 [not publically available]). In addition to deterministic criteria, LIC-504 contains risk criteria for determining when an emergent issue requires regulatory action to place or maintain a plant in a safe condition.

Despite NRC's determination that plants are safe to operate, MD 6.4, "Generic Issues Program," contains quantitative risk guidelines that place GI-199 into the category of continued evaluation to determine if cost-beneficial backfits can be justified at any plants.

Note: Also, New U.S. Geological Survey seismic hazard information provides ground acceleration likelihoods at each power plant site for both design basis and beyond design basis earthquakes. This seismic hazard information was combined with an estimate of each plant's resistance to earthquakes (seismic fragility) to produce an estimate of the frequency of damage to the reactor core due to earthquakes. This seismic core damage frequency (SCDF) was combined with estimates of the core-damage frequency (CDF) for internal events and fires, and the total CDF was then compared to risk thresholds used by the NRC to assess and assure that nuclear power plants are operated safely. The frequency calculated for all operating nuclear power plants in the CEUS is in the range considered safe.

Q16. Why are new nuclear plants being built to different seismic design requirements than existing nearby plants? Why are the currently operating plants not required to meet the new standards?

A16. Currently operating plants have been determined to adequately protect the public; new plants are designed to different requirements in order to meet the Nuclear Regulatory Commission's expectation that the new plants will provide enhanced margins of safety (see "Regulation of Advanced Nuclear Power Plants; Statement of Policy" 59 FR 35461 at http://www.nrc.gov/reading-rm/doc-collections/commission/policy/#power). There are two primary ways of determining safety: deterministic assessments (based on past events and engineering judgment) and probabilistic assessments. New plants employ probabilistic methods. Existing plants were built to older standards, based on deterministic assessments. Those standards have been monitored, and were found to be sufficient and appropriate. In order to impose new requirements on existing plants, the NRC must be able to justify the new requirements in accordance with the "Backfit Rule" (10 CFR 50.109, available at http://www.nrc.gov/reading-rm/doc-collections/cfr/part050/part050-0109.html). The NRC needs additional information to justify any new requirements, and the Safety/Risk Assessment Panel recommended taking action to acquire the information.

Q17. How does the occurrence of a new earthquake in the Central or Eastern United States affect Generic Issue 199?

A17. The effect of a single earthquake is small on the estimated *seismic hazard* (defined in answer A9) and hence on Generic Issue 199, unless it occurs in an area not previously recognized as being capable of producing earthquakes, or is larger than previously believed possible in a region. In a seismic hazard study, the seismic source zones are specifically delineated to include a sufficient number of earthquakes to provide a stable estimate of the seismicity rate and are thus relatively insensitive to the addition of a single earthquake. If an earthquake does occur in an area not previously recognized as being capable of producing earthquakes or if an earthquake occurs that is larger than previously believed possible in a region, changes to the seismic hazard model used to develop seismic hazard estimates would be required.

Note: The magnitude 5.2 earthquake that occurred on April 18, 2008 in southeastern Illinois provides a good example of the potential impact of a single earthquake. This earthquake occurred in an area recognized as being capable of producing significant earthquakes (the Wabash Valley seismic source zone) and was smaller than the maximum magnitude event defined for the zone based on geologic investigations (maximum magnitude of 7-7.5). The addition of a single event of this magnitude to the earthquake database for this area would likely change the activity rate by less than a few percent and thus have a very small impact on the estimated seismic hazard at any of the nuclear facilities in the area.

Schedule

Q18. What has been done about this issue since it was identified as a generic issue in the Generic Issues Program?

A18. The following summarizes what has been done on Generic Issue 199 (GI-199):

Prioritization and Screening

- *June 2005:* The issue was logged into the Generic Issues Program (GIP) and, based on the NRC determination that the seismic design of plants in the Central and Eastern United States still provided an adequate level of protection, the Agency decided that this issue was a relatively low priority.
- *November 2005 – February 2007:* The Agency awarded a contract to screen this issue and determine whether it should continue to be evaluated under the GIP. In 2006, the contractor notified RES of problems obtaining information that the contractor wanted to perform its task.
- *April 2007:* The NRC decided to use Agency staff to complete the screening analysis using guidance provided in Management Directive (MD) 6.4 and SECY-07-0022, "Status Report on Proposed Improvements to the Generic Issues Program," dated January 30, 2007. MD 6.4 outlines the seven GIP criteria for use in determining whether proposed generic issues should be designated generic issues (the screening process) and proceed to the Safety/Risk Assessment Stage of the GIP.
- *September 2007:* An initial screening analysis was completed.
- October 2007: For consistency with the performance-based approach for assessing *seismic hazards* for new reactors, the staff determined that the screening analysis should consider seismic hazard data and models besides those available from the U.S.

Geological Survey.

- *February 2008:* The NRC completed the GIP screening with the GI-199 Screening Panel concluding that the issue should proceed to the Safety/Risk Assessment Stage under the GIP. The NRC staff held a public meeting to engage external stakeholders. During the meeting, the representative from NEI expressed their willingness to support a collaborative approach to GI-199. (This led to a Seismic Risk Memorandum of Understanding Addendum between the Electric Power Research Institute and the NRC Office of Nuclear Regulatory Research (RES).)

Safety/Risk Assessment Stage

- GI-199 then entered the Safety/Risk Assessment Stage of the GIP. RES staff collected and analyzed seismic hazard information from the U.S. Geological Survey and other sources, and *seismic risk* information from Individual Plant Examination of External Events analyses.
- *November 2008:* The NRC Office of Nuclear Material Safety and Safeguards (NMSS) performed a preliminary review related to independent spent fuel storage installations (ISFSIs). A review of design earthquakes (DE) used at the existing ISFSI locations in Central and Eastern U.S., indicated that there is significant margin built into the existing designs and NMSS determined that they have confidence that the ISFSIs can continue to operate safely while GI-199 is processed.
- *June 2009:* In support of the Safety/Risk Assessment, the staff completed the review and detailed analysis of seismic data for 96 plants.
- *July 2009 – March 2010:* Several Safety/Risk Assessment Panel meetings were held to determine recommendations in light of stakeholder input that was received.
- *April 2010 – August 2010:* The Safety/Risk Assessment report is finalized. Internal briefings and communications are carried out (to build NRC consensus and to prepare for the release of the Safety/Risk Assessment report and associated public meeting).
- During the process of resolving GI-199, staff responded to Freedom of Information Act requests and held numerous meetings with internal and external stakeholders.

Q19. Why is it taking the NRC so long to process Generic Issue 199?

A19. This is a complicated issue involving the intersection of the probabilistic risk analysis and seismic disciplines. Obtaining data, developing methods, and performing analyses are all required to address the issue. Analyzing a few representative plants for this issue (as is normally done in the Generic Issues Program) is inappropriate because the *seismic hazard* and associated impact to the power plant are very site-specific; so analysis for 96 separate plants is required. (Refer to A14 for a summary of what has been done on GI-199 since it was first identified.) GI-199 has also been a communication-intensive generic issue because it affects many parts of the NRC and industry, and because it is important to NRC and all stakeholders that the Safety/Risk Assessment results are properly conveyed.

Q20. What will happen next regarding Generic Issue 199?

A20. The next step is for the staff to complete the Safety/Risk Assessment Stage of the Generic Issues Program (GIP). The Safety/Risk Assessment report will soon be published, followed by an information notice being sent to all licensees of nuclear power reactors and independent spent fuel storage installations. A public meeting will be held to discuss the results of the Safety/Risk Assessment and the next steps for GI-199. After the Safety/Risk Assessment

Stage, further action regarding GI-199 will be pursued (such as obtaining more detailed, plant-specific information and performing analysis to determine whether plant-specific improvements are warranted). NRC staff will also make presentations to the Advisory Committee on Reactor Safeguards.

Q21. Aside from evaluations for GI-199, what is the NRC's expectation regarding the use of updated probabilistic seismic hazard information in regulatory applications?

A21. It is expected that all NRC licensees that are required to analyze risks and hazards impacting their operations will use the most current seismic hazard information.

Regarding currently operating nuclear power plants, there is no requirement that the plants re-evaluate their seismic design basis (10 CFR 100, Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants"), but plants do need to use the most updated information available in the case of risk-informed licensing amendments.

Note: The NRC guidance for using probabilistic risk assessment (PRA) in risk-informed decisions on plant-specific changes to the licensing basis is provided in RG 1.174. The scope, level of detail, and technical acceptability of the PRA are to be commensurate with the application for which it is intended and the role that the PRA results play in the integrated decision process. One over-riding requirement is that the PRA should realistically reflect the actual design, construction, operational practices, and operational experience of the plant and its owner. RG 1.200 provides further guidance concerning the technical adequacy of PRAs and states that seismic hazard analysis should include current information. Consistent with this guidance, the staff expects that licensees will use the most recent seismic hazard information available for risk-informed regulatory applications.

Regarding seismic requirements for dry cask storage systems and independent spent fuel storage installations (ISFSIs), the staff also expects that licensees will use the most recent seismic hazard information available for risk-informed regulatory applications.

Note: NRC regulations (in 10 CFR Part 72) require licensees to perform written evaluations to establish that, for their site-specific conditions, the conditions set forth in the Certificate of Compliance (CoC) have been met. They must also perform evaluations showing that cask storage pads and areas have been designed to adequately support the static and dynamic loads of the stored casks, considering potential amplification of earthquakes through soil-structure interaction as well as soil liquefaction potential or other soil instability due to vibratory ground motion.

Stakeholder Interest

Q22. Has the NRC received any requests from government officials regarding seismic issues?

A22. Yes. On November 15, 2007, the NRC received a letter (available in the NRC Agencywide Documents Access and Management System, ADAMS, under Accession No. ML0732500954) from the Attorneys General of six states (Connecticut, Delaware, Illinois, Kentucky, New York, and Vermont). The letter encouraged the NRC to consider siting and safety requirements, including geographic and seismic issues, in the regulatory process for license renewal. The NRC reviewed this letter and responded that the items of concern are

addressed in "ongoing regulation [that]... occurs throughout the life of the license... [and that] expand[ing] the scope of license renewal to cover...[the] issues raised in [the] letter...[would be] duplicating the Commission's responsibilities..." (ADAMS Accession No. ML073400603). Additionally, several Freedom of Information Act requests were received, and NRC staff responded to the requests; the U.S. Geological Survey data related to these requests is publicly available under ADAMS Accession No. ML072880133.

Also, the County Executive of Westchester County (New York) and groups from New Jersey submitted a petition for rulemaking on license renewal, including a seismic-related aspect. The NRC denied this petition. The petitioners then filed suit in the U.S. Court of Appeals Second Circuit and the court upheld the NRC position. Details are available on the internal webpage of the NRC Office of General Counsel (under Law Library, Summary of AEC-NRC Litigation, "Spano v. NRC" (2d Cir. 2009): http://www.internal.nrc.gov/ogc/internal/AEC-NRC_Cases.pdf.)

Q23. Will the NRC release the results of the Safety/Risk Assessment? If so, will plant-specific results be included?

A23. The Safety/Risk Assessment report will be made available on the public NRC Generic Issues Program (GIP) website (http://www.nrc.gov/about-nrc/regulatory/gen-issues.html), on the internal NRC GIP website (http://www.internal.nrc.gov/RES/projects/GIP/), and in the NRC Agencywide Document Access and Management System (ADAMS) under Accession No. ML100270582.

Regarding the plant-specific results, they are included in the Safety/Risk Assessment report (in appendix D), and have been used in the aggregate for the determination that further, plant-specific information and analysis is needed to investigate possible plant-specific improvements. (See the last section, "Safety/Risk Assessment Results - Plants in the GIP "Continue Region," of this Communication Plan.)

Note: Results of the Safety/Risk Assessment confirm that currently operating plants have adequate protection against seismic hazards; however, the results also indicated that GI-199 meets the NRC Generic Issues Program numerical risk threshold for an issue to continue to be evaluated for possible regulatory action (see answer A13). The Safety/Risk Assessment utilized simplifying methods and assumptions to produce plant-specific results to determine trends, not to finalize which plants will or will not be further analyzed.

Safety/Risk Assessment Results - Plants in the GIP "Continue Region"

Plant-specific results are included in the Safety/Risk Assessment report (in appendix D) and have been used in the aggregate to determine that further, plant-specific information and analysis is needed to investigate possible plant-specific improvements. Listed below are plants that are currently above the Generic Issues Program (GIP) numerical risk threshold for an issue to continue to be evaluated for possible regulatory action (see answers A13 and A23). (Note that the plants are listed in alphabetical order by NRC region.) During the analysis, this group of plants was referred to as the "plants in the *continue region*."

As more information becomes available and more detailed analysis is performed, this group of plants *will* change. As discussed in answer A4, generic communications on this issue will be addressed to all operating power plants in the United States. More detailed, plant-specific analysis of all plants will allow NRC staff to prioritize plants that may be considered for regulatory action. The need to continue evaluating GI-199 is based on the collective results, not the results for any particular plant.

Region I
Indian Point 2
Indian Point 3
Limerick 1
Limerick 2
Peach Bottom 2
Peach Bottom 3
Seabrook 1

Region II
Crystal River 3
Farley 1
Farley 2
North Anna 1
North Anna 2
Oconee 1
Oconee 2
Oconee 3
Saint Lucie 1
Saint Lucie 2
Sequoyah 1
Sequoyah 2
Summer
Watts Bar 1

Region III
Dresden 2
Dresden 3
Duane Arnold
Perry 1

Region IV
River Bend 1
Wolf Creek 1

Q24. There was a recent Part 21 (60-Day Interim Report) Notification concerning seismic input for control rods that might lead to a failure to scram at Boiling Water Reactors (BWRs). Was this information included in the GI-199 Safety/ Risk Assessment (S/RA)? Could this information change the results of the S/RA?

A24. On September 3, 2010, General Electric Hitachi (GEH) Nuclear Energy submitted a 10CFR50 Part 21 Notification regarding a failure to include seismic input in reactor control blade customer guidance for BWRs. BWRs remain safe because (1) control rods are expected to fully or partially insert even with channel-control rod interference, (2) operators will still have the ability to manually scram partially inserted rods, and (3) the limited time spent at conditions where the failure to scram could occur (low reactor pressure). NRR has been following this Part 21 issue and has determined that the GEH has provided effective interim guidance to the affected licensees that experience channel-control rod interference, and that additional guidance detailed in the Part 21 notice, provides licensees with conservative strategies to assist in the insertion of control rods under low reactor pressure conditions.

The GI-199 S/RA was completed in August, prior to the Part 21 notice. Considering the above, information from the new Part 21 notice would not be expected to change the conclusions of the GI-199 S/RA. Information from this Part 21 Notification will be considered in future efforts to address GI-199.

September 2, 2010

MEMORANDUM TO: Brian W. Sheron, Director
Office of Nuclear Regulatory Research

FROM: Patrick Hiland, Chairman **/RA/**
Safety/Risk Assessment Panel for Generic Issue 199

SUBJECT: SAFETY/RISK ASSESSMENT RESULTS FOR GENERIC ISSUE 199, "IMPLICATIONS OF UPDATED PROBABILISTIC SEISMIC HAZARD ESTIMATES IN CENTRAL AND EASTERN UNITED STATES ON EXISTING PLANTS"

In accordance with Management Directive (MD) 6.4, "Generic Issues Program," a Safety/Risk Assessment panel was established to:

- Determine, on a generic basis, if the risk associated with Generic Issue (GI) 199, "Implications of Updated Probabilistic Seismic Hazard Estimates in Central and Eastern United States (CEUS) on Existing Plants," warrants further investigation for potential imposition as a cost-justified backfit.

- Provide a recommendation regarding the next step (i.e., should the issue continue to the Regulatory Assessment Stage for identification and evaluation of potential generic, cost-justified backfits, be dropped due to low risk, or have other actions taken outside the Generic Issues Program [GIP]).

The panel completed its independent review of the Safety/Risk Assessment (see Enclosure 1) for GI-199. The panel reached the following conclusions and observations:

- Overall seismic core damage risk estimates are consistent with the Commission's Safety Goal Policy Statement because they are within the subsidiary objective of 10^{-4}/year for core damage frequency. The GI-199 Safety/Risk Assessment, based in part on information from the U.S. Nuclear Regulatory Commission's (NRC's) Individual Plant Examination of External Events (IPEEE) program, indicates that no concern exists regarding adequate protection and that the current seismic design of operating reactors provides a safety margin to withstand potential earthquakes exceeding the original design basis.

- The changes in seismic core-damage frequency (SCDF) estimated in the Safety/Risk Assessment Stage of GI-199 for numerous plants lie in the range of 10^{-4}/yr to 10^{-5}/yr, which meet the numerical risk criteria for an issue to proceed to the Regulatory Assessment Stage of the GIP.

CONTACT: John Kauffman, RES/DRA
301-251-7465

- New consensus seismic-hazard estimates will become available in late 2010 or early 2011 (these are a product of a joint NRC, U.S. Department of Energy, U.S. Geological Survey (USGS) and Electric Power Research Institute (EPRI) project). These consensus seismic-hazard estimates will supersede the existing EPRI, Lawrence Livermore National Laboratory, and USGS hazard estimates used in the GI-199 Safety/Risk Assessment.

- Certain factors that affect the development of realistic SCDF estimates will remain unresolved even after the new consensus seismic hazard estimates are developed. The issue is primarily that many IPEEEs did not produce SCDF estimates and so lack some of the information needed to produce such estimates.

    - For a number of the plants that performed reduced-scope seismic margins analyses as part of the IPEEE program, limited detailed information exists regarding plant seismic capacity (the ability of a plant's structures, systems, and components [SSCs] to successfully withstand an earthquake) beyond the required design-basis level.

    - The approach used in the attached Safety/Risk Assessment to estimate SCDF considers the plant-level seismic capacity and, therefore, does not provide insight into which SSCs are important to seismic risk. Such knowledge would be required in order to postulate potential cost-beneficial backfits.

- IPEEE submittals generally provided limited, qualitative information about the seismic capability of containments. Any regulatory analysis of GI-199 should consider potential plant modifications for reducing the probability of seismically induced containment failure as discussed in Section 3.3.1 of NUREG/BR-0058, "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission."

The panel recommends the following:

- Transfer lead responsibility for subsequent GI-199 actions to the Office of Nuclear Reactor Regulation for regulatory office implementation, including maintenance of the GI-199 Communication Plan and stakeholder briefings and interactions. (Note: the GIP will continue to track the issue and report its status in the Generic Issues Management Control System until all actions are completed).

- Take further actions to address GI-199 outside the GIP (i.e. obtain information and develop methods, as needed, to complete plant-specific value-impact analyses of potential backfits to reduce seismic risk). Any needed Office of Nuclear Regulatory Research support can be obtained using the User Need Request process.

Enclosure:
Safety/Risk Assessment for GI-199

Approved: /RA/ Date: 9/2/2010

Brian W. Sheron, Director
Office of Nuclear Regulatory Research

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Enclosure:
Safety/Risk Assessment for GI-199

Approved: /RA/ Date: 9/2/2010
Brian W. Sheron, Director
Office of Nuclear Regulatory Research

DISTRIBUTION: See next page

ADAMS Accession No.: ML100270582

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DATE	5/24/10	5/24/10	5/4/10	6/14 /10	6/14/10	6/30 /10	6/15/10	6/30/10	8/23/10	

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Memo to Brian W. Sheron from Patrick L. Hiland dated September 2, 2010

SUBJECT: SAFETY/RISK ASSESSMENT RESULTS FOR GENERIC ISSUE 199, "IMPLICATIONS OF UPDATED PROBABILISTIC SEISMIC HAZARD ESTIMATES IN CENTRAL AND EASTERN UNITED STATES ON EXISTING PLANTS"

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From: Giessner, John 1811
To: Blamey, Alan; Taylor, Robert; Nakanishi, Tony
Cc: Scott, Michael
Subject: Next steps this AM
Date: Sunday, March 27, 2011 4:21:21 PM

Fellow team leads. I keep getting up early, but thought I'd provide an agenda and possible questions for the 7am and 10 am meeting.

7am
Get their feedback on unit 1 pressure (RPV) and discuss SFP

Strategy questions:
How long do we wait to inert and we our strategy to change to do it.
What do we look for.

For units 2 and 3 maybe the containment is partially filled for ex-vessel cooling. Will this be OK; are we expecting them to try. What would be our success criteria that we are OK on the vessel. I have a sneaking suspicion, they are not likely to want to flood too long or at all with the bypass of containment likely occurring. This would be a kick off discussion as we are researching, but want them to get industry feedback.

NISA/TEPCO meeting (perhaps we can bring simplified picture for SFP)

Thanks for the tour.

Share paper with caveats(ask them to review and provide their thoughts for Tues.)

Do you have a timeline to inert- when will you start? If we get no answer. Ask a bit pointed, is this your top priority. If no answer, ask what is YOUR top one.

Do you have N2 rigs and sources needed. Do you need help?

Regarding unit 2 high activity in TB. Do you have a possible source? Unit 3 as well.

Request: please provide radiation survey maps for the TB.

Where are the pressure indication sensed (elevationwise) for D/W and S/C pressure indicators?

Feel free to add; I think we should come to agreement ahead as when the meeting goes on, we have a priotized list.

Jack

(Sent from Blackberry)

3/312

From: Giessner, John
To: Blamey, Alan; Taylor, Robert; Sheikh, Abdul
Subject: sourced
Date: Sunday, March 27, 2011 1:03:41 AM

---

http://www.nisa.meti.go.jp/english/

From:	Sheikh, Abdul
To:	Taylor, Robert
Cc:	Scott, Michael
Subject:	Information Required
Date:	Sunday, March 27, 2011 1:58:23 AM

INRR

We need the following information:

1. From Headquarters

General arrangement drawing/equipment location of typical BWR Mark I plant that shows layout of spent fuel pool and skimmer tank.

2. From TEPCO

a. General arrangement drawings of a typical unit (Unit 1 or Unit 2 or Unit 3 or Unit 4)
b. A sketch which shows relative elevation of spent fuel pool and skimmer tank where the fuel pool water levels are being minitore.
c. Strutural drawings of the spent fuel pool

Abdul

W/3/4

Galloway, Melanie

From: Galloway, Melanie NRR
Sent: Monday, March 28, 2011 6:57 AM
To: Meighan, Sean
Subject: RE: i will be calling each of you now to ask if you can attend a meeting with Eric in 13D20 (meeting now). Japan delegation. eom

Louise Lund was acting for me last Friday afternoon. Were you able to get her to attend?

From: Meighan, Sean NRR
Sent: Friday, March 25, 2011 2:07 PM
To: Skeen, David; Nelson, Robert; Galloway, Melanie; Bahadur, Sher
Subject: i will be calling each of you now to ask if you can attend a meeting with Eric in 13D20 (meeting now). Japan delegation. eom

R

W/315

Pannier, Stephen

From: Garmon, David (NRR)
Sent: Monday, March 28, 2011 3:34 PM
Subject: New OpE COMM: International - Tohoku-Taiheiyou-Oki Earthquake and Tsunami (Honshu, Japan)

This email is being sent to notify recipients of a new posting on the @Operating Experience Community Forum.

Recipients are expected to review the posting for applicability to their areas of regulatory responsibility and consider appropriate actions. However, information contained in the posting is not tasking; therefore, no specific action or written response is required.

Information Security Reminder: OpE COMMs contain preliminary information in the interest of timely internal communication of operating experience. OpE COMMs may be pre-decisional and may contain sensitive/proprietary information. They are not intended for distribution outside the agency

The posting may be reviewed at: **Tohoku-Taiheiyou-Oki Earthquake and Tsunami (Honshu, Japan)**

This COMM is being posted to the following groups: ***All Communications, Chemistry/Chemical Engineering, Containment (leakage, degradation, cooling system performance), Control Room Habitability, Dose Assessment, ECCS, Electrical Power Systems, Emergency Diesel Generators, Emergency Preparedness, Fire Protection, Flood Protection & Missiles, Fuels, Health Physics, Human Performance, HVAC, Inspection Programs, Instrumentation and Controls, Main Steam & Condensate/Feed Systems, Materials/Aging, Natural Phenomena, New Reactors, Piping, Pump and Valve Performance, RCPB Leakage, Reactor Vessel/Pressurizer, Safety Culture, Shutdown Risk, Spent Fuel Storage & Load Handling, Station Service Water Systems & Ultimate Heat Sink, Steam Generators, Structural, Welding/Non-Destructive Examination, Worker Fatigue***

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For more information on the Reactor OpE Program, please visit our Reactor OpE Gateway.

Thank you for reviewing and using Operating Experience.

Regards,
David Garmon
NRR/DIRS/IOEB
(301) 415-3512
Office: O-7C20
Mail Stop OWFN-7C02A

3/31/11

From:	Nakanishi, Tony
To:	Liaison Japan
Subject:	For tomorrow"s 11 am NISA/TEPCO meeting
Date:	Tuesday, March 29, 2011 4:17:26 AM
Attachments:	1F1 Status Assessment.pptx

Mike,
Attached summarizes the NRC and NISA positions on the status of 1F1-1F4. Please let me know if anything in the attached needs to change.
Tony

Assessments of 1F1 Units 1-4

Unit 1	NISA	NRC	Comment
RPV	Intact	Intact	
Containment	Intact	Intact	
Core	Damaged	Damaged	
SFP	Not damaged	Not damaged	NISA assessment based on thermal image and video

Unit 2	NISA	NRC	Comment
RPV	No evidence supporting lost integrity	Damaged	
Containment	Damaged	Damaged	
Core	Damaged	Damaged	
SFP	Not damaged	Not damaged	NISA assessment based on thermal image and video

Unit 3	NISA	NRC	Comment
RPV	Damaged	Damaged	NRC does not understand NISA's basis (300C FW nozzle temp)
Containment	Damaged	Damaged	NRC does not understand NISA's basis (400C Containment temp)
Core	Damaged	Damaged	
SFP	Not damaged	Indeterminate – insufficient data to reach conclusion	NISA assessment based on thermal image and video

Unit 4	NISA	NRC	Comment
SFP	No evidence supporting fuel damage	Damaged – H2 generated from zirconium-steam reaction	NISA assessment based on thermal image and video

Nelson, Robert

From: Nelson, Robert
Sent: Tuesday, March 29, 2011 8:36 AM
To: Leeds, Eric; Boger, Bruce; Grobe, Jack; Landau, Mindy; Roberts, Darrell; Kennedy, Kriss; Lara, Julio; Croteau, Rick; Steger (Tucci), Christine; LIA06 Hoc; Bahadur, Sher; Blount, Tom; Brown, Frederick; Cheok, Michael; Evans, Michele; Ferrell, Kimberly; Galloway, Melanie; Giitter, Joseph; Givvines, Mary; Hiland, Patrick; Holian, Brian; Howe, Allen; Lee, Samson; Lubinski, John; McGinty, Tim; Quay, Theodore; Ruland, William; Skeen, David; Thomas, Brian; Westreich, Barry; Guzman, Richard; Lyon, Fred; Markley, Michael; Meighan, Sean; Nguyen, Quynh; Oesterle, Eric; Policikoski, James; Tam, Peter; Thomas, Eric
Cc: West, Steven; Shear, Gary; Burnell, Scott; Broaddus, Doug; Campbell, Stephen; Carlson, Robert; Chernoff, Harold; Kulesa, Gloria; Pascarelli, Robert; Salgado, Nancy; Simms, Sophonia; Wall, Scott
Subject: FYI: California Coastal Commission Report
Attachments: Tohoku_Earthquake_Report.pdf; image001.png

The California Coastal Commission has released, "THE TŌHOKU EARTHQUAKE OF MARCH 11, 2011: A PRELIMINARY REPORT ON IMPLICATIONS FOR COASTAL CALIFORNIA." It is a public document and is attached.

The report provides: a description of the Tōhoku Earthquake and tsunami effects; an evaluation of whether the seismic characteristics of the Tōhoku Earthquake are applicable to the California coast; and a brief description of the earthquake and tsunami risks at California's three coastal nuclear facilities. The Executive Summary is repeated below.

- **The vast majority of faults in California, including the San Andreas fault, could not produce a magnitude 9 earthquake.**
  Most of California is not susceptible to an event of the scale of the Tōhoku Earthquake. Nevertheless, it is important not to become complacent; large earthquakes are inevitable throughout coastal California, and could be devastating in their own right. There is a large population and much infrastructure at risk in central and southern coastal California.
- **The Cascadia Subduction Zone could produce a magnitude 9 earthquake similar to the Tōhoku Earthquake.**
  The northern part of the coastal California, as well as all of coastal Oregon, Washington, and part of coastal British Columbia—the Cascadia Subduction Zone—is susceptible to an earthquake and tsunami event similar to that of the Tōhoku Earthquake. Emergency response scenarios and land use planning must take this into account.
- **A nuclear emergency such as is occurring in Japan is extremely unlikely at the state's two operating nuclear power plants.**
  The combination of strong ground motion and massive tsunami that occurred in Japan cannot be generated by faults near the San Onofre Nuclear Generating Station and the Diablo Canyon Power Plant. Nevertheless, the geologic conditions near those plants are very likely different than previously believed and ongoing study is warranted. This has been understood for at least the past three years, and some of these studies, and the environmental planning process for other such studies, are underway.

If you already received this from Annie Kammerer, I apologize for the duplicate.

R.A. Nelson

Robert A. Nelson
NRR External Communications Coordinator, Japan Event
Deputy Director
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

W/318

From: Nakanishi, Tony
To: Liaison Japan
Subject: RE: For tomorrow"s 11 am NISA/TEPCO meeting
Date: Tuesday, March 29, 2011 5:04:59 AM
Attachments: 1F1 Status Assessment.pptx

Revised with qualifiers...

From: Nakanishi, Tony
Sent: Tuesday, March 29, 2011 4:17 AM
To: Liaison Japan
Subject: For tomorrow's 11 am NISA/TEPCO meeting

Mike,
Attached summarizes the NRC and NISA positions on the status of 1F1-1F4. Please let me know if anything in the attached needs to change.
Tony

3/29

Assessments of 1F1 Units 1-4

Unit 1	NISA	NRC	Comment
RPV	Likely intact	Likely intact	
Containment	Likely intact	Likely intact	
Core	Likely damaged	Likely damaged	
SFP	Likely not damaged	Likely not damaged	NISA assessment based on thermal image and video

Unit 2	NISA	NRC	Comment
RPV	No evidence supporting lost integrity	Likely damaged	
Containment	Likely damaged	Likely damaged	
Core	Likely damaged	Likely damaged	
SFP	Likely not damaged	Likely not damaged	NISA assessment based on thermal image and video

Unit 3	NISA	NRC	Comment
RPV	Likely damaged	Likely damaged	NRC does not understand NISA's basis (300C FW nozzle temp)
Containment	Likely damaged	Likely damaged	NRC does not understand NISA's basis (400C Containment temp)
Core	Likely damaged	Likely damaged	
SFP	Likely not damaged	Indeterminate – insufficient data to reach conclusion	NISA assessment based on thermal image and video

Unit 4	NISA	NRC	Comment
SFP	No evidence supporting fuel damage	Likely damaged – H2 generated from zirconium-steam reaction	NISA assessment based on thermal image and video

From: Blamey, Alan
To: Taylor, Robert
Subject: NISA Web Site.
Date: Tuesday, March 29, 2011 5:24:18 PM

The link.

http://www.nisa.meti.go.jp/english/

W/320

From:	Taylor, Robert
To:	Ross-Lee, MaryJane; Rini, Brett
Cc:	Scott, Michael
Subject:	Spent Fuel Pool Sloshing
Date:	Tuesday, March 29, 2011 5:23:00 AM

INRR

Mary-Jane and Brett,

I recall a video of the KK spent fuel pool during the 2007 earthquake. Is my recollection correct that one exists? Do you have a copy of it? What height of sloshing (best guess) occurred?

As you can guess, this relates to Daiichi.

Best regards,

Rob Taylor
NRC Japan Team

W/3/31

From: EUCI Events
To: Taylor, Robert
Subject: The Lessons of Fukushima Daiichi, April 26, 2011
Date: Tuesday, March 29, 2011 11:07:37 AM

The Lessons of Fukushima Daiichi:
An In-Depth Technical Analysis

April 26, 2011 :: 12:00 - 1:30 PM Eastern Time

As the events at the Fukushima Daiichi Nuclear Power Plant continue to unfold, this webinar will address:

- The design of the plant, including its safety systems
- Damage to the plant caused by the earthquake and tsunami
- What it means to safely shut down a nuclear reactor
- How hydrogen gas is generated and the resulting explosions
- A timeline of events that occurred at Fukushima
- How different countries and agencies have responded to these events, including the U.S. NRC
- How the Fukushima event will impact the nuclear power industry in the U.S. and worldwide

As this is an ongoing event, the latest information and detail available will be incorporated into the webinar.

PDF Brochure | Pricing and Registration

Topics Include

- The water-steam relation inside the BWR reactor
- What it means when the heat sink is lost by a combination of tripping the turbine and the loss of both normal and emergency core cooling capability
- The steam-pressure build-up inside the reactor vessel, resulting in uncovering the nuclear fuel
- The subsequent oxidation of the zircalloy fuel cladding
- The attempts to relieve the pressure, which also released explosive hydrogen gas
- Release of volatile radioactive fission products
- The design of the spent fuel pool and why it became another challenge to maintain it within its design basis

Full Agenda

Instructed By

Howard L. Sobel, PE, Nuclear Consultant

Instructor Bio

Browse All Events By Category

- Generation
- Natural Gas
- Nuclear
- Coal
- Future/Alternative Generation
- Solar
- Biomass
- Hydro
- Energy Storage
- Transmission
- Distribution
- Security/Safety
- Metering Technologies
- Demand Response, Energy Efficiency
- Environmental and Emissions
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Protecting People and the Environment

NRR All Supervisors Meeting

March 30, 2011

8/323

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Agenda

- **Discussion Related to Events in Japan**
  - Eric Leeds, Director
- **State of the Office: NRR Successes and Challenges**
  - Bill Ruland, Acting Deputy
- **State of the Office: Corporate Business**
  - Mary Givvines, Director, PMDA
- **Enlightened Leadership – Forward Focus**
  - David Pelton, Chief, DLR
- **Supervisor Training, Safety Culture, and IRRS**
  - Eric Leeds, Director
- **Questions and Answers**

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Key Messages – Events in Japan

- Focus on U.S. Operating Reactor Safety!
- Need all NRR Management to Step Up!
- Keep Work moving!

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Fukushima – Response and Support

- Support to U.S. Ambassador and Japanese Government
- Help Citizens in Japan
- Lessons Learned from the Event

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NRR Actions to Support

- Communications Task Force – R. Nelson
- Near-Term Action Task Force – J. Grobe
- Regulatory Action Conduit – B. Westreich

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Going Forward

- Anticipated Impacts on NRR Staff
- Communication with NRR Staff
- Communication with Stakeholders
- Impact on Regulatory Framework

Continue to Maintain Focus on Safety!

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State of the Office: NRR Successes and Challenges

Bill Ruland, Acting Deputy Director
Engineering and Corporate Support

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Accomplishments

- Support for Japan
- Completion of the Regulatory Information Conference
- Digital Instrumentation &Controls
- Generic Communications

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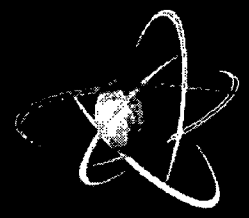
Looking Ahead

- Actions, including domestic, related to Fukushima events
- Completing NFPA 805 reviews
- Part 26 rulemaking and enforcement discretion
- Budget and Continuing Resolution efforts



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State of the Office: Corporate Business

Mary Givvines, Director

Program Management, Policy Development and Analysis Staff

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Current Financial Overview

- Continuing Resolution through April 8
- Contracts/ROMA System
- FY 2013 Budget Formulation

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Human Capital Update

- Current Staffing
- Union Activities
- FY 2011 Award Guidance
- Other Human Capital Activities

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Information Technology and Infrastructure Services

- On Boarding Effort within NRR
- Centralizing Web Services
- IT Coordination and Services
- Space Update

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Agency Initiatives of Interest

- Agency Overhead Effort - TABS
- Strategic Acquisition
- ADAMS P8

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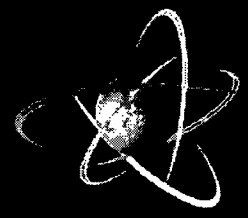
Support from Management

- Continued Patience Dealing with Continuing Resolution
- Developing Realistic Spending Plans
- Entering Accurate Data into ROMA System



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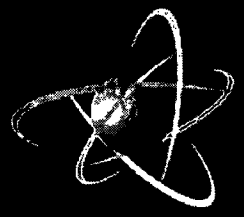
Enlightened Leadership
Forward Focus

David Pelton, Chief

Division of License Renewal



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Supervisor Training, Safety Culture, and IRRS

Eric Leeds, NRR Director

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Supervisor Training

- NRC Leader's Academy
- Difficult Conversations Training
- Orientation Training Initiative

Continue Your Personal and Career Development – Tools Are Available – We Support You!

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Safety Culture

- Completed 2 focus groups to generate new ideas to continue our work in improving the work environment in NRR.
  - Administrative Assistants Focus Group
  - Technical Staff Focus Group
- Continue to Hold Periodic Meetings with Divisions on Action Plans (May)

NRR Safety Culture Webpage:

http://nrr10.nrc.gov/nrr-office/safety-culture/index.cfm

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IRRS Mission Report

- Received Report March 4; Publicly Available
- Identified 25 Good Practices, 20 Suggestions, and 2 Recommendations

Next Steps

- Develop Detailed Action Plan – June
- Lessons Learned Workshop – October
- Follow-up IRRS Mission in 2013

Haskell, Russell

From: Thorp, John NRR
Sent: Wednesday, March 30, 2011 10:37 AM
To: Tabatabai, Omid
Cc: NRR_DIRS_IOEB Distribution
Subject: RE: ARTICLE: NRC, critic disagree on lessons for U.S. from Japan nuclear crisis

Thanks for sharing, Omid.

John

From: Tabatabai, Omid NRO
Sent: Wednesday, March 30, 2011 10:23 AM
To: King, Mark; Thorp, John; Copeland, Douglas; Craffey, Ryan; Harmon, David; Issa, Alfred; Patel, Jay
Cc: Tappert, John; Dudes, Laura
Subject: ARTICLE: NRC, critic disagree on lessons for U.S. from Japan nuclear crisis

From CNN International...

By **Mike M. Ahlers**, CNN
March 29, 2011 -- Updated 2323 GMT (0723 HKT)

- NRC executive says nothing from Japan so far suggests changes are needed in the U.S. A nuclear engineer says changes are needed in battery power and spent fuel pools "We will enhance safety as a result of Fukushima," a nuclear industry representative says

Washington (CNN) -- Two weeks into Japan's nuclear crisis, a top U.S. Nuclear Regulatory Commission official and an industry critic gave Congress starkly different opinions on whether lessons can already be gleaned from the disaster and applied to U.S. plants.

The commission's executive director, Bill Borchardt, repeated the agency's view that United States' 104 nuclear reactors are safe, and said early information out of Japan does not suggest changes are needed, at least so far.

But a representative from an industry watchdog group strongly disagreed, saying Fukushima Daiichi has exposed vulnerabilities in U.S. plants that deserve immediate attention. Chief among them, he said, is that U.S. plants need more emergency batteries to cope with longer power blackouts, and plants should reduce the amount of fuel stored in spent fuel pools.

"There are lessons, learned at high cost in Japan, that can and should be applied to lessen the vulnerabilities at U.S. reactors," said David Lochbaum, a nuclear engineer with the Union of Concerned Scientists.

The hearing before the Senate Energy Committee brought together representatives of government, industry and the Union of Concerned Scientists, all of whom said radiation from Fukushima Daiichi does not pose a significant health threat to people in the United States. But they differed on whether the Japanese experience demonstrates a need for immediate action in the United States.

Last week, the Nuclear Regulatory Commission launched a 90-day review of the Fukushima disaster and ordered its staff to release "quick reports" in 30 and 60 days.

"I'll knock on wood as I ask this question," said Sen. Bob Corker, R-Tennessee. "Your sense is that you've seen nothing in Japan so far that you haven't already tried to engineer or change in our own existing facilities of that nature?"

"I would say that's true," Borchardt replied. "But that's why we're doing this extensive both short-term and long-term review."

Borchardt said past incidents have led to safety improvements. The 1979 accident at Three Mile Island near Harrisburg, Pennsylvania, led to expansion of a program placing resident inspectors at every nuclear power plant,

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he noted. The United States also requires inert gas inside containment buildings to protect them from hydrogen explosions, and requires plants to have severe accident mitigation guidelines.

But the Lochbaum criticized the pace of change.

"If the past three decades have demonstrated anything, it's that the NRC will likely come up with a solid action plan to address problems revealed at Fukushima, but will be glacially slow in implementing those identified safety upgrades," he said.

Lochbaum said the agency should require nuclear plants to be able to withstand longer power shortages. Among other things, the United States should upgrade the batteries that are a back-up source of power. Like Fukushima, 11 U.S. nuclear plants have eight hours of battery capacity, Lochbaum said. Ninety-three have only four hours of capacity, he said.

"I think we can do that. I don't think it's difficult. I think Japan showed the price of not doing that," Lochbaum said. "So I think it's cheap insurance for the reactors in the United States to go ahead and do that."

An industry representative agreed with Lochbaum that the industry should develop severe accident mitigation plans for spent fuel pools.

"We have some measures in place, but not to the extent we do for the reactors," said Anthony Pietrangelo of the Nuclear Energy Institute.

Pietrangelo told the committee the Fukushima incident has prompted the industry to review existing measures, and consider staging emergency equipment regionally.

"One thing I can say going forward is that our industry, our hallmark is learning from operating experience," Pietrangelo said. "We will enhance safety as a result of Fukushima, we will get these lessons learned. ... We started that already but it's going to take a long time to get a full understanding of what transpired there. But when we do, I can assure you that we will enhance safety margins across the industry."

Thanks,
Omid

Esmaili, Hossein

From: Esmaili, Hossein
Sent: Wednesday, April 13, 2011 4:59 PM
To: Chang, Richard
Cc: Marksberry, Don
Subject: RE: SOARCA insights relevant to Japan 4711.docx
Attachments: Plant Status Chronologies of Units 1, 2, and 3

Richard,

Don is keeping an unofficial chronology of events (see attached email). We are still trying to figure out what went on.

Thanks

hossein

From: Chang, Richard
Sent: Wednesday, April 13, 2011 4:11 PM
To: Esmaili, Hossein
Subject: RE: SOARCA insights relevant to Japan 4711.docx

Hossein,

I was wondering if you had a chance to look through this?

Thanks,
Richard

From: Chang, Richard
Sent: Thursday, April 07, 2011 1:43 PM
To: Esmaili, Hossein; Tinkler, Charles
Cc: Schaperow, Jason
Subject: SOARCA insights relevant to Japan 4711.docx

Charlie and Hossein,

Kathy recommended that I send this over to you guys to look at in regards to the timeline...she was wondering if there was another timeline floating around that this may match. I got my information from 2 sources GRS and a 3/28/11 DOE Presentation.

The bullets I have essentially cannibalized from a previous writeup from Charlie (except for the bullet that starts SOARCA insights that may be relevant to Japan).

Thanks,
Richard

W325

Esmaili, Hossein

From: Marksberry, Don
Sent: Wednesday, April 13, 2011 8:29 AM
To: RST01 Hoc; Thorp, John; Tinkler, Charles; Schaperow, Jason; Esmaili, Hossein; Helton, Donald; Garmon, David
Cc: Lee, Richard; Demoss, Gary; Coyne, Kevin; Stutzke, Martin; Salley, MarkHenry; Siu, Nathan
Subject: Plant Status Chronologies of Units 1, 2, and 3
Attachments: Fukushima Daiichi Chronology (04-13-2011).xlsx

Here is this morning's edition of the plant status chronology and data tables for Units 1, 2, and 3. It does not include radiological information.

Please note that the info sources are official press releases from TEPCO and NISA. No other sources or speculations were included.

Earlier event descriptions were revised to match the press release text a little closer. Also, select Article 15 reports and emergency declarations (from TEPCO to NISA) were added for those that may imply change in unit status.

on

Don Marksberry

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Washington, D.C. 20555-0001

Fukushima Dai-ichi **Unit 1** - Reactor and Spent Fuel Pool Status - Unofficial Chronology

Revision 4/13/2011 (8:00 a.m. EST)

Notes: 1) Sources are limited to official press releases (PRs) from NISA and TEPCO. Events were selected relating to the status of the reactor and spent fuel pool in Units 1, 2, and 3. Select Article 15 reports and emergency declarations (from TEPCO to NISA) were included for those that may imply change in unit status.
2) All TEPCO press releases (PRs) to date have been reviewed; only recent NISA PRs reviewed. (All available sources other than NISA and TEPCO are largely based on TEPCO PRs.)
3) Time are approximate and may differ slightly between sources.
4) Event descriptions were standardized where possible; however, original statement were used for uncertain interpretations.
5) NISA PRs are noted by PR number; TEPCO PRs are noted by date and later by PR number and date.
6) Approx Time column time in gray means report time and not specific event time.
7) Event descriptions in gray are related to spent fuel pool; those in green relate operations relating to turbine building water transfers.
8) Japan (site) date and time are noted.

Unit	Date	Approx Time	Event Description	NISA ref.	TEPCO ref.
1	3/11	14:46	Earthquake at Sanriku-Oki, Epicenter: Off-Coast of Sanriku (North Latitude: 38; East Longitude: 142.9), 10km deep, M8.8)	#11	
1	3/11	????	"...emergency core cooling system (ECCS) automatically started up due to increase in the reactor containment pressure assumed to be caused by leakage of reactor coolant in the reactor containment."		#4(3/11)
0	3/11		Massive tsunami hits site (about 14-15 meters above mean sea level; 4 to 5 meters inundation depth). See Note 1.		#10(4/9)
1	3/11	15:41	". . emergency diesel generators shutdown due to malfunction resulting in the complete loss of alternating current for all three units."		#2(3/11)
1	3/11	16:36	Article 15 report: "Inability of water injection of the Emergency Core Cooling System" (Units 1 and 2). "...the status of the reactor water coolant injection could not be confirmed for the ECCS of Units 1 and 2 ..."	#81	#3(3/11)
1	3/12	0:00	"...nuclear steam is cooled by the isolation condenser."		#3(3/12)
1	3/12	0:49	Article 15 report: "Unusual rise of the pressure in Primary Containment Vessel (PCV)"	#81	
1	3/12	3:48	"Reactor Core Isolation Cooling System was used to inject water into the reactor to cool it. Today at 3:48 a.m., water injection by Make-up Water Condensate System began." See Note 2.		#12(3/12)
1	3/12	5:20	Pressure in the containment vessel could have arisen to 840kPa; design pressure of 400kPa *(NOTE: No report by TEPCO)*	#11	
1	3/12	5:22	"...temperature of the suppression chamber exceeded 100 degrees."		#12(3/12)
1	3/12	5:22	Article 15 report: "Loss of pressure suppression function"	#81	
1	3/12	6:50	Article 64 order: The order was issued to control the internal pressure of PCV of Units 1 and 2.	#81	
1	3/12	10:17	(Started?) Operation of Vent	#52	
1	3/12	11:00	"Reactor has been cooled by isolation condenser, but now it is stopped. Reactor water level is decreasing, TEPCO will continue injecting water step by step."		#17(3/12)
1	3/12	13:00	"Reactor water level is decreasing, TEPCO will continue injecting water step by step."		#19(2/13)

Unit	Date	Approx Time	Event Description	NISA ref.	TEPCO ref.
1	3/12	14:30	Completed venting of reactor containment vessel		12-Mar
1	3/12	15:36	A vertical earthquake hit the site	#52	#25(3/12)
1	3/12	15:36	Hydrogen explosion in Unit 1	#52	#25(3/12)
0	3/12	17:00	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
1	3/12	20:00	Unit is under inspection due to the explosive sound and white smoke that was confirmed after the big quake occurred at 3:36PM		12-Mar
1	3/12	20:05	Article 64 order: The order was issued to inject seawater (per the Directives from the Prime Minister)	#81	
1	3/12	20:20	Seawater injection and boric acid to the Reactor Pressure Vessel (RPV) via the Fire Extinguish Line started	#52	12-Mar
1	3/13	9:00	Continue to inject sea water and boric acid into the reactor core		13-Mar
0	3/13	9:01	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
0	3/13	14:36	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
1	3/13	21:00	Continue to inject sea water and boric acid into the reactor core		#12(3/13)
1	3/14	1:10	Seawater injection for Units 1 and 3 was interrupted due to the lack of seawater in pit	#52	
0	3/14	4:40	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
0	3/14	5:38	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
0	3/14	22:35	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
0	3/15	0:00	NISA decided the acceptance of experts dispatched from the U.S. NRC	#81	
0	3/15	7:24	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
0	3/15	8:54	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
0	3/15	16:30	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
0	3/15	23:46	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
1	3/17	9:00	Continue injecting seawater into RPV		#4(3/17)
0	3/18	15:55	Article 62-3 report: Leakage of the radioactive materials inside of the reactor buildings to non-controlled area of radiation (Units 1, 2, 3, 4)	#81	
1	3/18	14:00	Continue injecting seawater into RPV		#3(3/18)
0	3/19	8:58	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
1	3/19	12:00	Continue injecting seawater into RPV		#5(3/19)
1	3/20	9:00	Continue injecting seawater into RPV		#2(3/20)
1	3/21	9:00	Continue injecting seawater into RPV		#1(3/21)
1	3/22	9:00	Continue injecting seawater into RPV		#2(3/22)
1	3/23	2:30	Started injecting seawater to the nuclear reactor through the feedwater system		#2(2/23)
1	3/23	2:33	The amount of injected water to the to the Reactor Core was increased by utilizing the Water Supply Line in addition to the Fire Extinguish Line. (2m3/h→18m3/h)	#52	
1	3/23	9:00	Injected water to the Reactor Core was switched to the Water Supply Line only (around 11m3/h)	#52	
1	3/24	10:50	White fog-like steam arising from the roof part of the reactor building was observed		#4(3/24)
1	3/24	11:30	Lighting in the Central Operation Room was restored *(NOTE: NISA says same time on 3/26)*	#57	#4(3/24)

Unit	Date	Approx Time	Event Description	NISA ref.	TEPCO ref.
1	3/24	17:00	STARTED draining water from underground floor of turbine building to condenser	#64	#13(3/30)
1	3/25	6:20	White smoke was confirmed to generate continuously	#52	
1	3/25	15:37	Fresh water injection to RPV was started	#52	#14(3/25)
1	3/27	15:30	Injection of fresh water to RPV continues	#57	
1	3/28	6:30	White smoke was confirmed to generate continuously	#59	
1	3/28	15:00	Injection of fresh water to RPV continues	#59	
1	3/29	7:30	STOPPED draining water from underground floor of turbine building to condenser because the water level reached almost full capacity of a condenser. Plan to remove water from a condensate storage tank (CST) to a suppression pool water surge-tank to enable water transfer from condenser to the CST.		#15(3/30)
1	3/29	8:32	Injection of fresh water to RPV continues; however, transferred from fire fighting pump to a temporary motor driven pump	#61	#9(3/29)
1	3/29	15:00	Injection of fresh water to RPV continues	#61	
1	3/30	17:56	Discovered smoke generation from power panel (power panel: power supply board to supply electricity to the motor of a drawing water pump to the outdoor duct)at the turbine building Unit 1. About 6:13 pm, confirmed the smoke generation stopped after interrupt electrical supply to the power panel. Smoke determined to be caused by a fault in the power panel; no signs of fire.		#12(3/30)
1	3/30	6:30	White smoke was confirmed to generate continuously	#63	
1	3/30	15:30	Injection of fresh water to RPV continues	#63	
1	3/31	6:30	White smoke was confirmed to generate continuously	#64	
1	3/31	8:30	Injection of fresh water to RPV continues	#64	
1	3/31	12:00	STARTED water transfer from the CST to suppression pool water surge-tanks to enable water transfer from condenser to the CST, in order to prepare to transfer the stagnant water on the basement floor of the turbine building to the Condenser	#71	#6(3/31)
1	3/31	13:03	STARTED Spent Fuel Pool: freshwater spray by the concrete pumping vehicle	#66	#13(3/31)
0	3/31	15:42	A barge of the US armed forces carrying fresh water for cooling reactors, etc. arrived	#66	
1	3/31	16:04	COMPLETED Spent Fuel Pool: Water spray by the concrete pumping vehicle (90t)	#71	#13(3/31)
1	4/1	9:30	Injection of fresh water to RPV continues	#66	
1	4/1	15:30	Injection of fresh water to RPV continues	#67	
0	4/1	15:56	STARTED operations to transfer of fresh water from the barge to the Filtrate Tank	#67	
1	4/2	15:26	COMPLETED water transfer from the CST to suppression pool water surge-tanks to enable water transfer from condenser to the CST, in order to prepare to transfer the stagnant water on the basement floor of the turbine building to the Condenser	#71	#5(4/2)
1	4/2	12:30	Some lights in the turbine building were turned on		#4(4/3)
1	4/3	6:30	White smoke was confirmed to generate continuously	#70	
1	4/3	8:00	Injection of fresh water to RPV continues	#70	

Unit	Date	Approx Time	Event Description	NISA ref.	TEPCO ref.
1	4/3	10:42	Injection of fresh water to RPV continues by temporary motor driven pump, but switched to fire fighting pump for 10 minutes in order to connect offsite power to a motor driven pump (editor's note: not clear if the same MDP)	#71	#4(4/3)
1	4/3	12:12	Injection of fresh water to RPV continues by a motor driven pump powered from offsite power	#71	#4(4/3)
1	4/3	13:55	STARTED water transfer from the condenser to the CST, in order to prepare to transfer the stagnant water on the basement floor of the turbine building to the Condenser. (NOTE: Later TEPCO press release confirms this operation is associated with Unit 1, not Unit 2)	#71	#1(4/7)
1	4/3	15:30	Injection of fresh water to RPV continues	#71	
1	4/4	6:30	White smoke was confirmed to generate continuously	#72	
1	4/4	8:00	Injection of fresh water to RPV continues	#72	
1	4/4	15:00	Injection of fresh water to RPV continues	#73	
1	4/5	6:30	White smoke was confirmed to generate continuously	#74	
1	4/5	8:00	Injection of fresh water to RPV continues	#74	
1	4/5	16:00	Injection of fresh water to RPV continues	#75	
1	4/6	6:30	White smoke was confirmed to generate continuously	#76	
1	4/6	8:00	Injection of fresh water to RPV continues	#76	
1	4/6	14:30	Injection of fresh water to RPV continues	#77	
1	4/6	22:30	Started the operation of valve lineup for the injection of nitrogen gas to the vessel in order to prevent the increase of oxygen density		#1(4/7)
1	4/7	1:31	Started Nitrogen gas injection into the reactor containment vessel		#1(4/7)
1	4/7	6:30	White smoke was confirmed to generate continuously	#78	
1	4/7	8:00	Injection of fresh water to RPV continues	#78	
1	4/7	15:30	Injection of fresh water to RPV continues	#79	
1	4/7	23:32	7.1-magnitude aftershock (originally reported as 7.4) in the offshore of Miyagi Prefecture; epicenter about 70		#9(4/8)
1	4/8	6:30	White smoke was confirmed to generate continuously	#80	
1	4/8	8:00	Injection of fresh water to RPV continues	#80	
1	4/8	16:00	Injection of fresh water to RPV continues	#81	
1	4/9	6:30	White smoke was confirmed to generate continuously	#82	
1	4/9	8:00	Injection of fresh water to RPV continues	#82	
1	4/10	9:30	STOPPED (Completed?) water transfer from the condenser to the CST, in order to prepare to transfer the stagnant water on the basement floor of the turbine building to the Condenser.		#2(4/10)

Unit	Date	Approx Time	Event Description	NISA ref.	TEPCO ref.
0	4/11	17:16	7.1 magnitude earthquake centered in the Fukushima-Hama-dori: - Water injection to the reactor of the units 1-3 was suspended due to the shutdown of the offsite power; resumed 6:04 pm after restoration of off-site power. - Nitrogen gas injection to the reactor containment vessel in unit 1 was suspended and resumed at 11:34 pm. - No abnormalities were detected in the parameter of each of the units. - The water level of units 1-3's pit did not change significantly.		#3(4/12)
1	4/11	18:04	Injection of fresh water to RPV was restored following loss of offsite power.		#3(4/12)
1	4/11	23:34	Nitrogen gas injection to the reactor containment vessel of unit 1 was resumed.		#3(4/12)
0	4/12	14:07	6.8 magnitude earthquake centered in the Fukushima-Hama-dori: - No shutdown of the off-site power of the units 1-6 - No abnormalities in water injection to the reactor of the units 1-3 - No abnormalities in Nitrogen gas injection to the reactor containment vessel of unit 1. - No abnormalities were detected in the parameter of each of the units. - No abnormalities in the data taken from the monitoring before as well as after the earthquake. - Workers outdoor evacuated in the key earthquake-proof building.		#13(4/12)
0	4/12	18:38	A fire broke out at the distribution switchboard containing batteries located in the sampling equipment switchbox situated close to the south water discharge channel for Units 1-4. The self defense fire fighting team began extinguishing this fire soon after it broke out.		#3(4/12)
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Notes

1	Investigation results indicate that the inundation height at the Fukushima Daiichi Nuclear Power Station was approximately base (sea) level O.P. + 14 to 15 meters with an inundation depth at approximately 4 to 5 meters across the ocean-side of main building area where reactor buildings and turbine buildings are located. Base level of Onahama Port (O.P.) construction is 0.727 meters below Tokyo Bay mean sea height. Inundation depth is the height of the water discoloration from the ground level or base of the buildings.
2	Unit 1 has a Isolation Condenser instead of a RCIC. Units 2 and 3 have a RCIC system. The next two TEPCO press releases (11031213 and 11031214) have almost identical text; however, the text refer to Unit 1 in all three PRs and the titles refer to Units 1, 2, and 4. The Unit 4 must mean Unit 3.

Fukushima Dai-ichi **Unit 2** - Reactor and Spent Fuel Pool Status - Unofficial Chronology

Revision 4/13/2011 (8:00 a.m. EST)

Notes: 1) Sources are limited to official press releases (PRs) from NISA and TEPCO. Events were selected relating to the status of the reactor and spent fuel pool in Units 1, 2, and 3. Select Article 15 reports and emergency declarations (from TEPCO to NISA) were included for those that may imply change in unit status.
2) All TEPCO press releases (PRs) to date have been reviewed; only recent NISA PRs reviewed. (All available sources other than NISA and TEPCO are largely based on TEPCO PRs.)
3) Time are approximate and may differ slightly between sources.
4) Event descriptions were standardized where possible; however, original statement were used for uncertain interpretations.
5) NISA PRs are noted by PR number; TEPCO PRs are noted by date and later by PR number and date.
6) Approx Time column time in gray means report time and not specific event time.
7) Event descriptions in gray are related to spent fuel pool; those in green relate operations relating to turbine building water transfers.
8) Japan (site) date and time are noted.

Unit	Date	Approx Time	Event Description	NISA ref.	TEPCO ref.
2	3/11	14:46	Earthquake at Sanriku-Oki, Epicenter: Off-Coast of Sanriku (North Latitude: 38; East Longitude: 142.9), 10km deep, M8.8)	#11	
0	3/11		Massive tsunami hits site (about 14-15 meters above mean sea level; 4 to 5 meters inundation depth). See Note 1.		#10(4/9)
2	3/11	15:41	". . emergency diesel generators shutdown due to malfunction resulting in the complete loss of alternating current for all three units."		#2(3/11)
2	3/11	16:36	Article 15 report: "Inability of water injection of the Emergency Core Cooling System" (Units 1 and 2). "The status of the reactor water coolant injection could not be confirmed for the ECCS of Units 1 and 2"	#81	#3(3/11)
2	3/12	0:00	"...nuclear steam had been cooled by RCIC system, the current operating status is unclear. However, reactor coolant level can be monitored by a temporary power supply and the level is stable."		#3(3/12)
2	3/12	5:22	Article 15 report: "Loss of pressure suppression function"	#81	
2	3/12	6:50	Article 64 order: The order was issued to control the internal pressure of PCV of Units 1 and 2.	#81	
2	3/12	11:00	Continue injecting water by RCIC; current reactor water level is lower than normal, but level is steady		12-Mar
2	3/12	13:00	Continue injecting water by RCIC; current reactor water level is lower than normal, but level is steady		12-Mar
2	3/12	15:00	Continue injecting water by RCIC; current reactor water level is lower than normal, but level is steady		12-Mar
0	3/12	17:00	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
2	3/12	19:00	Continue injecting water by RCIC		12-Mar
2	3/12	20:00	Continue injecting water by RCIC; current reactor water level is lower than normal, but level is steady		13-Mar
2	3/13	9:00	Continue injecting water by RCIC; current reactor water level is lower than normal, but level is steady		#10(3/13)
0	3/13	9:01	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
2	3/13	11:00	Completed venting operation	#52	13-Mar
2	3/13	12:00	Continue injecting water by RCIC; current reactor water level is lower than normal, but level is steady		13-Mar
2	3/13	14:00	Continue injecting water by RCIC; current reactor water level is lower than normal, but level is steady		#12
0	3/13	14:36	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
2	3/13	21:00	Continue injecting water by RCIC; current reactor water level is lower than normal, but level is steady		

Unit	Date	Approx Time	Event Description	NISA ref.	TEPCO ref.
0	3/14	4:40	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
0	3/14	5:38	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
2	3/14	11:00	Blow-out Panel of reactor building was opened due to the explosion in the reactor building of Unit 3	#52	
2	3/14	13:18	Reactor water level tended to decrease	#52	#3(3/14)
2	3/14	13:25	RCIC failed		#8 (3/16)
2	3/14	13:25	Article 15 report: "Loss of reactor cooling function"	#81	
2	3/14	17:17	". . . while the water level in the reactor reached the top of the fuel rod, we have restarted the water injection with the valve operation"		#8 (3/16)
2	3/14	19:20	Seawater injection to RPV via the Fire Extinguish line was ready	#52	
0	3/14	22:35	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
2	3/14	22:50	Water level in RPV tended to decrease	#52	
0	3/15	0:00	NISA decided the acceptance of experts dispatched from the U.S. NRC	#81	
2	3/15	0:02	(Started?) Operation of Vent	#52	#8(3/16)
2	3/15	6:14	Explosion sound was confirmed near the suppression chamber and the pressure inside the chamber decreased afterwards. Seawater injection continues. (NOTE: NISA says 6:20 was the time of the explosion sound)	#24	#4(3/17)
0	3/15	7:24	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
0	3/15	8:54	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
2	3/15	10:30	Article 64 order: The order was issued to inject water to reactor vessel promptly and to vent Drywell	#81	
0	3/15	16:30	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
0	3/15	23:46	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
2	3/17	9:00	Continue injecting seawater		#3(3/18)
2	3/18	14:00	Continue injecting seawater into RPV		#1(3/19)
0	3/18	15:55	Article 62-3 report: Leakage of the radioactive materials inside of the reactor buildings to non-controlled area of radiation (Units 1, 2, 3, 4)	#81	
2	3/19	1:00	Continue injecting seawater into RPV		#5(3/19)
0	3/19	8:58	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
2	3/19	12:00	Continue injecting seawater into RPV		#1(3/19)
2	3/19	13:30	Electric power receiving at the emergency power source transformer from the external transmission line was completed. The work for laying the electric cable from the facility to the load side was carried out.	#52	#2(3/20)
2	3/20	9:00	Continue injecting seawater into RPV		
2	3/20	15:05	Started Injection of 40t of Seawater to the Spent Fuel Pool was started	#66	
2	3/20	17:20	Stopped Injection of 40t of Seawater to the Spent Fuel Pool was started	#52	#9(3/20)
2	3/20	15:46	Power Center in Unit 2 energized	#52	#1(3/21)
2	3/21	9:00	Continue injecting seawater into RPV		#5(3/22)
2	3/21	18:22	White smoke was confirmed arising from the top of the reactor building	#52	#4(3/22)
2	3/22	7:11	White smoke was died down and almost invisible	#52	#2(3/22)

Unit	Date	Approx Time	Event Description	NISA ref.	TEPCO ref.
2	3/22	9:00	Continue injecting seawater into RPV		#17(3/22)
2	3/22	16:07	Started Injection of 18t of Seawater to the Spent Fuel Pool was carried out	#52	#17(3/22)
2	3/22	17:01	Stopped Injection of 18t of Seawater to the Spent Fuel Pool was carried out	#52	26-Mar
2	3/24	10:20	White fog-like steam arising from the roof part of the reactor building was observed		
2	3/25	6:20	White smoke was confirmed to generate continuously	#52	#7(3/25)
2	3/25	10:30	Started Injection of seawater to the Spent Fuel Pool via the Fuel Pool Cooling Line	#52	#14(3/25)
2	3/25	12:19	Started Injection of seawater to the Spent Fuel Pool via the Fuel Pool Cooling Line was carried out	#52	
2	3/25	19:30	Seawater injection to RPV continues	#52	
2	3/26	8:00	White smoke was confirmed to generate continuously	#57	#2(3/26)
2	3/26	10:10	Started injecting fresh water (with boric acid) into the reactor		#5(3/28)
2	3/26	16:46	Restored lights in the Central Operations (main control) Room		
2	3/27	15:30	Injection of fresh water to RPV continues	#57	#11(3/27)
2	3/27	18:31	Injection of fresh water to RPV continues; however, switch from fire fighting pump to a temporary motor driven pump	#59	
2	3/28	6:30	White smoke was confirmed to generate continuously	#59	
2	3/28	15:00	Injection of fresh water to RPV continues	#59	
2	3/29	6:30	White smoke was confirmed to generate continuously	#61	
2	3/29	15:00	Injection of fresh water to RPV continues	#61	#13(3/30)
2	3/29	16:45	STARTED to remove water from a condensate storage tank (CST) to a suppression pool water surge-tank to enable water transfer from a condenser to the CST, in order to prepare to transfer the stagnant water on the basement floor of the turbine building of Unit 2 to the Condenser	#64	#2(30)
2	3/29	16:30	Started freshwater injection through Fuel Pool Cooling and Filtering System (switched from seawater using Fire Pump truck to freshwater using temporary motor driven pump)	#64	#2(30)
2	3/29	18:25	Completed freshwater injection through Fuel Pool Cooling and Filtering System	#64	
2	3/30	6:30	White smoke was confirmed to generate continuously	#63	#5(3/30)
2	3/30	9:25	Spent fuel pool injection: transferred from a temporary motor driven pump to the fire fighting pump due to pump problem	#64	#15(3/30)
2	3/30	13:10	Stopped Spent Fuel Pool: freshwater injection was paused due to hose leak	#64	
2	3/30	15:30	Injection of fresh water to RPV continues	#63	#15(3/30)
2	3/30	19:05	Spent Fuel Pool: STARTED freshwater injection	#64	#2(3/31)
2	3/31	23:50	Spent Fuel Pool: COMPLETED freshwater injection	#64	
2	3/31	6:30	White smoke was confirmed to generate continuously	#64	
2	3/31	8:30	Injection of fresh water to RPV continues	#64	
0	3/31	15:42	A barge of the US armed forces carrying fresh water for cooling reactors, etc. arrived	#66	
2	4/1	9:30	Injection of fresh water to RPV continues	#66	#7(4/1)

Unit	Date	Approx Time	Event Description	NISA ref.	TEPCO ref.
2	4/1	11:50	COMPLETED water transfer from a CST to a suppression pool water surge-tank to enable water transfer from a condenser to the CST, in order to prepare to transfer the stagnant water on the basement floor of the turbine building of Unit 2 to the Condenser		#5(4/1)
2	4/1	14:56	Spent Fuel Pool: STARTED freshwater injection via temporary motor driven pump		
2	4/1	15:30	Injection of fresh water to RPV continues	#67	
0	4/1	15:56	STARTED operations to transfer of fresh water from the barge to the Filtrate Tank	#67	#7(4/1)
2	4/1	17:05	Spent Fuel Pool: COMPLETED freshwater injection via temporary motor driven pump (70t)		#5(4/2)
2	4/2	17:10	STARTED water transfer from the condenser to the CST, in order to prepare to transfer the stagnant water on the basement floor of the turbine building of Unit 2 to the Condenser		#4(4/3)
2	4/2	12:30	Some lights in the turbine building were turned on	#71	
2	4/3	8:00	Injection of fresh water to RPV continues	#70	#4(4/3)
2	4/3	10:22	Injection of fresh water to RPV continues by temporary motor driven pump, but switched to fire fighting pump for < 2 hours (to 12:06) in order to connect offsite power to a motor driven pump (editor's note: not clear if the same MDP)	#71	#4(4/3)
2	4/3	12:12	Injection of fresh water to RPV continues by a motor driven pump powered from offsite power	#71	
2	4/3	13:47	As the measure to prevent the outflow of the water accumulated in the Pits for Conduit in the area around the Inlet Bar Screen of Unit 2, the upper part of the Power Cable Trench for power source at Intake Channel was crushed and high polymer absorbent, etc. were put inside. Completed at 14:30.	#71	
2	4/3	15:30	Injection of fresh water to RPV continues	#71	
2	4/4	8:00	Injection of fresh water to RPV continues	#72	#2(4/5)
2	4/4	11:05	Spent Fuel Pool: STARTED freshwater injection via temporary motor driven pump	#74	#2(4/5)
2	4/4	13:37	Spent Fuel Pool: COMPLETED freshwater injection via temporary motor driven pump (70t)	#74	
2	4/4	15:00	Injection of fresh water to RPV continues	#73	
2	4/5	6:30	White smoke was confirmed to generate continuously	#74	
2	4/5	8:00	Injection of fresh water to RPV continues	#74	
2	4/5	15:40	One more pump for the transfer of the water in the Condenser of Unit 2 to the CST was installed. (Two pumps in total: 30 m3/h)	#75	
2	4/5	16:00	Injection of fresh water to RPV continues	#75	
2	4/6	6:30	White smoke was confirmed to generate continuously	#76	
2	4/6	8:00	Injection of fresh water to RPV continues	#76	
2	4/6	14:30	Injection of fresh water to RPV continues	#77	
2	4/7	6:30	White smoke was confirmed to generate continuously	#78	
2	4/7	8:00	Injection of fresh water to RPV continues	#78	#6(4/7)
2	4/7	13:29	Spent Fuel Pool: STARTED freshwater injection via temporary motor driven pump	#79	#6(4/7)
2	4/7	14:34	Spent Fuel Pool: COMPLETED freshwater injection via temporary motor driven pump (36t)	#79	
2	4/7	15:30	Injection of fresh water to RPV continues	#79	#9(4/8)
2	4/7	23:32	7.1-magnitude aftershock (originally reported as 7.4) in the offshore of Miyagi Prefecture; epicenter about 70 mi		#2(4/9)

Unit	Date	Approx Time	Event Description	NISA ref.	TEPCO ref.
2	4/9	13:10	STOPPED (Completed?) water transfer from the condenser to the CST, in order to prepare to transfer the stagnant water on the basement floor of the turbine building of Unit 2 to the Condenser		
2	4/8	6:30	White smoke was confirmed to generate continuously	#80	
2	4/8	8:00	Injection of fresh water to RPV continues	#80	#2(4/10)
2	4/9	6:30	White smoke was confirmed to generate continuously	#82	
2	4/9	8:00	Injection of fresh water to RPV continues	#82	
2	4/10	10:37	Spent Fuel Pool: STARTED freshwater injection via temporary motor driven pump		#4(4/10)
2	4/10	12:38	Spent Fuel Pool: COMPLETED freshwater injection via temporary motor driven pump (xxt)		#3(4/11)
0	4/11	17:16	7.1 magnitude earthquake centered in the Fukushima-Hama-dori: - Water injection to the reactor of the units 1-3 was suspended due to the shutdown of the offsite power; resumed 6:04 pm after restoration of off-site power. - Nitrogen gas injection to the reactor containment vessel in unit 1 was suspended and resumed at 11:34 pm. - No abnormalities were detected in the parameter of each of the units. - The water level of units 1-3's pit did not change significantly.		#3(4/12)
2	4/11	18:04	Injection of fresh water to RPV was restored following loss of offsite power.		#3(4/12)
0	4/12	14:07	6.8 magnitude earthquake centered in the Fukushima-Hama-dori: - No shutdown of the off-site power of the units 1-6 - No abnormalities in water injection to the reactor of the units 1-3 - No abnormalities in Nitrogen gas injection to the reactor containment vessel of unit 1. - No abnormalities were detected in the parameter of each of the units. - No abnormalities in the data taken from the monitoring before as well as after the earthquake. - Workers outdoor evacuated in the key earthquake-proof building.		#13(4/12)
0	4/12	18:38	A fire broke out at the distribution switchboard containing batteries located in the sampling equipment switchbox situated close to the south water discharge channel for Units 1-4. The self defense fire fighting team began extinguishing this fire soon after it broke out.		#3(4/12)
2	4/12	19:35	STARTED transferring the high level radioactive puddle water in the trench of the turbine building to the condenser by an underwater pump.		#2(4/13)
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Unit	Date	Approx Time	Event Description	NISA ref.	TEPCO ref.
Notes					
1	Investigation results indicate that the inundation height at the Fukushima Daiichi Nuclear Power Station was approximately base (sea) level O.P. + 14 to 15 meters with an inundation depth at approximately 4 to 5 meters across the ocean-side of main building area where reactor buildings and turbine buildings are located. Base level of Onahama Port (O.P.) construction is 0.727 meters below Tokyo Bay mean sea height. Inundation depth is the height of the water discoloration from the ground level or base of the buildings.				

Fukushima Dai-ichi **Unit 3** - Reactor and Spent Fuel Pool Status - Unofficial Chronology

Revision 4/13/2011 (8:00 a.m. EST)

Notes: 1) Sources are limited to official press releases (PRs) from NISA and TEPCO. Events were selected relating to the status of the reactor and spent fuel pool in Units 1, 2, and 3. Select Article 15 reports and emergency declarations (from TEPCO to NISA) were included for those that may imply change in unit status.
2) All TEPCO press releases (PRs) to date have been reviewed; only recent NISA PRs reviewed. (All available sources other than NISA and TEPCO are largely based on TEPCO PRs.)
3) Time are approximate and may differ slightly between sources.
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6) Approx Time column time in gray means report time and not specific event time.
7) Event descriptions in gray are related to spent fuel pool; those in green relate operations relating to turbine building water transfers.
8) Japan (site) date and time are noted.

Unit	Date	Approx Time	Event Description	NISA ref.	TEPCO ref.
3	3/11	14:46	Earthquake at Sanriku-Oki, Epicenter: Off-Coast of Sanriku (North Latitude: 38; East Longitude: 142.9), 10km deep, M8.8)	#11	
0	3/11		Massive tsunami hits site (about 14-15 meters above mean sea level; 4 to 5 meters inundation depth). See Note 1.		#10(4/9)
3	3/11	15:41	". . emergency diesel generators shutdown due to malfunction resulting in the complete loss of alternating current for all three units."		#2(3/11)
3	3/12	0:00	Reactor "is cooled by the Reactor Core Isolation Cooling (RCIC) system. Currently, we do not believe there is any reactor coolant leakage inside the reactor containment vessel."		#3(3/12)
3	3/12	11:00	Continue to inject water by RCIC		12-Mar
3	3/12	13:00	Continue to inject water by RCIC.		12-Mar
3	3/12	15:00	Continue to inject water by RCIC.		12-Mar
0	3/12	17:00	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
3	3/12	19:00	Continue to inject water by RCIC.		12-Mar
3	3/12	20:00	Continue inject water by High Pressure Core Injection (HPCI) System		#29(3/12)
3			Operation of Vent (no report by TEPCO of this venting, but reported venting on 3/13 at 08:41)	#51	
3	3/13	2:00	Continue to inject water by HPCI		#1(3/13)
3	3/13	5:10	HPCI has been automatically shut down. Re-activation of RCIC was attempted but failed. Unable to confirm the level of water injection to the reactor		#3(3/13)
3	3/13	5:38	Article 15 report: "Total loss of coolant injection function"	#81	
3	3/13	8:41	Start (?) containment venting "completed procedure to open vent valve"		#8(3/11)
3	3/13	9:00	Steps to lowering the pressure of reactor containment vessel has been taken. Spraying in order to lower pressure level within the reactor containment vessel has been cancelled.		13-Mar
0	3/13	9:01	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
3	3/13	9:08	Pressure suppression and fresh water injection was started	#81	
3	3/13	9:20	"Successfully completed" containment venting	#51	#8(3/11)

Unit	Date	Approx Time	Event Description	NISA ref.	TEPCO ref.
3	3/13	9:25	Started injecting water containing boric acid by fire pump		13-Mar
3	3/13	11:55	Fresh water started to be injected to RPV via the Fire Extinguish Line.	#51	
3	3/13	12:00	Safety relief valve has been opened manually, lowering the pressure level of the reactor, which was immediately followed by injection of sea water and boric acid		13-Mar
3	3/13	13:12	Seawater started to be injected to RPV via the Fire Extinguish Line.	#51	
0	3/13	14:36	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
3	3/13	15:00	"Taking account of the situation that the water level within the pressure vessel did not rise for a long time and the radiation dose is increasing, we cannot exclude the possibility that the same situation occurred at Unit 1 on Mar 12 will occur. We are considering the countermeasure to prevent that."		#10(3/13)
3	3/14	1:10	Seawater injection for Units 1 and 3 was interrupted due to the lack of seawater in pit	#51	
3	3/14	3:20	Seawater injection to RPV for Unit 3 was restarted	#51	
0	3/14	4:40	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
3	3/14	5:20	Operation of Vent *(No specific report by TEPCO of this venting)*	#51	???
0	3/14	5:38	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
3	3/14	6:50	While water injection to the reactor was under operation, the pressure in the reactor containment vessel increased to 530 kPa.	#51	#8(3/16)
3	3/14	7:52	Article 15 report: "Unusual rise of the pressure in Primary Containment Vessel (PCV)"	#81	
3	3/14	9:05	Pressure in the reactor containment vessel decreased to 450 kPa		#8(3/16)
3	3/14	11:01	"... an explosive sound followed by white smoke occurred at the reactor building of the Unit 3. It was believed to be a hydrogen explosion. According to the parameter, it is estimated that the reactor containment vessel remains intact."	#51	#1(3/14)
0	3/14	22:35	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
0	3/15	0:00	NISA decided the acceptance of experts dispatched from the U.S. NRC	#81	
0	3/15	7:24	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
0	3/15	8:54	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
0	3/15	16:30	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
0	3/15	23:46	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
3	3/16	8:34	White smoke like steam generated	#51	
3	3/16	10:45	Because of the possibility that PCV of Unit 3 was damaged, the workers evacuated from the main control room of Units 3 and 4 (common room)	#51	
3	3/16	11:30	Operators returned to the control room and restarted the operation of water injection	#51	
3	3/17	6:15	Pressure in Suppression Chamber has temporarily increased. Venting not required at this time.		#4(3/17)
3	3/17	6:15	Continue injecting seawater into RPV		#4(3/17)
3	3/17	9:48	Seawater was discharged by the helicopters	#51	#2(3/20)
3	3/17	9:52	Seawater was discharged by the helicopters	#51	
3	3/17	9:58	Seawater was discharged by the helicopters	#51	
3	3/17	10:01	Seawater was discharged by the helicopters	#51	

Unit	Date	Approx Time	Event Description	NISA ref.	TEPCO ref.
3	3/17	19:05	Started water spray from the ground for 8 minutes (riot police water cannons)	#51	#2(3/20)
3	3/17	19:13	Stopped water spray from the ground (riot police)	#51	#2(3/20)
3	3/17	19:35	Started water spray from the ground using fire engine #1 (Self Defense Forces)	#51	
3	3/17	19:45	Started water spray from the ground using fire engine #2 (Self Defense Forces)	#51	
3	3/17	19:53	Started water spray from the ground using fire engine #3 (Self Defense Forces)	#51	
3	3/17	20:00	Started water spray from the ground using fire engine #4 (Self Defense Forces)	#51	
3	3/17	20:07	Started water spray from the ground using fire engine #5 (Self Defense Forces)	#51	
3	3/17	20:09	Stopped water spray from the ground using 5 fire engines	#51	#1(3/20)
3	3/18	14:00	Started water spray from the ground using 6 fire engines (6 tons of water spray per engine)	#51	#2(3/20)
3	3/18	14:38	Stopped water spray from the ground using 6 fire engines (6 tons of water spray per engine)	#51	#2(3/20)
3	3/18	14:00	Started water spray from the ground using U.S. fire engine provided by the US	#51	#1(3/19)
3	3/18	14:45	Stopped water spray from the ground using U.S. fire engine provided by the US	#51	#1(3/19)
0	3/18	15:55	Article 62-3 report: Leakage of the radioactive materials inside of the reactor buildings to non-controlled area of radiation (Units 1, 2, 3, 4)	#81	
3	3/18	23:30	Started water spray from the ground using TFD fire engine *(NOTE: Unable to confirm from TEPCO PR)*	#51	
3	3/19	0:45	Started water spray from the ground using TFD fire engine		#1(3/19)
3	3/19	1:10	Stopped water spray from the ground using TFD fire engine		#1(3/19)
0	3/19	8:58	Article 15 report: "Unusual increase of radiation dose at the site boundary" (site-wide)	#81	
3	3/19	14:10	Started water spray from the ground using TFD fire engine		#1(3/20)
3	3/20	3:40	Stopped water spray from the ground using TFD fire engine		#1(3/20)
3	3/19	9:00	Working on receiving external power supply to Units 3 and 4		#3(3/19)
3	3/19	12:00	Continue injecting seawater into RPV		#5(3/19)
3	3/20	9:00	Continue injecting seawater into RPV		#2(3/20)
3	3/20	11:00	PCV pressure increased to 320 kPa, then decreased to 120 kPa at 12:15 on 3/21	#66	
3	3/20	11:00	On-site survey for leading electric cable (From 11:00 till 16:00)	#51	
3	3/20	21:30	Start water spray over the Spent Fuel Pool by TFD	#51	#1(3/21)
3	3/21	3:58	Stopped water spray over the Spent Fuel Pool by TFD	#51	#1(3/21)
3	3/21	9:00	Continue injecting seawater into RPV		#1(3/21)
3	3/21	12:15	Pressure in PCV 120 kPa	#51	
3	3/21	15:55	"light gray smoke" from the "floor roof" of Unit 3 building. Parameters of reactor pressure vessel and reactor containment vessel of Unit 3, and monitored environmental data around the Nuclear Power Station remains at the same level. However, employees working around Unit 3 evacuated to a safe location. It is observed the smoke has been decreasing.	#51	#5(3/21)
3	3/21	17:55	Smoke was confirmed to be died down	#51	#8(3/21)
3	3/22	7:11	Grayish smoke changed to be whitish and seems to be ceasing	#51	#4(3/22)
3	3/22	9:00	Continue injecting seawater into RPV		#2(3/22)

Unit	Date	Approx Time	Event Description	NISA ref.	TEPCO ref.
3	3/22	15:10	Started Water spray (Around 180t) by TFD	#51	#10(3/22)
3	3/22	15:59	Stopped Water spray (Around 180t) by TFD	#51	#10(3/22)
3	3/22	22:43	Lighting was recovered in the Central Operation Room	#51	#3(3/23)
3	3/23	11:03	Started Injection of 35t of seawater to the Spent Fuel Pool via the Fuel Pool Cooling Line	#51	#7(3/23)
3	3/23	13:20	Stopped Injection of 35t of seawater to the Spent Fuel Pool via the Fuel Pool Cooling Line	#51	#7(3/23)
3	3/23	14:00	Continue injecting seawater into RPV		#12(3/23)
3	3/23	16:20	"Light black smoke belching" from the reactor building. Parameters reactor, reactor containment vessel, and monitored figures around the site's immediate surroundings remained stable without significant change. Workers in the main control room of Unit 3 and around Unit 3 evacuated to a safe location.	#51	#7(3/23)
3	3/23	23:30	At around 23:30 March 23rd and around 4:50 March 24th, it was reported that the smoke seemed to cease.	#51	#1(3/24)
3	3/24	5:35	Started Injection of 120t of seawater to the Spent Fuel Pool via the Fuel Pool Cooling Line	#57	#1(3/24)
3	3/24	14:30	3 workers from other companies who was in charge of cable laying work in the 1st floor and the underground floor of turbine building were exposed to the radiation dose of more than 170 mSv		#5(3/24)
3	3/24	16:05	Stopped Injection of 120t of seawater to the Spent Fuel Pool via the Fuel Pool Cooling Line	#57	#12(3/24)
3	3/25	13:28	Start water spray over the Spent Fuel Pool by TFD	#52	#1(3/26)
3	3/25	16:00	Stopped water spray over the Spent Fuel Pool by TFD	#52	#1(3/26)
3	3/25	12:30	Continue injecting seawater into RPV	#51	
3	3/25	18:02	Started injecting fresh water into RPV	#52	#1(3/26)
3	3/26	8:00	White smoke was confirmed to generate continuously	#57	
3	3/27	12:34	Started injection of seawater by concrete pump truck		#2(3/30)
3	3/27	14:36	Completed injection of seawater by concrete pump truck (100t)		#2(3/30)
3	3/27	8:00	Injection of fresh water to RPV continues	#57	
3	3/27	15:30	Injection of fresh water to RPV continues	#57	
3	3/28	6:30	White smoke was confirmed to generate continuously	#59	
3	3/28	15:00	Injection of fresh water to RPV continues	#59	
3	3/28	17:40	STARTED water transfer from a CST to a suppression pool water surge-tank to enable water transfer from a condenser to the CST, in order to prepare to transfer the stagnant water on the basement floor of the turbine building to the Condenser.	#64	#15(3/30)
3	3/28	20:30	Injection of fresh water to RPV continues; however, transferred from fire fighting pump to a temporary motor driven pump	#61	#10(3/28)
3	3/29	6:30	White smoke was confirmed to generate continuously	#61	
3	3/29	14:17	Started injection of fresh water by concrete pump truck (50t/h) (switched from seawater to freshwater)	#61	#2(3/30)
3	3/29	15:00	Injection of fresh water to RPV continues	#61	
3	3/29	18:18	Completed injection of fresh water (100t) by concrete pump truck	#64	#2(3/30)
3	3/30	6:30	White smoke was confirmed to generate continuously	#63	
3	3/30	15:00	Injection of fresh water to RPV continues	#63	

Unit	Date	Approx Time	Event Description	NISA ref.	TEPCO ref.
0	3/31	15:42	A barge of the US armed forces carrying fresh water for cooling reactors, etc. arrived	#66	
3	3/31	16:30	Spent Fuel Pool: STARTED water spray by the concrete pumping vehicle (105t)	#70	#13(3/31)
3	3/31	19:33	Spent Fuel Pool: COMPLETED water spray by the concrete pumping vehicle (105t))	#70	#13(3/31)
3	3/31	6:30	White smoke was confirmed to generate continuously	#64	
3	3/31	8:30	Injection of fresh water to RPV continues	#64	
3	3/31	8:40	COMPLETED water transfer from a CST to a suppression pool water surge-tank to enable water transfer from a condenser to the CST, in order to prepare to transfer the stagnant water on the basement floor of the turbine building to the Condenser.	#66	
3	4/1	9:30	Injection of fresh water to RPV continues	#66	
3	4/1	15:30	Injection of fresh water to RPV continues	#67	
0	4/1	15:56	STARTED operations to transfer of fresh water from the barge to the Filtrate Tank	#67	
3	4/2	9:52	Spent Fuel Pool: STARTED water spray by the concrete pumping vehicle (75t/h)	#70	#5(4/2)
3	4/2	12:54	Spent Fuel Pool: COMPLETED water spray by the concrete pumping vehicle (75t/h)	#70	#5(4/2)
3	4/2	12:30	Some lights in the turbine building were turned on		#4(4/3)
3	4/3	6:30	White smoke was confirmed to generate continuously	#70	
3	4/3	8:00	Injection of fresh water to RPV continues	#70	
3	4/3	10:03	Injection of fresh water to RPV continues by temporary motor driven pump, but switched to fire fighting pump for about 2 hours (until 12:16) in order to connect offsite power to a motor driven pump (editor's note: not clear if the same MDP)	#71	#4(4/3)
3	4/3	12:18	Injection of fresh water to RPV continues by a motor driven pump powered from offsite power	#71	#4(4/3)
3	4/3	15:30	Injection of fresh water to RPV continues	#71	
3	4/4	15:03	Spent Fuel Pool: STARTED water spray by the concrete pumping vehicle (50t/h)		#7(4/4)
3	4/4	6:30	White smoke was confirmed to generate continuously	#72	
3	4/4	8:00	Injection of fresh water to RPV continues	#72	
3	4/4	19:19	Spent Fuel Pool: COMPLETED water spray by the concrete pumping vehicle (70t)		#2(4/5)
3	4/4	15:00	Injection of fresh water to RPV continues	#73	
3	4/5	6:30	White smoke was confirmed to generate continuously	#74	
3	4/5	8:00	Injection of fresh water to RPV continues	#74	
3	4/5	16:00	Injection of fresh water to RPV continues	#75	
3	4/6	6:30	White smoke was confirmed to generate continuously	#76	
3	4/6	8:00	Injection of fresh water to RPV continues	#76	
3	4/6	14:30	Injection of fresh water to RPV continues	#77	
3	4/7	6:30	White smoke was confirmed to generate continuously	#78	
3	4/7	6:53	Spent Fuel Pool: STARTED water spray by the concrete pumping vehicle (50t/h)	#78	#1(4/7)
3	4/7	8:30	Injection of fresh water to RPV continues	#78	
3	4/7	8:53	Spent Fuel Pool: COMPLETED water spray by the concrete pumping vehicle (70t)	#79	#1(4/7)
3	4/7	15:30	Injection of fresh water to RPV continues	#79	

Unit	Date	Approx Time	Event Description	NISA ref.	TEPCO ref.
3	4/7	23:32	7.1-magnitude aftershock (originally reported as 7.4) in the offshore of Miyagi Prefecture; epicenter about 70 mi NE of the Fukushima Daiiichi site; 66 km deep (no reports of additional damage to the units)		#9(4/8)
3	4/8	6:30	White smoke was confirmed to generate continuously	#80	
3	4/8	8:00	Injection of fresh water to RPV continues	#80	
3	4/8	16:00	Injection of fresh water to RPV continues	#81	
3	4/8	17:06	Spent Fuel Pool: STARTED water spray by the concrete pumping vehicle (50t/h)	#82	#10(4/8)
3	4/8	20:00	Spent Fuel Pool: COMPLETED water spray by the concrete pumping vehicle (75t)	#82	#1(4/9)
3	4/9	6:30	White smoke was confirmed to generate continuously	#82	
3	4/9	8:00	Injection of fresh water to RPV continues	#82	
3	4/10	17:15	Spent Fuel Pool: STARTED water spray by the concrete pumping vehicle (XXt/h)		#1(4/11)
3	4/10	19:15	Spent Fuel Pool: COMPLETED water spray by the concrete pumping vehicle (XXt)		#1(4/11)
0	4/11	17:16	7.1 magnitude earthquake centered in the Fukushima-Hama-dori: - Water injection to the reactor of the units 1-3 was suspended due to the shutdown of the offsite power; resumed 6:04 pm after restoration of off-site power. - Nitrogen gas injection to the reactor containment vessel in unit 1 was suspended and resumed at 11:34 pm. - No abnormalities were detected in the parameter of each of the units. - The water level of units 1-3's pit did not change significantly.		#3(4/12)
3	4/11	18:04	Injection of fresh water to RPV was restored following loss of offsite power.		#3(4/12)
0	4/12	14:07	6.8 magnitude earthquake centered in the Fukushima-Hama-dori: - No shutdown of the off-site power of the units 1-6 - No abnormalities in water injection to the reactor of the units 1-3 - No abnormalities in Nitrogen gas injection to the reactor containment vessel of unit 1. - No abnormalities were detected in the parameter of each of the units. - No abnormalities in the data taken from the monitoring before as well as after the earthquake. - Workers outdoor evacuated in the key earthquake-proof building.		#13(4/12)
3	4/12	16:26	Spent Fuel Pool: STARTED water spray by the concrete pumping vehicle (XXt/h)		#11(4/12)
3	4/12	17:16	Spent Fuel Pool: COMPLETED water spray by the concrete pumping vehicle (XXt)		#11(4/12)
0	4/12	18:38	A fire broke out at the distribution switchboard containing batteries located in the sampling equipment switchbox situated close to the south water discharge channel for Units 1-4. The self defense fire fighting team began extinguishing this fire soon after it broke out.		#3(4/12)
3					
3					
3					
3					

Unit	Date	Approx Time	Event Description	NISA ref.	TEPCO ref.
Notes					
1	Investigation results indicate that the inundation height at the Fukushima Daiichi Nuclear Power Station was approximately base (sea) level O.P. + 14 to 15 meters with an inundation depth at approximately 4 to 5 meters across the ocean-side of main building area where reactor buildings and turbine buildings are located. Base level of Onahama Port (O.P.) construction is 0.727 meters below Tokyo Bay mean sea height. Inundation depth is the height of the water discoloration from the ground level or base of the buildings.				

Plant Parameters: **Unit 1**															
Revision 4/13/2011 (8:00 a.m. EST)															
Source: NISA Press Releases	Unit	3/14	3/15	3/16	3/17	3/17	3/18	3/18	3/18	3/19	3/19	3/19	3/20	3/20	3/20
		19:30	11:42	12:25	3:10	11:30	2:50	7:55	21:10	3:30	11:00	16:50	5:00	11:00	15:00
RPV Injection.....Water Source	Salt/Fresh														
via Feed Water Line	L/min														
	m3/h														
via Fire Extinguishing Line	L/min														
	m3/h														
RPV Level															
Fuel Range A	mm	dwn/scale	-1700	-1750	-1800	-1800	-1700	-1700	-1750	-1750	-1800	-1750	-1750	-1750	-1700
Fuel Range B	mm	dwn/scale	-1700	-1750	-1750	-1800	dwn/scale	dwn/scale	-1800	-1750	-1700	-1750	-1750	-1750	-1750
~~RRV Pressure (note 1)~~															
See NISA Press Release dated 4/11/2011															
~~Channel A~~	~~MPa g~~	~~0.047~~	~~0.072~~	~~0.207~~	~~0.198~~	~~0.173~~	~~0.164~~	~~0.169~~	~~0.194~~	~~0.205~~	~~0.196~~	~~0.205~~	~~0.203~~	~~0.194~~	~~0.187~~
~~Channel B~~	~~MPa g~~	~~0.270~~	~~0.185~~	~~0.171~~	~~0.151~~	~~0.144~~	~~0.142~~	~~0.146~~	~~0.151~~	~~0.155~~	~~0.151~~	~~0.160~~	~~0.162~~	~~0.160~~	~~0.158~~
~~Channel A~~	~~MPa abs~~	~~0.148~~	~~0.173~~	~~0.308~~	~~0.299~~	~~0.274~~	~~0.265~~	~~0.270~~	~~0.295~~	~~0.306~~	~~0.297~~	~~0.306~~	~~0.304~~	~~0.295~~	~~0.288~~
~~Channel B~~	~~MPa abs~~	~~0.371~~	~~0.286~~	~~0.272~~	~~0.252~~	~~0.245~~	~~0.243~~	~~0.247~~	~~0.252~~	~~0.256~~	~~0.252~~	~~0.261~~	~~0.263~~	~~0.261~~	~~0.259~~
Drywell Pressure	MPa abs	not avail	0.315	not avail	not avail	not avail	not avail	not avail	0.180	0.180	0.170	0.180	0.180	0.170	0.170
Suppression Chamber Pressure	MPa abs	not avail	not avail	not avail	not avail	not avail	not avail	not avail	0.160	0.165	0.170	0.170	0.170	0.160	0.160
RPV Temperature															
Feedwater Nozzle Temp	C														
RPV Bottom Head Temp	C														
Containment Atm Monitoring System															
Drywell	Sv/h														
Suppression Chamber	Sv/h														
Notes:															
1. NISA News releases started reported gage pressure, then converted readings to absolute pressure. NISA separate parameter tables report gage pressure. Conversion in this table in BLUE.															
Standard atmospheric pressure = 101.325 kPa = 0.101325 Mpa Absolute pressure = 0.101325 MPa + 0.06 MPa = 0.161325 Mpa															

Plant Parameters: **Unit 1**															
Revision 4/13/2011 (8:00 a.m. EST)															
Source: NISA Press Releases	Unit	3/21	3/21	3/21	3/22	3/22	3/22	3/23	3/23	3/24	3/24	3/24	3/24	3/24	3/25
		5:00	8:00	14:25	6:00	11:20	15:30	4:00	12:00	1:00	2:35	11:00	17:00	21:45	6:00
RPV Injection.....Water Source	Salt/Fresh										Salt			Salt	
via Feed Water Line	L/min										160			113	
	m3/h														
via Fire Extinguishing Line	L/min														
	m3/h														
RPV Level															
Fuel Range A	mm	-1750	-1750	-1750	-1750	-1800	-1800	-1750	-1750	-1700		-1700	-1650		-1700
Fuel Range B	mm	-1800	-1750	-1750	-1700	-1750	-1750	-1750	-1750	-1700		-1700	-1650		-1650
~~RRV Pressure (note 1)~~															
See NISA Press Release dated 4/11/2011															
~~Channel A~~	~~MPa g~~	~~0.194~~	~~0.196~~	~~0.198~~	~~0.196~~	~~0.227~~	~~0.216~~	~~0.302~~	~~0.356~~	~~0.410~~		~~0.432~~	~~0.439~~		~~0.365~~
~~Channel B~~	~~MPa g~~	~~0.158~~	~~0.164~~	~~0.171~~	~~0.167~~	~~0.205~~	~~0.169~~	~~0.290~~	~~0.319~~	~~0.387~~		~~0.401~~	~~0.367~~		~~0.351~~
~~Channel A~~	~~MPa abs~~	~~0.295~~	~~0.297~~	~~0.299~~	~~0.297~~	~~0.328~~	~~0.317~~	~~0.403~~	~~0.457~~	~~0.511~~		~~0.533~~	~~0.540~~		~~0.466~~
~~Channel B~~	~~MPa abs~~	~~0.259~~	~~0.265~~	~~0.272~~	~~0.268~~	~~0.306~~	~~0.270~~	~~0.391~~	~~0.420~~	~~0.488~~		~~0.502~~	~~0.468~~		~~0.452~~
Drywell Pressure	MPa abs	0.160	0.160	0.160	0.160	0.175	0.175	0.260	0.320	0.385		0.400	0.355		0.310
Suppression Chamber Pressure	MPa abs	0.160	0.160	0.155	0.155	0.155	0.160	0.240	0.300	0.370		0.395	0.355		0.305
RPV Temperature															
Feedwater Nozzle Temp	C									243.0		175.3	217.9		204.5
RPV Bottom Head Temp	C									229.0		182.8	172.4		157.5
Containment Atm Monitoring System															
Drywell	Sv/h									43.9		43.5	40.9		40.0
Suppression Chamber	Sv/h									27.9		26.3	25.8		25.1
Notes:															
1. NISA News releases started reported gage pressure, then converted readings to absolute pressure. NISA separate parameter tables report gage pressure. Conversion in this table in BLUE.															
Standard atmospheric pressure = 101.325 kPa = 0.101325 Mpa Absolute pressure = 0.101325 MPa + 0.06 MPa = 0.161325 Mpa															

Plant Parameters: **Unit 1**															
Revision 4/13/2011 (8:00 a.m. EST)															
Source: NISA Press Releases	Unit	3/25	3/25	3/25	3/26	3/26	3/26	3/27	3/27	3/27	3/28	3/28	3/28	3/29	3/29
		10:00	15:37	16:30	5:00	9:30	13:00	5:00	9:00	14:00	3:00	12:30	20:00	4:00	8:32
RPV Injection.....Water Source	Salt/Fresh		Fresh							Fresh			Fresh		Fresh
via Feed Water Line	L/min		120							113			141		133
	m3/h														
via Fire Extinguishing Line	L/min														
	m3/h														
RPV Level															
Fuel Range A	mm	-1650		-1650	-1650	-1650	-1650	-1650	-1650		-1700	-1700		-1600	
Fuel Range B	mm	-1650		-1600	-1600	-1600	-1600	-1600	-1600		-1650	-1650		-1600	
~~RRV Pressure (note 1)~~															
See NISA Press Release dated 4/11/2011															
~~Channel A~~	~~MPa g~~	~~0.349~~		~~0.342~~	~~0.353~~	~~0.376~~	~~0.351~~	~~0.371~~	~~0.374~~		~~0.376~~	~~0.376~~		~~0.392~~	
~~Channel B~~	~~MPa g~~	~~0.349~~		~~0.342~~	~~0.360~~	~~0.360~~	~~0.380~~	~~0.407~~	~~0.416~~		~~0.443~~	~~0.432~~		~~0.502~~	
~~Channel A~~	~~MPa abs~~	~~0.450~~		~~0.443~~	~~0.454~~	~~0.477~~	~~0.452~~	~~0.472~~	~~0.475~~		~~0.477~~	~~0.477~~		~~0.493~~	
~~Channel B~~	~~MPa abs~~	~~0.450~~		~~0.443~~	~~0.461~~	~~0.461~~	~~0.481~~	~~0.508~~	~~0.517~~		~~0.544~~	~~0.533~~		~~0.603~~	
Drywell Pressure	MPa abs	0.295		0.275	0.270	0.270	0.275	0.270	0.270		0.270	0.270		0.285	
Suppression Chamber Pressure	MPa abs	0.290		0.275	0.270	0.270	0.275	0.270	0.270		0.270	0.270		0.285	
RPV Temperature															
Feedwater Nozzle Temp	C	197.8		196.9	209.4	195.3	212.3	212.8	224.8		273.8			323.3	
RPV Bottom Head Temp	C	153.6		148.5	144.3	146.3	146.9	141.7	143.4		139.2			139.4	
Containment Atm Monitoring System															
Drywell	Sv/h	38.9		37.1	35.3	35.1	35.4	34	34.6		33.8			36.0	
Suppression Chamber	Sv/h	24.9		24.5	23.8	23.6	23.4	22.5	22.2		21.3			20.0	
Notes:															
1. NISA News releases started reported gage pressure, then converted readings to absolute pressure. NISA separate parameter tables report gage pressure. Conversion in this table in BLUE.															
Standard atmospheric pressure = 101.325 kPa = 0.101325 Mpa Absolute pressure = 0.101325 MPa + 0.06 MPa = 0.161325 Mpa															

Plant Parameters: **Unit 1**															
Revision 4/13/2011 (8:00 a.m. EST)															
Source: NISA Press Releases	Unit	3/29	3/29	3/30	3/30	3/31	3/31	4/1	4/1	4/1	4/2	4/2	4/2	4/3	4/3
		9:40	13:00	4:00	13:00	4:00	12:00	6:00	10:00	16:18	4:00	12:00	20:27	3:00	9:00
RPV Injection.....Water Source	Salt/Fresh									Fresh			Fresh		
via Feed Water Line	L/min									117			100		
	m3/h														
via Fire Extinguishing Line	L/min														
	m3/h														
RPV Level															
Fuel Range A	mm	-1650	-1650	-1600	-1600	-1650	-1600	-1600	-1650		-1600	-1650		-1650	-1650
Fuel Range B	mm	-1650	-1600	-1600	-1600	-1650	-1650	-1600	-1650		-1600	-1650		-1650	-1650
~~RRV Pressure (note 1)~~															
See NISA Press Release dated 4/11/2011															
~~Channel A~~	~~MPa g~~	~~0.383~~	~~0.371~~	~~0.353~~	~~0.34~~	~~0.333~~	~~0.329~~	~~0.293~~	~~0.295~~		~~0.288~~	~~0.290~~		~~0.290~~	~~0.293~~
~~Channel B~~	~~MPa g~~	~~0.491~~	~~0.491~~	~~0.488~~	~~0.491~~	~~0.511~~	~~0.506~~	~~0.495~~	~~0.497~~		~~0.52~~	~~0.531~~		~~0.542~~	~~0.547~~
~~Channel A~~	~~MPa abs~~	~~0.484~~	~~0.472~~	~~0.454~~	~~0.441~~	~~0.434~~	~~0.430~~	~~0.394~~	~~0.396~~		~~0.389~~	~~0.391~~		~~0.391~~	~~0.394~~
~~Channel B~~	~~MPa abs~~	~~0.592~~	~~0.592~~	~~0.589~~	~~0.592~~	~~0.612~~	~~0.607~~	~~0.596~~	~~0.598~~		~~0.621~~	~~0.632~~		~~0.643~~	~~0.648~~
Drywell Pressure	MPa abs	0.275	0.265	0.235	0.230	0.210	0.210	0.170	0.165		0.160	0.155		0.155	0.155
Suppression Chamber Pressure	MPa abs	0.275	0.265	0.235	0.230	0.210	0.205	0.170	0.165		0.160	0.155		0.16	0.155
RPV Temperature															
Feedwater Nozzle Temp	C		299.4	281.2	270.1	251.2	246.1	255.2	248.6		261.5	259.4		256.7	252.8
RPV Bottom Head Temp	C		135.8	133.9	130.2	128	126.1	119.7	118.5		118	117.6		117.2	116.7
Containment Atm Monitoring System															
Drywell	Sv/h		33.8	33.2	37.7	41.7	41.2	44.3	43		45.5	45.1		31.8	44.6
Suppression Chamber	Sv/h		19.7	19.1	18.2	18.2	17.2	17.4	17.2		16.5	16.0		15.3	14.9
Notes:															
1. NISA News releases started reported gage pressure, then converted readings to absolute pressure. NISA separate parameter tables report *gage pressure. Conversion in this table in BLUE.*															
Standard atmospheric pressure = 101.325 kPa = 0.101325 Mpa Absolute pressure = 0.101325 MPa + 0.06 MPa = 0.161325 Mpa															

Plant Parameters: **Unit 1**															
Revision 4/13/2011 (8:00 a.m. EST)															
Source: NISA Press Releases	Unit	4/3	4/3	4/4	4/4	4/5	4/6	4/6	4/7	4/7	4/8	4/8	4/9		
		12:02	17:30	0:00	11:00	6:00	0:00	12:00	6:00	12:00	0:00	12:00	0:00		
RPV Injection.....Water Source	Salt/Fresh	Fresh	Fresh												
via Feed Water Line	L/min														
	m3/h	6.5	6												
via Fire Extinguishing Line	L/min														
	m3/h														
RPV Level															
Fuel Range A	mm			-1650	-1650	-1700	-1650	-1650	-1650	-1650	-1650	-1650	-1650		
Fuel Range B	mm			-1650	-1650	-1650	-1650	-1650	-1650	-1650	-1650	-1650	-1650		
~~RRV Pressure (note 1)~~															
See NISA Press Release dated 4/11/2011															
~~Channel A~~	~~MPa g~~			~~0.304~~	~~0.299~~	~~0.308~~	~~0.304~~	~~0.313~~	~~0.363~~	~~0.375~~	~~0.390~~	~~0.395~~	~~0.395~~		
~~Channel B~~	~~MPa g~~			~~0.592~~	~~0.603~~	~~0.619~~	~~0.632~~	~~0.653~~	~~0.758~~	~~0.758~~	~~0.788~~	~~0.793~~	~~0.803~~		
~~Channel A~~	~~MPa abs~~			~~0.405~~	~~0.400~~	~~0.409~~	~~0.405~~	~~0.414~~	~~0.464~~	~~0.476~~	~~0.491~~	~~0.496~~	~~0.496~~	~~0.101~~	~~0.101~~
~~Channel B~~	~~MPa abs~~			~~0.693~~	~~0.704~~	~~0.720~~	~~0.733~~	~~0.754~~	~~0.859~~	~~0.859~~	~~0.889~~	~~0.894~~	~~0.904~~	~~0.101~~	~~0.101~~
Drywell Pressure	MPa abs			0.155	0.150	0.150	0.150	0.150	0.155	0.165	0.180	0.185	0.190		
Suppression Chamber Pressure	MPa abs			0.155	0.150	0.150	0.150	0.150	0.155	0.150	0.150	0.155	0.155		
RPV Temperature															
Feedwater Nozzle Temp	C			243.1	242.8	233.5	221.6	214.0	216.3	223.8	260.7	246.6	240.5		
RPV Bottom Head Temp	C			113.4	115.3	114.8	114.8	115.0	116.2	116.9	118.6	119.4	119.7		
Containment Atm Monitoring System															
Drywell	Sv/h			38.3	38.7	31.5	31.1	31.0	30.8	31.7	100	68.3	Note 1		
Suppression Chamber	Sv/h			13.4	12.2	10.2	8.79	8.01	12.9	12.9	12.7	12.2	12.2		
Notes:													Note 1: "Measuring instrumer		
1. NISA News releases started reported gage pressure, then converted readings to absolute pressure. NISA separate parameter tables report gage pressure. Conversion in this table in BLUE.															
Standard atmospheric pressure = 101.325 kPa = 0.101325 Mpa Absolute pressure = 0.101325 MPa + 0.06 MPa = 0.161325 Mpa															

Plant Parameters: **Unit 1**														
Revision 4/13/2011 (8:00 a.m. EST)														
Source: NISA Press Releases	Unit													
RPV Injection.....Water Source	Salt/Fresh													
via Feed Water Line	L/min													
	m3/h													
via Fire Extinguishing Line	L/min													
	m3/h													
RPV Level														
Fuel Range A	mm													
Fuel Range B	mm													
~~RRV Pressure (note 1)~~														
See NISA Press Release dated 4/11/2011														
~~Channel A~~	~~MPa g~~													
~~Channel B~~	~~MPa g~~													
~~Channel A~~	~~MPa abs~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~
~~Channel B~~	~~MPa abs~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~
Drywell Pressure	MPa abs													
Suppression Chamber Pressure	MPa abs													
RPV Temperature														
Feedwater Nozzle Temp	C													
RPV Bottom Head Temp	C													
Containment Atm Monitoring System														
Drywell	Sv/h													
Suppression Chamber	Sv/h													
Notes:		t malfunction"												
1. NISA News releases started reported gage pressure, then converted readings to absolute pressure. NISA separate parameter tables report gage pressure. Conversion in this table in BLUE.														
Standard atmospheric pressure = 101.325 kPa = 0.101325 Mpa Absolute pressure = 0.101325 MPa + 0.06 MPa = 0.161325 Mpa														

Plant Parameters: **Unit 2**															
Revision 4/13/2011 (8:00 a.m. EST)															
Source: NISA Press Releases	Unit	3/14	3/15	3/16	3/17	3/17	3/18	3/18	3/18	3/19	3/19	3/19	3/20	3/20	3/20
		19:30	11:42	12:25	3:10	11:30	2:50	7:55	21:10	3:30	11:00	16:30	5:00	11:00	15:00
RPV Injection.....Water Source	Salt/Fresh														
via Feed Water Line	L/min														
via Fire Extinguishing Line	L/min														
	m3/h														
RPV Level															
Fuel Range A	mm	dwn/scale	-1400	-1400	-1400	-1800	-1400	-1400	-1400	-1400	-1400	-1300	-1300	-1400	-1400
Fuel Range B	mm	dwn/scale	not avail	not avail	not avail	not avail	not avail	not avail	not avail	not avail	not avail	not avail	not avail	not avail	not avail
~~RRV Pressure (note 1)~~		~~Note 1~~	~~Note 1~~	~~Note 2~~											
See NISA Press Release dated 4/11/2011															
~~Channel A~~	~~MPa-g~~	~~0.650~~	~~0.315~~	~~no dc~~	~~-0.065~~	~~-0.029~~	~~-0.016~~	~~-0.014~~	~~-0.005~~	~~-0.005~~	~~-0.009~~	~~-0.009~~	~~-0.014~~	~~-0.016~~	~~-0.016~~
~~Channel B~~	~~MPa-g~~			~~no dc~~	~~-0.079~~	~~-0.047~~	~~-0.032~~	~~-0.029~~	~~-0.020~~	~~-0.018~~	~~-0.023~~	~~-0.025~~	~~-0.029~~	~~-0.032~~	~~-0.020~~
~~Channel A~~	~~MPa abs~~	~~0.751~~	~~0.416~~		~~0.036~~	~~0.072~~	~~0.085~~	~~0.087~~	~~0.096~~	~~0.096~~	~~0.092~~	~~0.092~~	~~0.087~~	~~0.085~~	~~0.085~~
~~Channel B~~	~~MPa abs~~				~~0.022~~	~~0.054~~	~~0.069~~	~~0.072~~	~~0.081~~	~~0.083~~	~~0.078~~	~~0.076~~	~~0.072~~	~~0.069~~	~~0.081~~
Drywell Pressure	MPa abs	0.395	0.155	0.040	0.075	0.115	0.130	0.130	0.140	0.135	0.135	0.135	0.130	0.125	0.125
Suppression Chamber Pressure	MPa abs	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale
RPV Temperature		Note 1: No instrument channel specified													
Feedwater Nozzle Temp	C			Note 2: "Due to loss of battery power"											
RPV Bottom Head Temp	C														
Containment Atm Monitoring System															
Drywell	Sv/h														
Suppression Chamber	Sv/h														
Notes:															
NISA News releases started reported gage pressure, then converted readings to absolute pressure. NISA separate parameter tables report gage pressure. Conversion in this table in BLUE.															
Standard atmospheric pressure = 101.325 kPa = 0.101325 Mpa Absolute pressure = 0.101325 MPa + 0.06 MPa = 0.161325 MPa															

Plant Parameters: **Unit 2**															
Revision 4/13/2011 (8:00 a.m. EST)															
Source: NISA Press Releases	Unit	3/21	3/21	3/21	3/22	3/22	3/22	3/23	3/23	3/24	3/24	3/24	3/24	3/25	3/25
		3:00	8:00	14:25	6:00	11:20	15:30	4:20	9:00	1:00	9:00	17:00	21:45	1:07	6:00
RPV Injection.....Water Source	Salt/Fresh									Salt	Salt	Salt		Salt	
via Feed Water Line	L/min														
via Fire Extinguishing Line	L/min													340	
	m3/h									11	12	12	Note 3	Note 4	
RPV Level															
Fuel Range A	mm	-1350	-1350	-1350	-1350	-1350	-1300	-1300	-1300	-1200	-1150	-1200			-1100
Fuel Range B	mm	not avail	not avail	not avail	not avail	not avail	not avail	not avail	not avail	not avail	not avail	not avail			not avail
~~RRV Pressure (note 1)~~															
See NISA Press Release dated 4/11/2011															
~~Channel A~~	~~MPa-g~~	~~-0.018~~	~~-0.020~~	~~-0.023~~	~~-0.005~~	~~-0.018~~	~~-0.029~~	~~-0.025~~	~~-0.023~~	~~-0.025~~	~~-0.135~~	~~-0.036~~			~~-0.020~~
~~Channel B~~	~~MPa-g~~	~~-0.020~~	~~-0.020~~	~~-0.025~~	~~-0.029~~	~~-0.018~~	~~-0.032~~	~~-0.025~~	~~-0.023~~	~~-0.025~~	~~-0.038~~	~~-0.036~~			~~-0.020~~
~~Channel A~~	~~MPa-abs~~	~~0.083~~	~~0.081~~	~~0.078~~	~~0.096~~	~~0.083~~	~~0.072~~	~~0.076~~	~~0.078~~	~~0.076~~	~~-0.034~~	~~0.065~~			~~0.081~~
~~Channel B~~	~~MPa-abs~~	~~0.081~~	~~0.081~~	~~0.076~~	~~0.072~~	~~0.083~~	~~0.069~~	~~0.076~~	~~0.078~~	~~0.076~~	~~0.063~~	~~0.065~~			~~0.081~~
Drywell Pressure	MPa abs	0.120	0.120	0.120	0.110	0.110	0.110	0.110	0.110	0.105	0.110	0.110			0.120
Suppression Chamber Pressure	MPa abs	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale			dwn/scale
RPV Temperature															
Feedwater Nozzle Temp	C									102	100	100			105
RPV Bottom Head Temp	C									109	105	105			105
Containment Atm Monitoring System															
Drywell	Sv/h									49.3	48.4	47.4			45.9
Suppression Chamber	Sv/h									1.49	1.4	1.36			1.54
Notes:													Note 3: "10 m3/hr neighborhc		
NISA News releases started reported gage pressure, then converted readings to absolute pressure. NISA separate parameter tables report gage pressure. Conversion in this table in BLUE.														Note 4: Flow readir	
Standard atmospheric pressure = 101.325 kPa = 0.101325 Mpa Absolute pressure = 0.101325 MPa + 0.06 MPa = 0.161325 MPa															

Plant Parameters: **Unit 2**															
Revision 4/13/2011 (8:00 a.m. EST)															
Source: NISA Press Releases	Unit	3/25	3/25	3/26	3/26	3/26	3/26	3/26	3/27	3/27	3/28	3/28	3/28	3/29	3/29
		10:00	14:00	5:00	10:10	10:40	13:00	17:22	5:00	9:00	0:12	4:00	12:30	4:00	10:00
RPV Injection.....Water Source	Salt/Fresh				Fresh			Fresh			Fresh				
via Feed Water Line	L/min							Note 6							
via Fire Extinguishing Line	L/min				310			270			117				
	m3/h														
RPV Level															
Fuel Range A	mm	-1200	-1400	-1000		-1100	-1200		-1200	-1200		-1500	-1500	-1500	-1500
Fuel Range B	mm	not avail	not avail	not avail		not avail	not avail		not avail	not avail		not avail	not avail	not avail	not avail
~~RRV Pressure (note 1)~~															
See NISA Press Release dated 4/11/2011															
~~Channel A~~	~~MPa g~~	~~-0.020~~	~~-0.016~~	~~-0.014~~		~~-0.014~~	~~-0.027~~		~~-0.018~~	~~-0.018~~		~~-0.020~~	~~-0.032~~	~~-0.027~~	~~-0.025~~
~~Channel B~~	~~MPa g~~	~~-0.020~~	~~-0.018~~	~~-0.014~~		~~-0.016~~	~~-0.027~~		~~-0.018~~	~~-0.020~~		~~-0.023~~	~~-0.032~~	~~-0.029~~	~~-0.027~~
~~Channel A~~	~~MPa abs~~	~~0.081~~	~~0.085~~	~~0.087~~		~~0.087~~	~~0.074~~		~~0.083~~	~~0.083~~		~~0.081~~	~~0.069~~	~~0.074~~	~~0.076~~
~~Channel B~~	~~MPa abs~~	~~0.081~~	~~0.083~~	~~0.087~~		~~0.085~~	~~0.074~~		~~0.083~~	~~0.081~~		~~0.078~~	~~0.069~~	~~0.072~~	~~0.074~~
Drywell Pressure	MPa abs	0.120	0.120	0.120		0.115	0.110		0.110	0.110		0.110	0.100	0.100	0.100
Suppression Chamber Pressure	MPa abs	dwn/scale	dwn/scale	dwn/scale		dwn/scale	dwn/scale		dwn/scale	dwn/scale		dwn/scale	dwn/scale	dwn/scale	dwn/scale
RPV Temperature															
Feedwater Nozzle Temp	C	107	107	109		107	107		123.9	123.6		130.3		153.7	
RPV Bottom Head Temp	C	105	104	100		100	99		96.6	111.2		81.5		77.7	
Containment Atm Monitoring System -						Note 5									
Drywell	Sv/h	45.6	45.2	43.8		43.4	43.2		41.9	41.6		40.5		40.4	
Suppression Chamber	Sv/h	1.54	1.54	1.51		1.49	1.48		1.43	1.41		1.37		1.37	
Notes:		od";				Note 5: 09:30		Note 6: 270 to 280 l/hr							
NISA News releases started reported gage pressure, then converted readings to absolute pressure. NISA separate parameter tables report gage pressure. Conversion in this table in BLUE.		gs from "temporary measuring instrument"													
Standard atmospheric pressure = 101.325 kPa = 0.101325 Mpa Absolute pressure = 0.101325 MPa + 0.06 MPa = 0.161325 MPa															

Plant Parameters: **Unit 2**															
Revision 4/13/2011 (8:00 a.m. EST)															
Source: NISA Press Releases	Unit	3/29	3/30	3/30	3/30	3/30	3/31	3/31	4/1	4/1	4/2	4/2	4/2	4/3	4/3
		13:00	4:00	10:14	13:00	14:00	4:00	12:00	6:00	10:00	4:00	12:00	20:43	3:00	9:00
RPV Injection.....Water Source	Salt/Fresh			Fresh		Fresh							Fresh		
via Feed Water Line	L/min														
via Fire Extinguishing Line	L/min			133		150							133		
	m3/h														
RPV Level															
Fuel Range A	mm	-1500	-1500		-1500		-1500	-1500	-1500	-1500	-1500	-1550		-1500	-1500
Fuel Range B	mm	not avail													
~~RRV Pressure (note 1)~~															
See NISA Press Release dated 4/11/2011															
~~Channel A~~	~~MPa-g~~	~~-0.025~~	~~-0.025~~		~~-0.023~~		~~-0.018~~	~~-0.011~~	~~-0.014~~	~~-0.007~~	~~-0.011~~	~~-0.007~~		~~-0.016~~	~~-0.016~~
~~Channel B~~	~~MPa-g~~	~~-0.025~~	~~-0.025~~		~~-0.023~~		~~-0.020~~	~~-0.011~~	~~-0.016~~	~~-0.009~~	~~-0.014~~	~~-0.007~~		~~-0.018~~	~~-0.018~~
~~Channel A~~	~~MPa-abs~~	~~0.076~~	~~0.076~~		~~0.078~~		~~0.083~~	~~0.090~~	~~0.087~~	~~0.094~~	~~0.090~~	~~0.094~~		~~0.085~~	~~0.085~~
~~Channel B~~	~~MPa-abs~~	~~0.076~~	~~0.076~~		~~0.078~~		~~0.081~~	~~0.090~~	~~0.085~~	~~0.092~~	~~0.087~~	~~0.094~~		~~0.083~~	~~0.083~~
Drywell Pressure	MPa abs	0.100	0.100		0.100		0.110	0.110	0.110	0.110	0.110	0.110		0.105	0.105
Suppression Chamber Pressure	MPa abs	dwn/scale	dwn/scale		dwn/scale		dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale		dwn/scale	dwn/scale
RPV Temperature															
Feedwater Nozzle Temp	C	160.5	170.7		174.3		181.2	172.4	163.6	161.0	155.0	152.9		153.4	150.5
RPV Bottom Head Temp	C	143.6	87.7		Note 7		Note 7	Note 7	Note 7	Note 7	Note 7	Note 7		Note 7	Note 7
Containment Atm Monitoring System															
Drywell	Sv/h	40.5	40		39.6		38.7	37.9	37.2	37.0	36.1	35.7		35.0	34.3
Suppression Chamber	Sv/h	1.33	1.28		1.26		1.19	1.16	1.11	1.09	0.981	0.966		0.947	0.935
Notes:					Note 7: "Measuring instrument malfunction"										
NISA News releases started reported gage pressure, then converted readings to absolute pressure. NISA separate parameter tables report gage pressure. Conversion in this table in BLUE.															
Standard atmospheric pressure = 101.325 kPa = 0.101325 Mpa Absolute pressure = 0.101325 MPa + 0.06 MPa = 0.161325 MPa															

Plant Parameters: **Unit 2**															
Revision 4/13/2011 (8:00 a.m. EST)															
Source: NISA Press Releases	Unit	4/3	4/4	4/4	4/5	4/6	4/6	4/7	4/7	4/7	4/8	4/8	4/9		
		12:12	0:00	11:00	6:00	0:00	12:00	6:00	12:00	19:00	3:00	12:00	0:00		
RPV Injection.....Water Source	Salt/Fresh	Fresh								Fresh					
via Feed Water Line	L/min														
via Fire Extinguishing Line	L/min														
	m3/h	8								7					
RPV Level															
Fuel Range A	mm		-1500	-1500	-1500	-1500	-1500	-1500	-1500		-1500	-1500	-1500		
Fuel Range B	mm														
~~RRV Pressure (note 1)~~															
See NISA Press Release dated 4/11/2011															
~~Channel A~~	~~MPa g~~		~~0.011~~	~~0.018~~	~~0.018~~	~~0.018~~	~~0.016~~	~~0.018~~	~~0.009~~		~~0.011~~	~~0.020~~	~~0.018~~		
~~Channel B~~	~~MPa g~~		~~0.014~~	~~0.020~~	~~0.018~~	~~0.023~~	~~0.018~~	~~0.025~~	~~0.016~~		~~0.016~~	~~0.020~~	~~0.020~~		
~~Channel A~~	~~MPa abs~~		~~0.090~~	~~0.083~~	~~0.083~~	~~0.083~~	~~0.085~~	~~0.083~~	~~0.092~~		~~0.090~~	~~0.081~~	~~0.083~~	~~0.101~~	~~0.101~~
~~Channel B~~	~~MPa abs~~		~~0.087~~	~~0.081~~	~~0.083~~	~~0.078~~	~~0.083~~	~~0.076~~	~~0.085~~		~~0.085~~	~~0.081~~	~~0.081~~	~~0.101~~	~~0.101~~
Drywell Pressure	MPa abs		0.105	0.100	0.100	0.100	0.100	0.100	0.100		0.100	0.100	0.095		
Suppression Chamber Pressure	MPa abs		dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale		dwn/scale	dwn/scale	dwn/scale		
RPV Temperature															
Feedwater Nozzle Temp	C		140.3	139.0	141.7	140.9	142.5	144.2	143.6		143.0	141.2	141.6		
RPV Bottom Head Temp	C		Note 7	Note 7	Note 7	Note 7	Note 7	Note 7	Note 7		Note 7	Note 7	Note 7		
Containment Atm Monitoring System															
Drywell	Sv/h		33.4	32.8	32.1	31.5	31.1	30.6	30.5		30.0	29.4	29.4		
Suppression Chamber	Sv/h		0.911	0.879	0.867	0.839	0.825	0.801	0.794		0.772	0.765	0.751		
Notes:															
NISA News releases started reported gage pressure, then converted readings to absolute pressure. NISA separate parameter tables report gage pressure. Conversion in this table in BLUE.															
Standard atmospheric pressure = 101.325 kPa = 0.101325 Mpa Absolute pressure = 0.101325 MPa + 0.06 MPa = 0.161325 MPa															

Plant Parameters: **Unit 2**								
Revision 4/13/2011 (8:00 a.m. EST)								
Source: NISA Press Releases	Unit							
RPV Injection.....Water Source	Salt/Fresh							
via Feed Water Line	L/min							
via Fire Extinguishing Line	L/min							
	m3/h							
RPV Level								
Fuel Range A	mm							
Fuel Range B	mm							
~~RRV Pressure (note 1)~~								
See NISA Press Release dated 4/11/2011								
~~Channel A~~	~~MPa g~~							
~~Channel B~~	~~MPa g~~							
~~Channel A~~	~~MPa abs~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~
~~Channel B~~	~~MPa abs~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~
Drywell Pressure	MPa abs							
Suppression Chamber Pressure	MPa abs							
RPV Temperature								
Feedwater Nozzle Temp	C							
RPV Bottom Head Temp	C							
Containment Atm Monitoring System								
Drywell	Sv/h							
Suppression Chamber	Sv/h							
Notes:								
NISA News releases started reported gage pressure, then converted readings to absolute pressure. NISA separate parameter tables report gage pressure. Conversion in this table in BLUE.								
Standard atmospheric pressure = 101.325 kPa = 0.101325 Mpa Absolute pressure = 0.101325 MPa + 0.06 MPa = 0.161325 MPa								

Plant Parameters: **Unit 3**															
Revision 4/13/2011 (8:00 a.m. EST)															
Source: NISA Press Releases	Unit	3/14	3/15	3/16	3/17	3/17	3/18	3/18	3/18	3/19	3/19	3/19	3/20	3/20	3/20
		19:30	11:42	12:40	3:20	11:10	2:45	12:35	21:05	6:10	11:15	17:25	4:30	11:00	16:00
RPV Injection.....Water Source	Salt/Fresh														
via Feed Water Line	L/min														
via Fire Extinguishing Line	L/min														
via Fire Extinguishing Line	m3/h														
RPV Level															
Fuel Range A	mm	-1900	-1900	-1900	-1950	-1950	-2000	-2000	-1900	-1200	-1950	-1850	-1950	-1950	-1650
Fuel Range B	mm	-2300	-2300	-2300	-2300	-2300	-2300	-2300	-2300	-2300	-2300	-2300	-2300	2350	-2000
~~RRV Pressure (see note)~~		~~Note: 1~~	~~Note: 1~~	~~Note: 1~~	~~Note: 1~~	~~Note: 1~~									
See NISA Press Release dated 4/11/2011															
~~Channel A~~	~~MPa-g~~	~~0.183~~	~~0.244~~	~~0.059~~	~~0.023~~	~~0.014~~	~~-0.005~~	~~-0.018~~	~~-0.016~~	~~0.045~~					
~~Channel B~~	~~MPa-g~~	~~0.183~~	~~0.244~~	~~0.065~~	~~0.032~~	~~0.023~~	~~0.014~~	~~0.000~~	~~0.016~~	~~0.005~~	~~-0.023~~	~~0.086~~	~~0.216~~	~~0.189~~	~~0.162~~
~~Channel C~~	~~MPa-g~~										~~-0.023~~	~~-0.050~~	~~0.180~~	~~0.149~~	~~0.119~~
~~Channel A~~	~~MPa-abs~~	~~0.284~~	~~0.345~~	~~0.160~~	~~0.124~~	~~0.115~~	~~0.096~~	~~0.083~~	~~0.085~~	~~0.146~~					
~~Channel B~~	~~MPa-abs~~	~~0.284~~	~~0.345~~	~~0.166~~	~~0.133~~	~~0.124~~	~~0.115~~	~~0.101~~	~~0.117~~	~~0.106~~	~~0.078~~	~~0.187~~	~~0.317~~	~~0.290~~	~~0.263~~
~~Channel C~~	~~MPa-abs~~										~~0.078~~	~~0.051~~	~~0.281~~	~~0.250~~	~~0.220~~
Drywell Pressure	MPa abs	0.335	0.415	0.230	0.200	0.190	0.155	0.155	0.160	0.185	0.160	0.210	0.340	0.310	0.290
Suppression Chamber Pressure	MPa abs	0.500	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	dwn/scale	Note 2	Note 3	Note 4
RPV Temperature		Note 1: Both readings are noted in the press releases as coming from channel A											Note 2: "Down scale 100"		
Feedwater Nozzle Temp	C												Note 3: "400 overscale"		
RPV Bottom Head Temp	C												Note 4: "800 down scale"		
Containment Atm Monitoring System															
Drywell	Sv/h														
Suppression Chamber	Sv/h														
Notes:															
NISA News releases started reported gage pressure, then converted readings to absolute pressure. NISA separate parameter tables report gage pressure. Conversion in this table in BLUE.															
Standard atmospheric pressure = 101.325 kPa = 0.101325 Mpa Absolute pressure = 0.101325 MPa + 0.06 MPa = 0.161325 Mpa															

Plant Parameters: **Unit 3**															
Revision 4/13/2011 (8:00 a.m. EST)															
Source: NISA Press Releases	Unit	3/21	3/21	3/21	3/22	3/22	3/23	3/23	3/24	3/24	3/24	3/25	3/25	3/25	3/25
		4:00	12:15	14:55	5:30	10:35	4:00	9:10	2:40	10:20	18:00	6:10	16:10	18:02	20:05
RPV Injection.....Water Source	Salt/Fresh								Salt	Salt	Salt			Fresh	Fresh
via Feed Water Line	L/min														
via Fire Extinguishing Line	L/min								Note 8	Note 8	Note 8			240	240
via Fire Extinguishing Line	m3/h														Note 7
RPV Level															
Fuel Range A	mm	-1650	-1600	-1550	-1575	-1575	-1900	-1800	-1800	-1900	-1850	-1900	-1900		
Fuel Range B	mm	-1950	-2000	-2025	-2350	-2350	-2300	-2300	-2300	-2300	-2300	-2300	-2300		
~~RRV Pressure (see note)~~															
See NISA Press Release dated 4/11/2011															
~~Channel A~~	~~MPa g~~	~~0.214~~	~~0.043~~	~~0.045~~	~~0.038~~	~~0.036~~	~~0.036~~	~~0.034~~	~~0.041~~	~~0.036~~	~~0.038~~	~~0.038~~	~~0.036~~		
~~Channel B~~	~~MPa g~~														
~~Channel C~~	~~MPa g~~	~~-0.027~~	~~-0.083~~	~~-0.088~~	~~-0.101~~	~~-0.101~~	~~-0.101~~	~~-0.104~~	~~-0.097~~	~~-0.099~~	~~-0.101~~	~~-0.097~~	~~-0.099~~		
~~Channel A~~	~~MPa abs~~	~~0.315~~	~~0.144~~	~~0.146~~	~~0.139~~	~~0.137~~	~~0.137~~	~~0.135~~	~~0.142~~	~~0.137~~	~~0.139~~	~~0.139~~	~~0.137~~		
~~Channel B~~	~~MPa abs~~														
~~Channel C~~	~~MPa abs~~	~~0.074~~	~~0.018~~	~~0.013~~	~~0.000~~	~~0.000~~	~~0.000~~	~~-0.003~~	~~0.004~~	~~0.002~~	~~0.000~~	~~0.004~~	~~0.002~~		
Drywell Pressure	MPa abs	0.160	0.120	0.110	0.100	0.100	0.100	0.100	dwn'scale	0.107	0.107	0.1074	0.1075		
Suppression Chamber Pressure	MPa abs	dwn'scale	dwn'scale	dwn'scale	dwn'scale	dwn'scale	dwn'scale	dwn'scale	dwn'scale	0.199	0.200	0.1937	0.1895		
RPV Temperature									Note 5,6	Note 6	Note 6	Note 6	Note 6		
Feedwater Nozzle Temp	C								80.7	14.1	65.6	42.8	-33.4		
RPV Bottom Head Temp	C								185.4	185.5	155.7	111.6	111.0		
Containment Atm Monitoring System															
Drywell	Sv/h								57.9	55.9	53.3	51.0	38.8		
Suppression Chamber	Sv/h								1.66	1.62	1.45	1.5	1.31		
									Note 5: Time of temperatures 2:20						
Notes:									Note 6: Feedwater nozzle temperature reading under survey						
NISA News releases started reported gage pressure, then converted readings to absolute pressure. NISA separate parameter tables report gage pressure. Conversion in this table in BLUE.									Note 7: 240 to 250 l/hr Note 8: "measurement instrument malfunction"						
Standard atmospheric pressure = 101.325 kPa = 0.101325 Mpa Absolute pressure = 0.101325 MPa + 0.06 MPa = 0.161325 Mpa															

Plant Parameters: **Unit 3**															
Revision 4/13/2011 (8:00 a.m. EST)															
Source: NISA Press Releases	Unit	3/26	3/26	3/26	3/26	3/26	3/27	3/27	3/27	3/28	3/28	3/28	3/29	3/29	3/29
		5:05	7:00	10:00	11:15	18:00	4:45	10:10	14:00	5:30	10:30	20:32	4:45	12:00	14:39
RPV Injection.....Water Source	Salt/Fresh		Fresh			Fresh			Fresh			Fresh			Fresh
via Feed Water Line	L/min														
via Fire Extinguishing Line	L/min		230			220			210			200			116
via Fire Extinguishing Line	m3/h														
RPV Level															
Fuel Range A	mm	-1850		-1800	-1850		-1850	-1900		-1900	-1850		-1900	-1850	
Fuel Range B	mm	-2300		-2300	-2300		-2300	-2300		-2300	-2250		-2300	-2250	
~~RRV Pressure (see note)~~															
See NISA Press Release dated 4/11/2011															
~~Channel A~~	~~MPa g~~	~~0.038~~		~~0.038~~	~~0.038~~		~~0.029~~	~~0.032~~		~~0.029~~	~~0.025~~		~~0.034~~	~~0.029~~	
~~Channel B~~	~~MPa g~~														
~~Channel C~~	~~MPa g~~	~~-0.101~~		~~-0.101~~	~~-0.101~~		~~-0.099~~	~~-0.099~~		~~-0.099~~	~~-0.095~~		~~-0.099~~	~~-0.095~~	
~~Channel A~~	~~MPa abs~~	~~0.139~~		~~0.139~~	~~0.139~~		~~0.130~~	~~0.133~~		~~0.130~~	~~0.126~~		~~0.135~~	~~0.130~~	
~~Channel B~~	~~MPa abs~~														
~~Channel C~~	~~MPa abs~~	~~0.000~~		~~0.000~~	~~0.000~~		~~0.002~~	~~0.002~~		~~0.011~~	~~0.006~~		~~0.011~~	~~0.006~~	
Drywell Pressure	MPa abs	0.1069		0.1066	0.1068		0.1073	0.1076		0.1083	0.1076		0.1085	0.1075	
Suppression Chamber Pressure	MPa abs	0.1848		0.1839	0.1836		0.1804	0.1806		0.1794	0.1792		0.1792	0.1796	
RPV Temperature		Note 6		Note 6	Note 6		Note 6	Note 6		Note 6			Note 6	Note 6	
Feedwater Nozzle Temp	C	26.1		37.6	33.7		-1.7	13.6		38			61.5	62.2	
RPV Bottom Head Temp	C	102.5		106.1	100.4		106.8	121.6		123.0			120.9	121.1	
Containment Atm Monitoring System															
Drywell	Sv/h	36.6		36.1	36.1		34.2	33.7		31.5			29.2	28.6	
Suppression Chamber	Sv/h	1.41		1.4	1.4		1.34	1.31		1.24			1.18	1.16	
Notes:															
NISA News releases started reported gage pressure, then converted readings to absolute pressure. NISA separate parameter tables report gage pressure. Conversion in this table in BLUE.															
Standard atmospheric pressure = 101.325 kPa = 0.101325 Mpa Absolute pressure = 0.101325 MPa + 0.06 MPa = 0.161325 Mpa															

Plant Parameters: **Unit 3**															
Revision 4/13/2011 (8:00 a.m. EST)															
Source: NISA Press Releases	Unit	3/30	3/30	3/31	3/31	4/1	4/1	4/2	4/2	4/3	4/3	4/3	4/3	4/4	4/4
		3:50	13:30	4:40	9:40	5:45	11:45	1:30	12:10	2:30	10:30	12:18	17:32	3:30	9:30
RPV Injection.....Water Source	Salt/Fresh											Fresh	Fresh		
via Feed Water Line	L/min														
via Fire Extinguishing Line	L/min														
via Fire Extinguishing Line	m3/h											8	7		
RPV Level															
Fuel Range A	mm	-1850	-1850	-1900	-1850	-1900	-1900	-1850	-1850	-1850	-1850			-1800	-1800
Fuel Range B	mm	-2250	-2250	-2300	-2250	-2250	-2250	-2250	-2250	-2250	-2250			-2250	-2250
~~RRV Pressure (see note)~~															
See NISA Press Release dated 4/11/2011															
~~Channel A~~	~~MPa-g~~	~~0.023~~	~~0.018~~	~~0.020~~	~~0.016~~	~~0.018~~	~~0.016~~	~~0.025~~	~~0.014~~	~~0.011~~	~~0.011~~			~~0.007~~	~~0.005~~
~~Channel B~~	~~MPa-g~~														
~~Channel C~~	~~MPa-g~~	~~-0.092~~	~~-0.095~~	~~-0.09~~	~~-0.092~~	~~-0.086~~	~~-0.088~~	~~-0.086~~	~~-0.095~~	~~-0.088~~	~~-0.083~~			~~-0.081~~	~~-0.083~~
~~Channel A~~	~~MPa-abs~~	~~0.124~~	~~0.119~~	~~0.121~~	~~0.117~~	~~0.119~~	~~0.117~~	~~0.126~~	~~0.115~~	~~0.112~~	~~0.112~~			~~0.108~~	~~0.106~~
~~Channel B~~	~~MPa-abs~~														
~~Channel C~~	~~MPa-abs~~	~~0.009~~	~~0.006~~	~~0.011~~	~~0.009~~	~~0.015~~	~~0.013~~	~~0.015~~	~~0.006~~	~~0.013~~	~~0.018~~			~~0.020~~	~~0.018~~
Drywell Pressure	MPa abs	0.1071	0.1064	0.1073	0.1066	0.1071	0.1068	0.1055	0.1050	0.1061	0.1062			0.1073	0.1069
Suppression Chamber Pressure	MPa abs	0.1780	0.1775	0.1764	0.1755	0.1755	0.1757	0.1748	0.1748	0.1748	0.1750			0.1754	0.1757
RPV Temperature			Note 6	Note 6	Note 6	Note 6	Note 6	Note 6	Note 6	Note 6	Note 6			Note 6	Note 6
Feedwater Nozzle Temp	C	75.3	76.7	88.5	88.6	92.6	90.2	90.8	92.3	90.6	90.6			89.8	90.0
RPV Bottom Head Temp	C	116	115.4	114.2	114.4	116.3	117.8	119.4	117.8	115.9	114.3			114.1	113.7
Containment Atm Monitoring System															
Drywell	Sv/h	27.6	26.8	25.7	25.4	24.5	24.2	24.0	23.2	22.2	21.7			21.5	21.1
Suppression Chamber	Sv/h	1.11	1.09	1.05	1.04	1.00	0.98	0.955	0.935	0.911	0.897			0.871	0.864
Notes:															
NISA News releases started reported gage pressure, then converted readings to absolute pressure. NISA separate parameter tables report gage pressure. Conversion in this table in BLUE.															
Standard atmospheric pressure = 101.325 kPa = 0.101325 Mpa Absolute pressure = 0.101325 MPa + 0.06 MPa = 0.161325 Mpa															

Plant Parameters: **Unit 3**															
Revision 4/13/2011 (8:00 a.m. EST)															
Source: NISA Press Releases	Unit	4/5	4/5	4/6	4/6	4/7	4/7	4/8	4/8	4/9					
		5:40	10:20	0:00	12:30	6:00	12:00	1:30	12:00	0:00					
RPV Injection.....Water Source	Salt/Fresh														
via Feed Water Line	L/min														
via Fire Extinguishing Line	L/min														
via Fire Extinguishing Line	m3/h														
RPV Level															
Fuel Range A	mm	-1850	-1850	-1850	-1800	-1850	-1900	-2000	-1850	-1950					
Fuel Range B	mm	-2250	-2250	-2250	-2200	-2250	-2250	-2250	-2250	2300					
~~RRV Pressure (see note)~~															
See NISA Press Release dated 4/11/2011															
~~Channel A~~	~~MPa g~~	~~0.011~~	~~0.005~~	~~0.009~~	~~0.005~~	~~0.002~~	~~0.000~~	~~-0.002~~	~~-0.004~~	~~-0.002~~					
~~Channel B~~	~~MPa g~~														
~~Channel C~~	~~MPa g~~	~~-0.081~~	~~-0.083~~	~~-0.081~~	~~-0.086~~	~~-0.079~~	~~-0.081~~	~~-0.081~~	~~-0.079~~	~~-0.085~~					
~~Channel A~~	~~MPa abs~~	~~0.112~~	~~0.106~~	~~0.110~~	~~0.106~~	~~0.103~~	~~0.101~~	~~0.099~~	~~0.097~~	~~0.099~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~
~~Channel B~~	~~MPa abs~~														
~~Channel C~~	~~MPa abs~~	~~0.020~~	~~0.018~~	~~0.020~~	~~0.015~~	~~0.022~~	~~0.020~~	~~0.020~~	~~0.022~~	~~0.016~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~
Drywell Pressure	MPa abs	0.1078	0.1071	0.1069	0.1069	0.1075	0.1059	0.1061	0.1052	0.1054					
Suppression Chamber Pressure	MPa abs	0.1733	0.1733	0.1733	0.1731	0.1729	0.1720	0.1726	0.1722	0.1727					
RPV Temperature		Note 6	Note 6	Note 6	Note 6	Note 6	Note 6	Note 6	Note 6	Note 6					
Feedwater Nozzle Temp	C	84.7	84.7	84.4	78.8	83.4	88.3	88.2	88.8	99.2					
RPV Bottom Head Temp	C	113.7	114.1	114.1	115.0	115.8	112.3	110.8	110.7	107.5					
Containment Atm Monitoring System															
Drywell	Sv/h	21.0	20.6	20.9	19.5	19.6	19.3	19.0	18.8	18.6					
Suppression Chamber	Sv/h	0.839	0.833	0.815	0.799	0.777	0.768	0.748	0.738	Note 9					
										Note 9: 0.028 "Under investigation of the change of the situ					
Notes:															
NISA News releases started reported gage pressure, then converted readings to absolute pressure. NISA separate parameter tables report gage pressure. Conversion in this table in BLUE.															
Standard atmospheric pressure = 101.325 kPa = 0.101325 Mpa Absolute pressure = 0.101325 MPa + 0.06 MPa = 0.161325 Mpa															

Plant Parameters: **Unit 3**						
Revision 4/13/2011 (8:00 a.m. EST)						
Source: NISA Press Releases	Unit					
RPV Injection.....Water Source	Salt/Fresh					
via Feed Water Line	L/min					
via Fire Extinguishing Line	L/min					
via Fire Extinguishing Line	m3/h					
RPV Level						
Fuel Range A	mm					
Fuel Range B	mm					
~~RRV Pressure (see note)~~						
See NISA Press Release dated 4/11/2011						
~~Channel A~~	~~MPa g~~					
~~Channel B~~	~~MPa g~~					
~~Channel C~~	~~MPa g~~					
~~Channel A~~	~~MPa abs~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~
~~Channel B~~	~~MPa abs~~					
~~Channel C~~	~~MPa abs~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~	~~0.101~~
Drywell Pressure	MPa abs					
Suppression Chamber Pressure	MPa abs					
RPV Temperature						
Feedwater Nozzle Temp	C					
RPV Bottom Head Temp	C					
Containment Atm Monitoring System						
Drywell	Sv/h					
Suppression Chamber	Sv/h					
		ation"				
Notes:						
NISA News releases started reported gage pressure, then converted readings to absolute pressure. NISA separate parameter tables report gage pressure. Conversion in this table in BLUE.						
Standard atmospheric pressure = 101.325 kPa = 0.101325 Mpa Absolute pressure = 0.101325 MPa + 0.06 MPa = 0.161325 Mpa						

Haskell, Russell

From: Thompson, John NRR
Sent: Wednesday, March 30, 2011 1:42 PM
To: King, Mark; Garmon, David; Thomas, Eric; Thorp, John; Sigmon, Rebecca; Giantelli, Joseph; Fields, Leslie
Cc: NRR_DIRS_IOEB Distribution
Subject: RE: Japan Nuclear Incident Explanation Presentation

A bit of trivia:

I don't know who copied who between the DOE slides and Dr Braun of Areva, but there is mentioned in the Areva slides of a caution where potassium iodide pills can interfere with heart medications (p. 29). I think this is a reference to established protocol for treatment of one of the most common forms of heart arrithymas, otherwise known as atrial fibrillation. One drug used to treat this condition is amiodarone, which is a form of iodine itself. Amiodarone is an antiarrhythmic agent (medication used for irregular heart beat) and also used for various types of tachyarrhythmias (fast forms of irregular heart beat), both ventricular and supraventricular (atrial) arrhythmias.

Amiodarone is also used in advanced cardiac life support emergency protocols for cardiac arrests and other arrhythmias. This drug is complex in that it has significant side effects that are hard to control. Taking additional iodine in the form of potassium iodide pills on top of amiodarone causes significant complications for patients.

From: King, Mark NRR
Sent: Wednesday, March 30, 2011 10:53 AM
To: Garmon, David
Cc: NRR_DIRS_IOEB Distribution
Subject: FW: Japan Nuclear Incident Explanation Presentation

Interesting power point slide presentation that Leslie has shared.
See the attached item.

From: Fields, Leslie NRR
Sent: Wednesday, March 30, 2011 10:50 AM
To: King, Mark
Subject: FW: Japan Nuclear Incident Explanation Presentation

fyi

R

From: dave.krause@dpimc.com [mailto:dave.krause@dpimc.com]
Sent: Friday, March 25, 2011 10:40 AM
To: Fredrichs, Thomas; Pittiglio, Clayton; Simmons, Anneliese
Cc: njc@abzinc.com
Subject: Japan Nuclear Incident Explanation Presentation

Tom, Larry & Anneliese,

Nick Capik of ABZ (a nuclear decommissioning engineering firm) sent me this presentation, which does an excellent job of explaining the construction and the impact of the tsunami for one of the affected nuclear plants in Japan. To view the presentation and advance each page, left click your mouse.

W/326

Dave Krause
Duff & Phelps Investment Management Co.

Munro, John

From: Vick, Lawrence MRR
Sent: Wednesday, March 30, 2011 7:26 AM
To: McHale, John; Kolb, Timothy; Currie, Sean; Muller, David; Allsopp, David; Munro, John
Subject: FW: Good Tech Brief on MOX Fuel
Attachments: ANS-Technical-Brief-MOX-Fukushima.pdf

FYI, interesting discussion on MOX fuel.

Larry

From: Felker, Robert [mailto:felker@ws-corp.com]
Sent: Monday, March 28, 2011 9:32 AM
To: Vick, Lawrence
Subject: Good Tech Brief on MOX Fuel

FYI,

Bob

W/327

AMERICAN NUCLEAR SOCIETY

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Date: March 25, 2011

To: Joe Colvin
ANS President

From: Michaele (Mikey) Brady Raap
Chair, ANS Professional Divisions Committee

Below please find the Technical Brief on The Impact of Mixed Oxide Fuel Use on Accident Consequences at Fukushima Daiichi. This Technical Brief contains factual information prepared by the ANS Special Committee on Nuclear Non-Proliferation.

The Impact of Mixed Oxide Fuel Use on Accident Consequences at Fukushima Daiichi

American Nuclear Society Technical Brief – March 2011

Conclusion

Mixed Oxide (MOX) fuel has been used safely in nuclear power reactors for decades. The presence of a limited number of MOX fuel assemblies at Fukushima Daiichi Unit 3 has not had a significant impact on the ability to cool the reactor or on any radioactive releases from the site due to damage from the earthquake and tsunami.

Summary

At the time of the magnitude 9.0 earthquake, Fukushima Daiichi Unit 3 was operating with 32 mixed oxide (MOX) fuel assemblies and 516 low enriched uranium (LEU) fuel assemblies in its reactor core. In other words, less than 6% of the fuel in the Unit 3 core was MOX fuel. There were no other MOX fuel assemblies (new, in operation or used) at the Fukushima Daiichi plant at the time of the accident.

MOX fuel assemblies were loaded into Fukushima Daiichi Unit 3 for the first time in the fall of 2010. The MOX fuel had been used for less than five months at the time of the accident. Differences in initial fuel composition between MOX and LEU fuel can lead to differences in consequences (prompt fatalities and latent cancers) following a core damage event with releases to the environment.

There are indications that Fukushima Daiichi Unit 3 suffered damage to some of its core. The core damage resulted from a loss of core cooling due to damage to plant systems from the tsunami that followed the earthquake. The damage was not related to the presence of MOX fuel.

There have been no prompt fatalities as a result of radiation exposure from Fukushima Daiichi. Prompt evacuation has minimized radiation exposure to the public, so long-term public health consequences from radiation exposure are expected to be small. Given the small number of MOX fuel assemblies at Fukushima Daiichi Unit 3 at the time of the event, coupled with the short time of irradiation of the MOX fuel, it can be concluded that MOX fuel has had and will have no perceptible impact on any consequences from the event.

Background

It is important to note that while LEU fuel begins its useful life with no plutonium, as it is used in a light water reactor it builds up plutonium as a result of the nuclear reactions in the core. By the end of its useful life an LEU fuel assembly contains about 1% plutonium actually generates more power from plutonium than from uranium. All reactor cores contain plutonium; those cores loaded with some MOX fuel contain more.

Mixed oxide (MOX) fuel is comprised of a blend of uranium oxide and plutonium oxide. MOX fuel is predominantly uranium, with average concentrations of plutonium that range from 3-10%. The presence of plutonium produces modest changes in some physical characteristics of the fuel material such as thermal conductivity. However, MOX fuel and low-enriched uranium (LEU) fuel are fundamentally similar. Moreover, the physical dimensions and structural material of a MOX fuel assembly are essentially identical to that of a LEU fuel assembly. To the naked eye, a MOX fuel assembly and a LEU fuel assembly are identical.

Nuclear power plants have been generating electricity for use by the public since the 1950s, and over those years the industry has compiled an enviable safety record. Today over 400 reactors worldwide generate substantial amounts of emissions-free electricity. Dozens of those reactors currently generate power using a mixture of conventional LEU fuel assemblies and MOX fuel assemblies in their reactor cores. The majority of the fuel loaded into these reactors is LEU (60-70% or more), while the remainder (30-40% or less) is MOX. The use of MOX fuel allows the re-use of plutonium that was recovered during nuclear fuel recycling operations. The fabrication and use of MOX fuel has been carried out safely and efficiently on an industrial scale since the 1970s. Safety authorities in France, Belgium, Germany, Switzerland and Japan have all approved the use of MOX fuel in light water reactors using the same rigorous standards that are applied for the licensing of LEU fuel.

Safety is the cornerstone of nuclear power plant operations. Nuclear power plant operators perform safety analyses to determine how the plants will respond during various "what if" problem scenarios. Some of those scenarios involve extreme conditions coupled with multiple equipment failures that lead to estimates of damage to the fuel in the reactor core. Scenarios with significant damage to the reactor core are referred to as severe accidents, and such accidents can result in the calculated release of radionuclides to the environment. Severe accident consequences are the adverse public health effects – fatalities and latent cancers – that arise from the offsite release of radionuclides from a damaged reactor core.

When uranium or plutonium atoms split (fission), they release a relatively large amount of energy which is converted into heat and eventually electricity. The smaller atoms left behind after fission are referred to as fission products. In addition, some of the uranium and plutonium atoms in nuclear fuel assemblies absorb neutrons without fissioning, becoming even heavier atoms called actinides. Both fission products and actinides are radioactive, posing a health hazard if they are released to the environment. Using MOX fuel alters somewhat the "source term," or mix of radionuclides in the core and available for release following a severe accident. The different source term between MOX fuel and LEU fuel leads to different calculated consequences following a postulated severe accident.

In November 1999 the Department of Energy published the Surplus Plutonium Disposition Environmental Impact Statement which documented, among other things, the consequences of four severe accident scenarios at three different reactors using some MOX fuel derived from weapons grade plutonium. Each reactor accident sequence was analyzed with two different reactor core assumptions: a reference case with all LEU fuel, and a second case with a mixed core of approximately 40% MOX fuel and the remainder LEU fuel. For each case the severe accident was assumed to progress in the same manner. Relative to the reference case with all LEU fuel, the offsite consequences to the public with the mixed MOX-LEU core ranged from 4% lower to 22% higher, depending on the reactor studied and the accident sequence. Most cases resulted in consequence increases of 10% or less. The differences between the consequences relate back to differences in the source term. The mixed MOX-LEU core consequences were generally higher because of the presence of more radioactive actinides in the MOX fuel at the time of the postulated accident. However, the differences were modest compared to the uncertainty associated with the consequence calculations for these extremely low probability events.

The type of plutonium used in MOX fuel can also impact severe accident consequences. The aforementioned analysis assumed weapons grade plutonium. If the calculations had been done for MOX fuel containing plutonium from recycled commercial nuclear fuel, as is the practice in Europe and Asia today, the difference between the all uranium cases and the 40% MOX fuel consequences would have been greater than cited above. This is again due primarily to the presence of more radioactive actinides in used "reactor grade" MOX fuel (with plutonium from recycled reactor fuel) than in used weapons grade MOX fuel (with plutonium from retired nuclear weapons).

Turning to the Fukushima Daiichi reactors in Japan, Unit 3 was using some reactor grade MOX fuel at the time of the March 2011 earthquake. Had it been using a 40% MOX fuel core, one could expect an increase in severe accident consequences on the order of 10% for weapons grade MOX. With a 40% reactor grade MOX core, and applying a bounding factor of four increase relative to weapons grade MOX, the overall increase in severe accident consequences would have been on the order of 40% relative to the all LEU fuel case. However, Unit 3 was loaded with only 32 MOX fuel assemblies during refueling operations in the fall of 2010. There are a total of 548 fuel assemblies in the Unit 3 reactor core, so this represents less than 6% of the total fuel in the core. The MOX fuel had been operating in Unit 3 for less than five months; fuel assemblies are typically used for a total of 3-4 years in reactor cores before being replaced by new fuel and discharged to used fuel pools. Therefore, the MOX fuel would have built up relatively few radioactive fission products and actinides at the time of the earthquake and subsequent damage to the reactor core. With these facts in mind – the low percentage of MOX fuel in the core and the short operation time for the MOX fuel – it is evident that the presence of MOX fuel at Fukushima Daiichi Unit 3 has had no significant impact on the offsite releases of radioactivity following the earthquake and tsunami.

Other than the 32 MOX fuel assemblies in the Unit 3 reactor core, at the time of the earthquake there were no other MOX fuel assemblies (new or used) at the Fukushima Daiichi plant. The problems encountered at Fukushima Daiichi reactors stem from plant damage due to the tsunami that followed the earthquake, not the use of MOX fuel in Unit 3.

It is also important to put the public health consequences from the event in perspective. There have been no prompt fatalities as a result of radiation exposure. Moreover, prompt evacuation has minimized the exposure of the population to radiation. At this point, the consequences of the event are expected to be small. MOX fuel effects, if any, would be a small change to an already small number.

In conclusion, MOX fuel has been used safely in nuclear power reactors for decades. The presence of a limited number of MOX fuel assemblies at Fukushima Daiichi Unit 3 has not had a significant impact on the ability to cool the reactor or on any radioactive releases from the site due to damage from the earthquake and tsunami.

From:	Nakanishi, Tony
To:	"?? ?"
Cc:	Taylor, Robert
Subject:	RE: Radiation dose map
Date:	Thursday, March 31, 2011 4:18:13 AM

NRC

Sato-san,

Going forward, please send the site dose map information to Robert Taylor, as cc'd in this email.

Thank you for all your support.

Tony Nakanishi

-----Original Message-----
From: 佐藤 隆 [mailto:satoh.takashi@tepco.co.jp]
Sent: Thursday, March 31, 2011 3:10 AM
To: Nakanishi, Tony
Subject: Radiation dose map

Dear Tony,

Here is the revised radiation dose map.
Please let me know the person whom I can send this type of information.

Again, thank you very much for your kind support.

Safe trip back to the USA.

Best regards,

Takashi Sato
TEPCO

東京電力株式会社
本店　子力立　業務
　子力企画グループマネージャー
佐藤 隆(Takashi Sato)
〒100-8560 東京都千代田区内幸町1-1-3
TEL:03-6373-4721
FAX:03-3596-8538
E-Mail:satoh.takashi@tepco.co.jp

----- Original Message -----
From: "Nakanishi, Tony" <Tony.Nakanishi@nrc.gov>
To: <bannai-toshihiro@meti.go.jp>; "'?? ?'" <satoh.takashi@tepco.co.jp>
Cc: "nei-hisanori" <nei-hisanori@meti.go.jp>; "Dorman, Dan"
<Dan.Dorman@nrc.gov>; "Monninger, John" <John.Monninger@nrc.gov>; "Foggie, Kirk"
<Kirk.Foggie@nrc.gov>; "Scott, Michael" <Michael.Scott@nrc.gov>
Sent: Sunday, March 27, 2011 9:33 AM
Subject: NRC Meetings for March 27, 2011

> Bannai-sama, Sato-sama,
>
> Please find the attached document with the schedule for NRC meetings
> today.
>

W/328

> Best Regards,
>
> Tony Nakanishi
> USNRC
>
>

Nelson, Robert

From: Nelson, Robert (NRR
Sent: Thursday, March 31, 2011 9:54 AM
To: Giitter, Joseph
Subject: RE: Need Help

The version that I sent you has been approved with the indicated changes.

NELSON

From: Giitter, Joseph (NRR
Sent: Thursday, March 31, 2011 9:25 AM
To: Nelson, Robert; Markley, Michael
Subject: Need Help

To your knowledge did we generate any Q/A s why the U.S recommendation for evacuation that was more conservative than the Japanese government? It's not in the set on the NRR webpage.

W/329

Nelson, Robert

From: Nelson, Robert | NRR
Sent: Thursday, March 31, 2011 8:07 AM
To: Boger, Bruce
Subject: RE: HEADS UP - MISLEADING HOMELAND SECURITY NEWSWIRE ARTICLE
Attachments: image001.jpg

Thanks!

NELSON

From: Boger, Bruce | NRR
Sent: Thursday, March 31, 2011 7:22 AM
To: Nelson, Robert
Subject: FW: HEADS UP - MISLEADING HOMELAND SECURITY NEWSWIRE ARTICLE

Be on the lookout .....

From: Weber, Michael | EDO
Sent: Thursday, March 31, 2011 7:19 AM
To: Brenner, Eliot; Hayden, Elizabeth
Cc: Leeds, Eric; Wilson, George; Sheron, Brian; Gibson, Kathy; Wittick, Brian; Boger, Bruce; LIA06 Hoc; LIA08 Hoc; Andersen, James; Muessle, Mary; Borchardt, Bill
Subject: HEADS UP - MISLEADING HOMELAND SECURITY NEWSWIRE ARTICLE

Good morning, Eliot and Beth. I suggest that we issue a "For the Record" or Blog posting or stronger response to this misleading article that was posted this morning in the Homeland Security Newswire. AP ran a story similar to this earlier this week picking up on Dave Lochbaum's testimony. NRC staff (NRR & RES, led by George Wilson) scrambled on Tuesday to pull together information to rebut this misinformation. However, it appears that the story has legs.

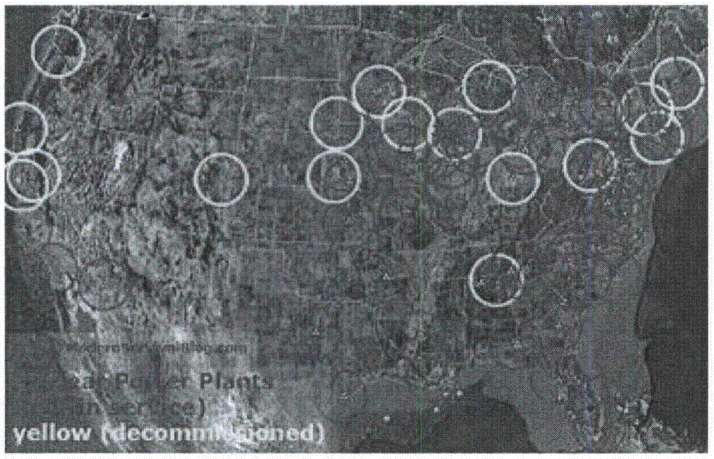
Thanks

U.S. reactors have weaker back-up batteries than Fukushima Daiichi had

Published 31 March 2011

Almost all American nuclear power plants have backup batteries that would last only half as long as those at Japan's troubled Fukushima Daiichi plant did after a tsunami knocked out power there; just eleven of the U.S. 104 plants had eight-hour batteries, and 93 had four-hour batteries; the batteries are not powerful enough to run pumps that direct cooling water, but they can operate valves and can power instruments that give readings of water levels, flow and temperatures

W/330



U.S. reactors, all with underpowered batteries // Source: modernsurvivalblog.com

Almost all American nuclear power plants have backup batteries that would last only half as long as those at Japan's troubled Fukushima Daiichi plant did after a tsunami knocked out power there, an expert testified Tuesday at a Senate committee briefing on nuclear safety.

An industry official, addressing the Senate Energy and Natural Resources Committee, conceded that battery life was "one of the obvious places" that nuclear operators would examine for potential improvements. The *New York Times* reports that David Lochbaum, a nuclear expert at the Union of Concerned Scientists, which generally takes a critical tone toward nuclear reactors, said that just eleven of the nation's 104 plants had eight-hour batteries, and 93 had four-hour batteries. The batteries are not powerful enough to run pumps that direct cooling water, but they can operate valves and can power instruments that give readings of water levels, flow and temperatures.

After the 11 March tsunami disabled the local electricity grid at the Fukushima Daiichi plant and the plant's emergency diesel generators, the failure of the batteries deprived the plant's operators of those crucial measurements.

Addressing the committee with Lochbaum was Anthony R. Pietrangelo, senior vice president and chief nuclear officer of the Nuclear Energy Institute (NEI), the industry trade association. "To get to 48 hours, or 72 hours, pick a number," he said of the backup batteries. "We're going to have to take a hard look and see what resources would be required."

The *Times* notes that after the committee briefing, Pietrangelo said that one alternative to adding long-lasting batteries could be having portable diesel generators available for quick dispatch to a reactor. Some equipment intended to cope with a severe accident or terrorist attack is already centrally stockpiled, he said.

Separately, Representative Edward J. Markey (D-Massachusetts), said Tuesday that he would introduce legislation to require that American plants acquire 72-hour batteries along with fourteen days of fuel for the backup diesel generators.

Fukushima reportedly had seven days of diesel fuel, but the tanks were washed away by the tsunami; most American plants bury their tanks for safety, according to industry officials.

The bill would also impose a moratorium on license renewals and on new plant licenses.

Another expert who spoke before the Senate committee, William Borchardt, the chief staff official of the Nuclear Regulatory Commission (NRC), said that the Fukushima crisis would have no impact on the commission's granting of new licenses or license extensions.

If Japan's experience shows that changes in reactors are needed here, he said, those will be ordered immediately, regardless of the status of the plant's license, license extension or license application.

Another American practice that appears likely to be re-evaluated in view of Japan's crisis is filling pools with spent fuel to the maximum extent possible. Markey and others called for reducing the risk by moving some fuel to dry casks, something that is done now only when the pool is at capacity.

Mike

Michael Weber
Deputy Executive Director for Materials, Waste, Research,
State, Tribal, and Compliance Programs
U.S. Nuclear Regulatory Commission

301-415-1705
Mail Stop O16E15

From: Scott, Michael
To: Nakanishi, Tony; Giessner, John; Taylor, Robert
Subject: RE: Running minutes for 1100 NISA/TEPCO meetings
Date: Thursday, March 31, 2011 8:56:56 PM

You did a GREAT job with this – thanks!

From: Nakanishi, Tony
Sent: Thursday, March 31, 2011 7:45 PM
To: Scott, Michael; Giessner, John; Taylor, Robert
Subject: Running minutes for 1100 NISA/TEPCO meetings

W1337

From: Nakanishi, Tony
To: Scott, Michael; Taylor, Robert; Giessner, John
Date: Thursday, March 31, 2011 7:46:33 PM
Attachments: 1F1 Status Assessment.pptx

In case you need to update this document.

W/332

Assessments of Fukushima Daiichi Units 1-4

Unit 1	NISA	NRC	Comment
RPV	Likely intact	Likely intact	
Containment	Likely intact	Likely intact	
Core	Likely damaged	Likely damaged	
SFP	Likely not damaged	Likely not damaged	NISA assessment based on thermal image and video

Unit 2	NISA	NRC	Comment
RPV	No evidence supporting lost integrity	Likely damaged	
Containment	Likely damaged	Likely damaged	
Core	Likely damaged	Likely damaged	
SFP	Likely not damaged	Likely not damaged	NISA assessment based on thermal image and video

Unit 3	NISA	NRC	Comment
RPV	Likely damaged	Likely damaged	NRC does not understand NISA's basis (300C FW nozzle temp)
Containment	Likely damaged	Likely damaged	NRC does not understand NISA's basis (400C Containment temp)
Core	Likely damaged	Likely damaged	
SFP	Likely not damaged	Indeterminate – insufficient data to reach conclusion	NISA assessment based on thermal image and video

Unit 4	NISA	NRC	Comment
SFP	No evidence supporting fuel damage	Likely damaged – H2 generated from zirconium-steam reaction	NISA assessment based on thermal image and video

From: 佐藤 隆
To: Nakanishi, Tony
Cc: Taylor, Robert
Subject: Re: Radiation dose map
Date: Thursday, March 31, 2011 4:23:21 AM

NRR

Dear Tony,

I will send the radiation dose map to Mr. Taylor from tomorrow.

Thank you.

Takashi Sato

東京電力株式会社
本店　子力･立　業務
　子力企画グループマネージャー
佐藤 隆(Takashi Sato)
〒100-8560 東京都千代田区内幸町1-1-3
TEL:03-6373-4721
FAX:03-3596-8538
E-Mail:satoh.takashi@tepco.co.jp

----- Original Message -----
From: "Nakanishi, Tony" <Tony.Nakanishi@nrc.gov>
To: "'?? ?'" <satoh.takashi@tepco.co.jp>
Cc: "Taylor, Robert" <Robert.Taylor@nrc.gov>
Sent: Thursday, March 31, 2011 5:18 PM
Subject: RE: Radiation dose map

> Sato-san,
>
> Going forward, please send the site dose map information to Robert Taylor,
> as cc'd in this email.
>
> Thank you for all your support.
>
> Tony Nakanishi
>
> -----Original Message-----
> From: 佐藤 隆 [mailto:satoh.takashi@tepco.co.jp]
> Sent: Thursday, March 31, 2011 3:10 AM
> To: Nakanishi, Tony
> Subject: Radiation dose map
>
> Dear Tony,
>
> Here is the revised radiation dose map.
> Please let me know the person whom I can send this type of information.
>
> Again, thank you very much for your kind support.
>
> Safe trip back to the USA.
>
> Best regards,
>

W/333

> Takashi Sato
> TEPCO
> ----------
> 東京電力株式会社
> 本店　子力･立　業務
>　子力企画グループマネージャー
> 佐藤 隆(Takashi Sato)
> 〒100-8560 東京都千代田区内幸町1-1-3
> TEL:03-6373-4721
> FAX:03-3596-8538
> E-Mail:satoh.takashi@tepco.co.jp
> ----------
> ----- Original Message -----
> From: "Nakanishi, Tony" <Tony.Nakanishi@nrc.gov>
> To: <bannai-toshihiro@meti.go.jp>; "'?? ?'" <satoh.takashi@tepco.co.jp>
> Cc: "nei-hisanori" <nei-hisanori@meti.go.jp>; "Dorman, Dan"
> <Dan.Dorman@nrc.gov>; "Monninger, John" <John.Monninger@nrc.gov>; "Foggie,
> Kirk" <Kirk.Foggie@nrc.gov>; "Scott, Michael" <Michael.Scott@nrc.gov>
> Sent: Sunday, March 27, 2011 9:33 AM
> Subject: NRC Meetings for March 27, 2011
>
>
>> Bannai-sama, Sato-sama,
>>
>> Please find the attached document with the schedule for NRC meetings
>> today.
>>
>> Best Regards,
>>
>> Tony Nakanishi
>> USNRC
>>
>>
>

From: Carlson, Donald NRO
To: Taylor, Robert; "Wagner, John C."; Lee, Richard; "Parks, Cecil V."; "Hopper, Calvin Mitchell"; Wood, Kent; VanWert, Christopher
Cc: Scott, Michael; Scott, Harold; Esmaili, Hossein; Aissa, Mourad; Ulses, Anthony; Yarsky, Peter; "Gehin, Jess C."; Nakanishi, Tony; "Marshall, William BJ J."; "Mueller, Don"; Giessner, John
Subject: FW: Seven Daiichi Fuel Pools
Date: Thursday, March 31, 2011 4:24:17 PM

All,

Please see the note below regarding the "Confidential" page markings on pool contents attachment from earlier today.

Don

From: RST01 Hoc
Sent: Thursday, March 31, 2011 3:06 PM
To: Carlson, Donald
Subject: RE: Seven Daiichi Fuel Pools

Those Pages are marked Licensee Confidential which is equivalent to Licensee Proprietary. The information was sent to us to forward to supporting agencies for criticality and heat load analysis.

RST Coordinator

From: Carlson, Donald NRO
Sent: Thursday, March 31, 2011 2:05 PM
To: RST01 Hoc
Subject: RE: Seven Daiichi Fuel Pools

Does anyone know why the pool contents attachment had pages marked Confidential?

From: RST01 Hoc
Sent: Thursday, March 31, 2011 8:01 AM
To: Carlson, Donald
Subject: Seven Daiichi Fuel Pools

Description and Contents

RST Coordinator

W/334

Einziger, Robert

From: Z.Lovasic@iaea.org
Sent: Friday, April 01, 2011 6:47 AM
To: Einziger, Robert
Subject: FW: Urgent; Consultancy in preparation for the Ministerial Meeting
Attachments: TOR Fukushima-1 Spent fuel.doc

Hi Bob,

This is FYI only. Please do not distribute.

Regards

Zvonko

From: LOVASIC, Zvonko
Sent: Friday,01 April 2011 12:42
To: 'vonna.ordaz@nrc.gov'
Cc: DYCK, Gary R.; AWADISSIAN, Emalina
Subject: FW: Urgent; Consultancy in preparation for the Ministerial Meeting

Dear Ms Ordaz,

I am working as a consultant for Mr G. Dyck and Mr T. Varjoranta in the field of spent fuel management.

We are planning a consultancy meeting on a short notice in a preparation for the Ministerial Conference related to the Fukushima Daichi Nuclear Power Station Accident. The consultancy is planned for 4-6 May, 2011.

We would appreciate if you could attend the consultancy and contribute to the topic. Attached is the preliminary Terms of Reference for the consultancy. The intent of the consultancy is to provide directions for investigations related to prevention and mitigation of spent fuel storage accidents.

If you would not be able to attend could you please recommend an expert from the U.S.A that could participate in the consultancy.

This is urgent we would need your answer ASAP as the time is very short.

Best regards

Zvonko Lovasic
Consultant
Nuclear Fuel Cycle and Material Section
IAEA - Nuclear Fuel Cycle and Waste Technology

W/335

intended recipient, please do not read, copy, use or disclose this communication to others. Also please notify the sender by replying to this message and then delete it from your system.

TERMS of REFERENCE

Preparation of the Programme Structure for Ministerial Conference related Fukushima Dai Ichi Nuclear Power Station Accident

Part 3: Engineering and System Analysis of Severe Accidents in Fuel Pools

May 4-6, 2011 at the Agency Headquarters in Vienna/Austria

Background

The massive earthquake that occurred off the coast of Japan on March 11, 2011 was one of the most powerful earthquakes ever recorded. It resulted in a tsunami that caused widespread devastation and loss of life. At the Fukushima Daiichi Nuclear Power Plant, located on the Pacific Coast just west of the earthquake epicenter, this earthquake-tsunami combined event rendered the plant's backup safety systems incapable of performing their design basis function, which was to safely shut down the nuclear reactors and maintain them and spent fuel in a controlled and safe condition.

The Agency is planning to hold a ministerial conference on nuclear safety on 20-24 June 2011 at Vienna, Austria. To prepare the programme structure of the conference, the political and technical aspects will be discussed during consultancy meeting. Also it will discuss the perspective how different countries and agencies have responded to these events and how the Fukushima event will impact the nuclear power industry in worldwide.

Objective

The Agency is organizing four consultant meetings to prepare the programme structure of ministerial conference. The objective of this CM is to consider directions for engineering and analysis of current and new systems that could be used and developed for prevention and mitigation of severe accidents in fuel pools, namely to suggest a programme structure addressing issues such as:

- Taking stock and making synthesis of sever fuel pool accident analysis done and results gained
- Fuel pool severe accidents, Zirconium fires, possibilities of re-criticality, etc.
- Assess the validity of the current design basis
- Source term generation
- Design and operations of spent fuel pool cooling and make-up systems, technologies to effectively mitigate major loss of water inventory
- Mitigation technology and its availability
- Vulnerability studies for different types of reactors (PWRs, HWRs, GCRs, etc.), fuels (incl. MOX) and pools
- Updating analysis for new fuel types, MOX, new dense racks, higher burn-ups, loss of cooling, seismicity etc.
- Codes for all countries to be used for analysis
- Spent fuel storage strategy (wet/dry storage, disposal/reprocessing)
- Recommendations regarding "quick fixes" (e.g. pool locations for newly discharged fuel (heat sinks)
- Containment, covers, new systems, components, materials etc. protective and mitigating structures and components for spent fuel pools

- Disseminate information and knowledge from analysis done and those having analytical experience to less prepared counterparts
- Technological responses to severe accidents
- Robustness of instrumentations in harsh condition
- Spent fuel pool stress tests
- Management systems for planning and implementing the work

Responsible officers

The Agency officer responsible for the whole task is ****NEFW.

Sigmon, Rebecca

From: Sigmon, Rebecca NRR
Sent: Friday, April 01, 2011 3:05 PM
To: Garmon, David
Subject: power availability

Here's where my information on power availability came from (had to go back to refresh my memory):

Dai'ichi – declared an article 10 shortly after the tsunami for a station blackout that said they had lost offsite power during the earthquake and EDGs to the tsunami (relevant press release).

Daini never declared an article 10 related to power, they only declared based on the ECCS injection and presumed RCS leakage that they initially thought had caused the injection. The first mention of power for Daini is in the overall status update at midnight, about 9 hours after the tsunami, which says offsite power is available to all units. Whether it was always available I can't say, but if it wasn't they recovered it within their battery life. I haven't found any mention of their EDG operability anywhere yet, though I think if nothing else it was impacted by the unavailability of the seawater cooling pumps. (relevant press release and the other one)

Rebecca

W/036

Cheok, Michael

From: Leeds, Eric NRR
Sent: Friday, April 01, 2011 12:34 PM
To: Bahadur, Sher; Blount, Tom; Brown, Frederick; Cheok, Michael; Evans, Michele; Galloway, Melanie; Giitter, Joseph; Givvines, Mary; Hiland, Patrick; Holian, Brian; Howe, Allen; Lee, Samson; Lubinski, John; McGinty, Tim; Nelson, Robert; Quay, Theodore; Ruland, William; Skeen, David
Cc: Doane, Margaret; Miller, Charles; Virgilio, Martin; Grobe, Jack; Boger, Bruce; Mamish, Nader; Sheron, Brian; Uhle, Jennifer; Wiggins, Jim; Dean, Bill; Satorius, Mark; McCree, Victor; Howell, Art; Johnson, Michael; Flanders, Scott
Subject: FYI: NEA/CNRA task group on Fukushima Implications
Attachments: CNRA task group_Fukushima.doc

Please see below. NRR plans to place an SES manager on the NEA task force.

Eric J. Leeds, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
301-415-1270

R

From: Diane.JACKSON@oecd.org [mailto:Diane.JACKSON@oecd.org]
Sent: Friday, April 01, 2011 11:40 AM
Subject: NEA/CNRA task group on Fukushima Implications

Sent on behalf of Mike Weightman

Dear CNRA members –

As our Japanese colleagues continue to work tirelessly towards stabilising the Fukushima nuclear power plants, the safety of all nuclear power plants world-wide have come under close scrutiny. Regulatory bodies have been called upon to affirm the safety of its power plants, regardless of type. Earlier this week, the CNRA Chair and Vice-chairs discussed the issue to seek ways to combine efforts internationally for improved effectiveness and efficiency.

The CNRA is establishing a senior-level task group to coordinate the response of CNRA activities, exchange information on national activities, and look at generic implications of the event. The task group will be asked to identify areas that in-depth evaluation would benefit on an international level and can be undertaken by CNRA or CSNI working groups, or by new task groups to address gaps that are not within the scope of an existing working group. The group would be also chartered to identify short-term and long-term activities.

Countries generally with operating nuclear power plants are invited to nominate a senior-level delegate to the group. It would be expected that the group could commence work through the immediate sharing of national activities, and follow-on shortly with a group meeting. Task group delegates should be available for a meeting in Paris in early May. Please send your nominations to Javier.Reig@oecd.org and Diane.Jackson@oecd.org

Additionally, in order for all CNRA members stay informed of the task group and National activities, documents for exchange will be posted on a NEA password protected member website. It will be accessible to CNRA, CSNI, and working group members. If you could send your documents regarding your country's plans for plant reviews and the timelines to Diane Jackson, she will make sure they are posted on the website.

Best regards,
Mike Weightman, CNRA Chair

W/337

30 March 2011
Paris, France

Dear CNRA members –

As our Japanese colleagues continue to work tirelessly towards stabilising the Fukushima nuclear power plants, the safety of all nuclear power plants world-wide have come under close scrutiny. Regulatory bodies have been called upon to affirm the safety of its power plants, regardless of type. Earlier this week, the CNRA Chair and Vice-chairs discussed the issue to seek ways to combine efforts internationally for improved effectiveness and efficiency.

The CNRA is establishing a senior-level task group to coordinate the response of CNRA activities, exchange information on national activities, and look at generic implications of the event. The task group will be asked to identify areas that in-depth evaluation would benefit on an international level and can be undertaken by CNRA or CSNI working groups, or by new task groups to address gaps that are not within the scope of an existing working group. The group would be also chartered to identify short-term and long-term activities.

Countries generally with operating nuclear power plants are invited to nominate a senior-level delegate to the group. It would be expected that the group could commence work through the immediate sharing of national activities, and follow-on shortly with a group meeting. Task group delegates should be available for a meeting in Paris in early May. Please send your nominations to Javier.Reig@oecd.org and Diane.Jackson@oecd.org

Additionally, in order for all CNRA members stay informed of the task group and National activities, documents for exchange will be posted on a NEA password protected member website. It will be accessible to CNRA, CSNI, and working group members. If you could send your documents regarding your country's plans for plant reviews and the timelines to Diane Jackson, she will make sure they are posted on the website.

Best regards,

Mike Weightman, CNRA Chair

Pannier, Stephen

From: Sigmon, Rebecca NRR
Sent: Friday, April 01, 2011 11:59 AM
To: Sigmon, Rebecca
Subject: New OpE COMM: International - Tsunami Causes Complete Loss of Ultimate Heat Sink and Near Miss Incidents at Three Units at Fukushima DAINI Site

This email is being sent to notify recipients of a new posting on the @Operating Experience Community Forum.

Recipients are expected to review the posting for applicability to their areas of regulatory responsibility and consider appropriate actions. However, information contained in the posting is not tasking; therefore, no specific action or written response is required.

Summary

Following the magnitude 9.0 Tohoku-Taiheiyou-Oki Earthquake and ensuing tsunami on March 11, 2011 off the eastern coast of Japan, three of four units at the Fukushima Daini (or Fukushima II) reactor site experienced a complete loss of ultimate heat sink due to a loss of all seawater pumps. After suppression pool temperatures reached the saturation point at each of the three units, containment pressure started to increase. Unlike at the Fukushima Dai'ichi site though, offsite power was never lost. Operators were able to restore sufficient seawater cooling to RHR heat exchangers before core damage occurred. The Japanese regulator (NISA) assigned an International Nuclear and Radiological Event Scale (INES) rating of level 3 to the events at each of these three plants.

Information Security Reminder: OpE COMMs contain preliminary information in the interest of timely internal communication of operating experience. OpE COMMs may be pre-decisional and may contain sensitive/proprietary information. They are not intended for distribution outside the agency

The posting may be reviewed at: **International - Tsunami Causes Complete Loss of Ultimate Heat Sink and Near Miss Incidents at Three Units at Fukushima DAINI Site**

or at

http://nrr10.nrc.gov/forum/forumtopic.cfm?selectedForum=03&forumId=AllComm&topicId=3299

This COMM is being posted to the following groups: ***All Communications, Containment (leakage, degradation, cooling system performance), ECCS, Electrical Power Systems, Emergency Diesel Generators, Emergency Preparedness, Flood Protection & Missiles, Fuels, Natural Phenomena, New Reactors, Pump and Valve Performance, Station Service Water Systems & Ultimate Heat Sink***

To unsubscribe from this distribution list or to subscribe to a different list on the OpE Community, please visit: http://nrr10.nrc.gov/rps/dyn/subscription1.cfm

For more information on the Reactor OpE Program, please visit our Reactor OpE Gateway.

Thank you for reviewing and using Operating Experience.

Rebecca Sigmon
Reactor Systems Engineer
NRR/DIRS/IOEB

W/338

From: Taylor, Robert
To: "?? ?"
Subject: RE: Today"s Plant Day
Date: Sunday, April 03, 2011 7:44:00 PM

Satoh-san,

No apologies necessary.

Thanks.

Rob

-----Original Message-----
From: 佐藤 隆 [mailto:satoh.takashi@tepco.co.jp]
Sent: Sunday, April 03, 2011 7:43 PM
To: Taylor, Robert
Subject: Re: Today's Plant Day

Mr. Taylor,

I am very sorry that we have not sent the plant status data of April 3rd.
My colleague will send you both April 3rd and 4th soon.

I apologize this inconvenience to you.

Takashi Sato
TEPCO

Sigmon, Rebecca

From: Sigmon, Rebecca
Sent: Friday, April 01, 2011 11:59 AM
To: Sigmon, Rebecca
Subject: New OpE COMM: International - Tsunami Causes Complete Loss of Ultimate Heat Sink and Near Miss Incidents at Three Units at Fukushima DAINI Site

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For more information on the Reactor OpE Program, please visit our Reactor OpE Gateway.

Thank you for reviewing and using Operating Experience.

Rebecca Sigmon
Reactor Systems Engineer
NRR/DIRS/IOEB

W/340

Operating Experience Branch
(301) 415-4018
Rebecca.Sigmon@nrc.gov

From: Taylor, Robert
To: Miller, Marie
Subject: RE: simple concept for air sampling
Date: Sunday, April 03, 2011 1:27:00 AM

Let's discuss. I have some thoughts on this.

-----Original Message-----
From: Miller, Marie
Sent: Saturday, April 02, 2011 2:54 AM
To: Taylor, Robert; Scott, Michael; Jackson, Todd
Cc: Dorman, Dan; Monninger, John
Subject: FW: simple concept for air sampling

Attached is the conceptual ideas that DOE had provided to us for our considerations. Given the high reactor conditions, I believe the Helicopter option seems more workable. However, from an RST standpoint, can this type of sample provide useful information. Or, should we try to further develop the giraffe sampling idea and work with TEPCO to get a higher quality sample.

I would like to get back to DOE by Monday.

-----Original Message-----
From: Blumenthal, Daniel [mailto:Daniel.Blumenthal@nnsa.doe.gov]
Sent: Friday, April 01, 2011 6:43 AM
To: 'DARTDOELiaison1'; Miller, Marie
Cc: Van Etten, Donald (NST); Riland, Carson (NST); Honaker, Ricky (NEV); Haley, Billy
Subject: simple concept for air sampling

Marie,

Here is a short description of the concepts we discussed for hanging or flying an air sampler at the plant. Please pass this on to your colleagues. If I need to clarify anything, expact it, shorten it, let me know. Keep Alan and me updated on the status of the idea.

Thanks,
Dan

Bano, Mahmooda

From: Scott, Michael
Sent: Monday, April 04, 2011 4:53 AM
To: RST01 Hoc
Cc: Taylor, Robert; Blamey, Alan; Giessner, John; Bernhard, Rudolph; Bernhard, Rudolph; Salay, Michael; Hay, Michael
Subject: LIST OF CURRENT RST/CONSORTIUM ACTIONS

Dear RST: To minimize confusion, here are the current taskings and status as I understand them, not in priority order. Please provide feedback as to whether you agree on status or have a status where I don't know it.

1. Provide evaluation of TEPCO differing views on merits of flooding vs. status quo, including hydrogen assumptions. Status?

2. Respond to "Elmo question" on how to optimize safety while remaining in feed-and-bleed mode. Due Tuesday Japan time.

3. SFP for unit 4 white paper. Awaiting Rob Taylor feedback/input on rough draft.

4. Input on Japan request regarding what a stable reactor condition (no further energetic events or major rad releases) looks like. Status?

5. Words from consortium (GE) to close loop on why guidance for flooding impact on containment pressure is not practical or value-added.

6. Evaluate the consequences of inadvertently adding the organic fixing agent to the spent fuel pools. Due Tuesday Japan time. Status?

W342

Pannier, Stephen

From: Thomas, Eric 1 NRR
Sent: Monday, April 04, 2011 8:44 AM
To: NRR_DIRS_IOEB Distribution
Subject: FW: FYI - GOOD SITE FOR HIGH RESOLUTION PHOTOS OF FUKUSHIMA

More pix. Similar to what is on the G-Drive but I think a later drone flight.

Eric

From: Nelson, Robert 1 NRR
Sent: Monday, April 04, 2011 7:58 AM
To: Croteau, Rick; Roberts, Darrell; Kennedy, Kriss; Lara, Julio; Guzman, Richard; Lyon, Fred; Markley, Michael; Meighan, Sean; Nguyen, Quynh; Oesterle, Eric; Polickoski, James; Tam, Peter; Thomas, Eric; Broaddus, Doug; Campbell, Stephen; Carlson, Robert; Chernoff, Harold; Kulesa, Gloria; Pascarelli, Robert; Salgado, Nancy; Simms, Sophonia; Wall, Scott
Cc: West, Steven; Shear, Gary; Hay, Michael
Subject: FYI - GOOD SITE FOR HIGH RESOLUTION PHOTOS OF FUKUSHIMA

From: Weber, Michael 1 EDO
Sent: Saturday, April 02, 2011 5:02 PM
To: LIA06 Hoc; LIA08 Hoc
Cc: Brenner, Eliot; Hayden, Elizabeth; Ellmers, Glenn; Nelson, Robert
Subject: FYI - GOOD SITE FOR HIGH RESOLUTION PHOTOS OF FUKUSHIMA

In case you are looking for a good site for high resolution photographs of the damaged Fukushima-Daiichi NPPs, you might find this site handy... http://cryptome.org/eyeball/daiichi-npp/daiichi-photos.htm

W/343

From:	Taylor, Robert
To:	Jaczko, Gregory
Cc:	Borchardt, Bill; Virgilio, Martin; Weber, Michael; Holahan, Vincent; Casto, Chuck; Leeds, Eric
Subject:	NRC"s Daily Assesment of Conditions at Fukushima Daiichi
Date:	Monday, April 04, 2011 2:55:58 AM
Attachments:	NRC Daily Assessment of Daiichi - 4-4-11.pdf

Dear Mr. Chairman,

Attached please find the NRC Japan Team's Daily Assessment of conditions at the Fukushima Daiichi nuclear power plants and spent fuel pools.

There is only one change of note for today. This involves TEPCO's throttling back of injection flow to the Unit 1 reactor. The team's assessment is that this reduces the margin available to ensure adequate cooling flow to the core and is reflected with a down arrow on the attached.

If you have any questions, please don't hesitate to ask.

Best regards,
Rob Taylor
NRC Japan Team

W/344

NRC's Daily Assessment of Conditions at Fukushima Daiichi Nuclear Power Plant

Unit 1		Today	Yesterday
Vessel	Cooling	Challenged	Challenged
		↓	↔
	Integrity	Intact	Intact
		↔	↔
Containment	Flooding	Inc./Needed	Inc./Needed
		↔	↔
	Integrity	Challenged	Challenged
		↔	↓
Spent Fuel Pool	Cooling/Level	Adequate	Adequate
		↔	↔
	Integrity	Intact	Intact
		↔	↔

Unit 2		Today	Yesterday
Vessel	Cooling	Challenged	Challenged
		↔	↔
	Integrity	Failed	Failed
		↔	↔
Containment	Flooding	Inc./Needed	Inc./Needed
		↔	↔
	Integrity	Failed	Failed
		↔	↔
Spent Fuel Pool	Cooling/Level	Adequate	Adequate
		↔	↔
	Integrity	Intact	Intact
		↔	↔

Unit 3		Today	Yesterday
Vessel	Cooling	Adequate	Adequate
		↔	↔
	Integrity	Failed	Failed
		↔	↔
Containment	Flooding	Challenged	Challenged
		↔	↔
	Integrity	Failed	Failed
		↔	↔
Spent Fuel Pool	Cooling/Level	Challenged	Challenged
		↔	↔
	Integrity	Challenged	Challenged
		↔	↔

Unit 4		Today	Yesterday
Spent Fuel Pool	Cooling/Level	Challenged	Challenged
		↔	↑
	Integrity	Failed	Failed
		↔	↔

		Today	Yesterday
Protective Measures	Exposure Risk	Low	Low
		↔	↔

Methodology for Developing the Fukushima Daiichi Daily Assessment Report

PURPOSE: The report is prepared to provide a qualitative high level assessment of daily conditions at Fukushima Daiichi that the U.S. Ambassador can use to assess the safety of American citizens in Japan.

DISCLAIMER: The development of the daily assessment report includes a number of inputs. Some of these are objective, such as plant data provided by TEPCO, while others are subjective, such as engineering insights from the NRC's reactor and protective measures specialists in Japan. It should be recognized that there are many unknowns and uncertainties associated with having a complete understanding of conditions in each of the Daiichi reactors and spent fuel pools. As such, this tool represents the collective judgment of the NRC staff in Japan based on all available data.

For each of the major plant parameters listed below, the NRC staff assesses its status daily and bins it into one of the three categories listed. The staff uses the listed plant information and conditions in making its assessment. The arrows on the report indicate the relative trend in plant conditions from the previous day.

1. Reactor Pressure Vessel
    a. Cooling – Adequate, Challenged, or Inadequate.
        i. Flow or Injection Rate
        ii. Reliability of Injection
        iii. Source of Water
    b. Integrity – Intact, Challenged, or Failed.
        i. Temperature indications
        ii. Pressure readings
2. Primary Containment
    a. Flooding Status – Complete/Not needed, Challenged, or Incomplete/Needed.
        i. Water Level
        ii. Sources
        iii. Injection capacity/rate
    b. Integrity - Intact, Challenged, or Failed.
        i. Pressure readings
        ii. Bypass evaluations
        iii. Temperature indications
3. Spent Fuel Pools
    a. Cooling/Level – Adequate, Challenged, or Inadequate.
        i. Flow or Injection Rate
        ii. Reliability of Injection
        iii. Source of Water
    b. Integrity – Intact, Challenged, or Failed. Due to limited available data, this assessment relies strongly on the NRC team's engineering judgment.
4. Protective Measures – Exposure Risk to American citizens in Japan outside the U.S. government's recommended 50-mile evacuation zone.
    a. Low – 50-mile recommendation remains sufficient
    b. Medium – New information has raised questions regarding the sufficiency of the 50-mile recommendation.
    c. High – 50-mile recommendation is no longer sufficient due to changing plant condition

NRR Nuclear Reactor Regulation

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Information Security Reminder

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Page: **1**

David Garmon-Candelaria *(3/28/2011 2:18:40 pm)*

Revised on 4/3/2011 10:06:23 pm

Tohoku-Taiheiyou-Oki Earthquake and Tsunami (Honshu, Japan)

Summary:

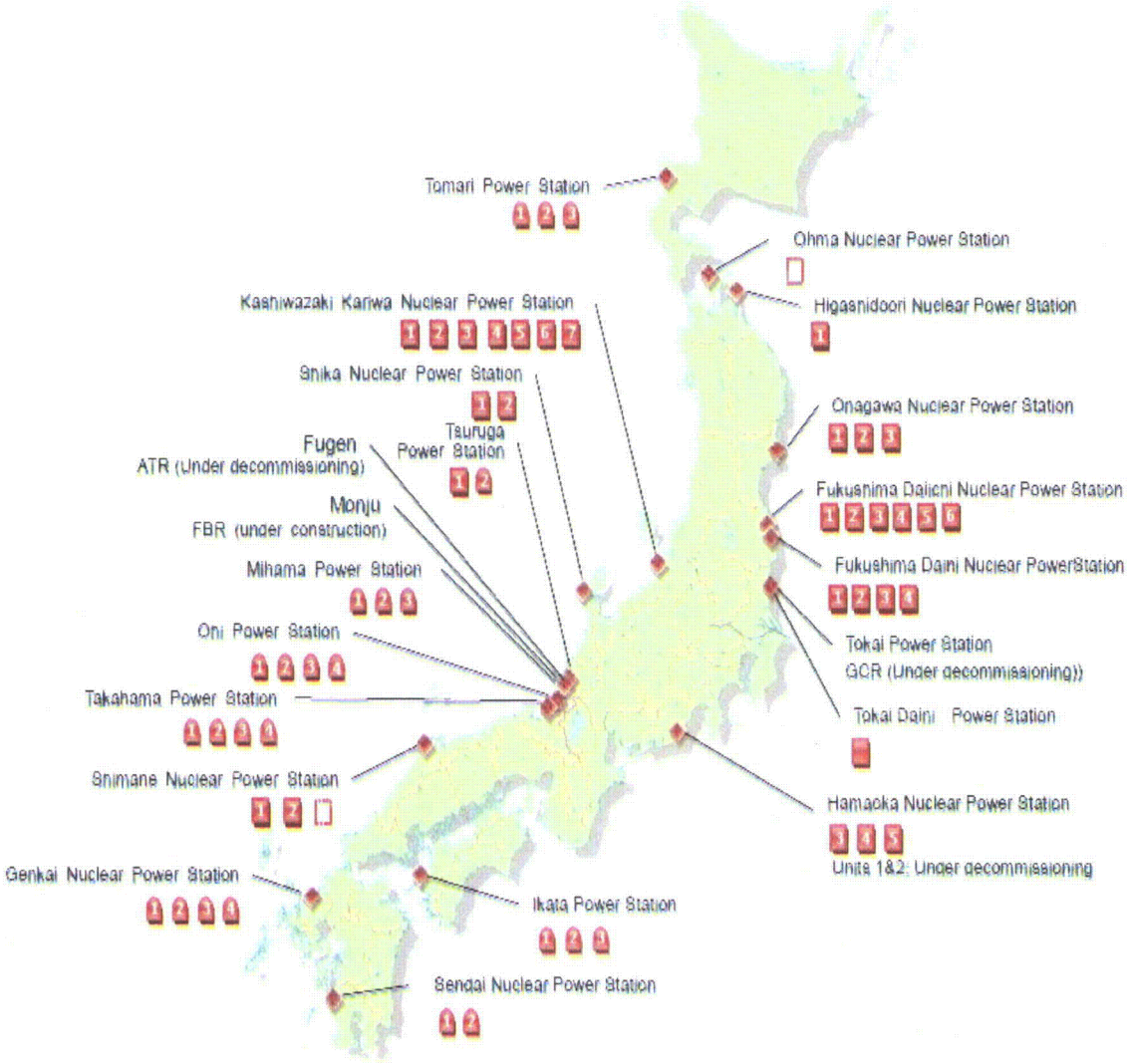
A magnitude 9.0 earthquake struck off the east coast of Honshu, Japan (IAEA Country Nuclear Power Profile) on March 11, 2011. There are four sites that contain multiple reactors (14 total) that have been affected by the earthquake: Onagawa; Fukushima Dai'ichi; Fukushima Daini and Tokai. All plants successfully tripped; however, a varying degree of damage at each site prompted the declaration of several emergency response conditions as defined in Japan's Act on Special Measures Concerning Nuclear Emergency Preparedness. A reactor accident at the Fukushima Dai'ichi site has been preliminarily rated as an International Nuclear Event Scale (INES) Level 5 event and a temporary loss of ultimate heat sink at the Fukushima Daini site has been rated as an INES Level 3 event.

The NRC is coordinating its actions with other Federal agencies as part of the U.S. government response to the events in Japan. The NRC is examining all available information as part of the effort to analyze the event and understand its implications both for Japan and the United States.

It is possible that some of us will be requested by colleagues in another country to provide technical advice and assistance during this emergency. It is essential that all such communications be handled through the NRC Operations Center. Any assistance to a foreign government or entity must be coordinated through the NRC Operations Center and the U.S. Department of State (DOS). If you receive such a request, contact the NRC Operations Officer (**301-816-5100 or via the NRC Operator**) immediately.

If you receive information regarding this or any emergency (foreign or domestic) and you are not certain that the NRC's Incident Response Operations Officer is already aware of that information, you should contact the NRC Operations Officer and provide that information.

W345



Discussion:

Onagawa, a three unit site, experienced a fire in a turbine building but this fire was extinguished; all units at the site are in cold shutdown with stable reactor water level. There were initial reports of elevated radiation readings at the Onagawa plant; however, these were later attributed to the accident at the Fukushima Dai'ichi site.

There has been minimal reporting concerning the **Tokai** site; however, the plant was shutdown after the earthquake.

All reactors at **Fukushima Daini,** a four unit site, were shutdown after the earthquake and are currently in cold shutdown with stable water level.

The **Fukushima Dai'ichi** (plant description) plant operator is responding to a reactor accident that is preliminarily classified as an "Accident with Wider Consequences" in INES (Three Mile Island was rated at an INES Level 5). The situation at the Fukushima

Dai'ichi site remains dynamic; related technical information is still preliminary in nature and subject to change.

The reactors' response to the earthquake was according to design. The ensuing tsunami, however, caused the loss of emergency AC power to six units at the Fukushima Daiichi site, resulting in a station blackout. About two hours after the earthquake, it appears that the injection capability into the reactor vessels of Units 1, 2, and 3 was lost. On Saturday, March 12th, a hydrogen explosion occurred in Unit 1; and on Monday, March 14th, a hydrogen explosion occurred in Unit 3. On Tuesday, March 15th, there were explosions in Unit 2 and in Unit 4 from hydrogen potentially originating from, overheated fuel in a spent fuel pool (SFP). Grey smoke emitted from Unit 3, which is the cause of the site evacuation that was reported on Monday, March 21st.

Fukushima Dai'ichi Units 1, 2, and 3 have experienced some degree of core damage. At present, Units 1-4 appear to be in a stable condition, with freshwater injection being used to keep the reactors cool. Primary containment integrity for Unit 1 is believed to be intact; however, it is believed that the Unit 2 Torus was damaged as a result of one of the reported explosions and the condition of the Unit 3 containment is in question. The reactor buildings for all four units have been damaged to some extent or another (pictures). The exact status of the SFPs that serve Units 1-4 is unknown; however, it is believed that the Unit 3 and 4 SFPs may have been compromised resulting in at least some degree of fuel uncovering.

The plant operator is in various stages of completing the restoration of offsite electrical power to the different units. Switchgear damage and uncertainty in equipment status is impacting the repair activities.

The Nuclear and Industrial Safety Agency (NISA) releases updates that can be accessed here.

Overall Event Timeline

NRC Response:

The NRC's event response priorities are:
1) Continued assessment of radiological conditions, dose projections, and protective action recommendations.
2) Providing technical assistance to the U.S. Ambassador in Japan and the Japanese Government, including assessment of Unit 1 drywell status.
3) Coordination with other U.S. Departments and Agencies, the Institute of Nuclear Power Operations (INPO), Bechtel, General Electric Hitachi (GEH), Tokyo Electric Power Company (TEPCO), and the Japanese military.

The NRC's Headquarters Operations Center in Rockville, MD has been stood up since the beginning of the emergency in Japan and is operating on a 24-hour basis.

U.S. International Agency for International Development (USAID) is the Federal government agency primarily responsible for providing assistance to countries recovering from disasters. A team of NRC experts supporting USAID response efforts is in Japan and is working with the U.S. Ambassador to Japan and his staff. A relief team is being staffed and dispatched. Also, NRC Incident Responders at Headquarters have spoken with the agency's Japanese counterpart and offered the assistance of U.S. technical experts.

Background Information:

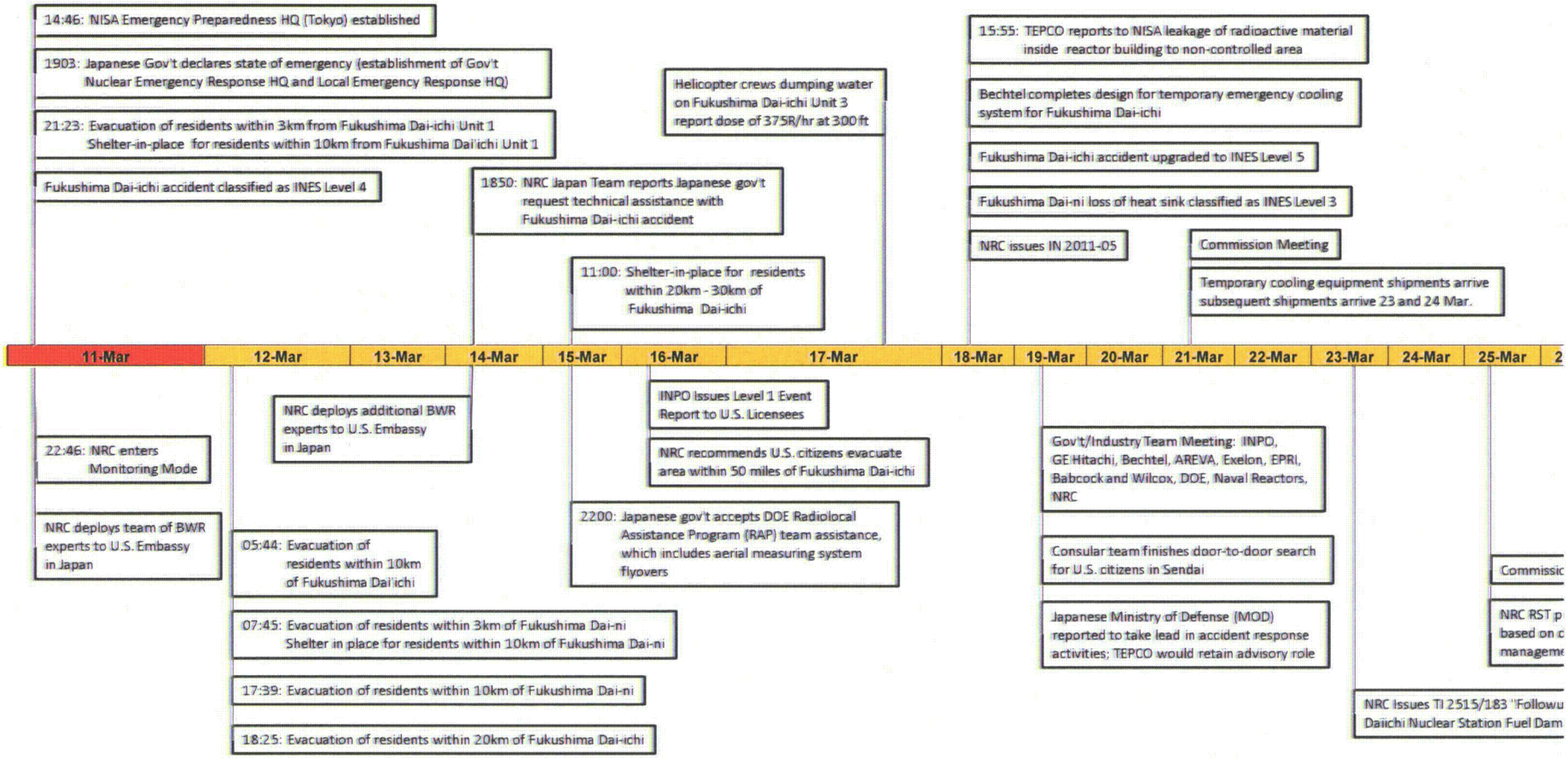
Under Construction. Check back for updates.

This section will be updated to include information concerning the evolution of the Mark I containment design and severe accident considerations.

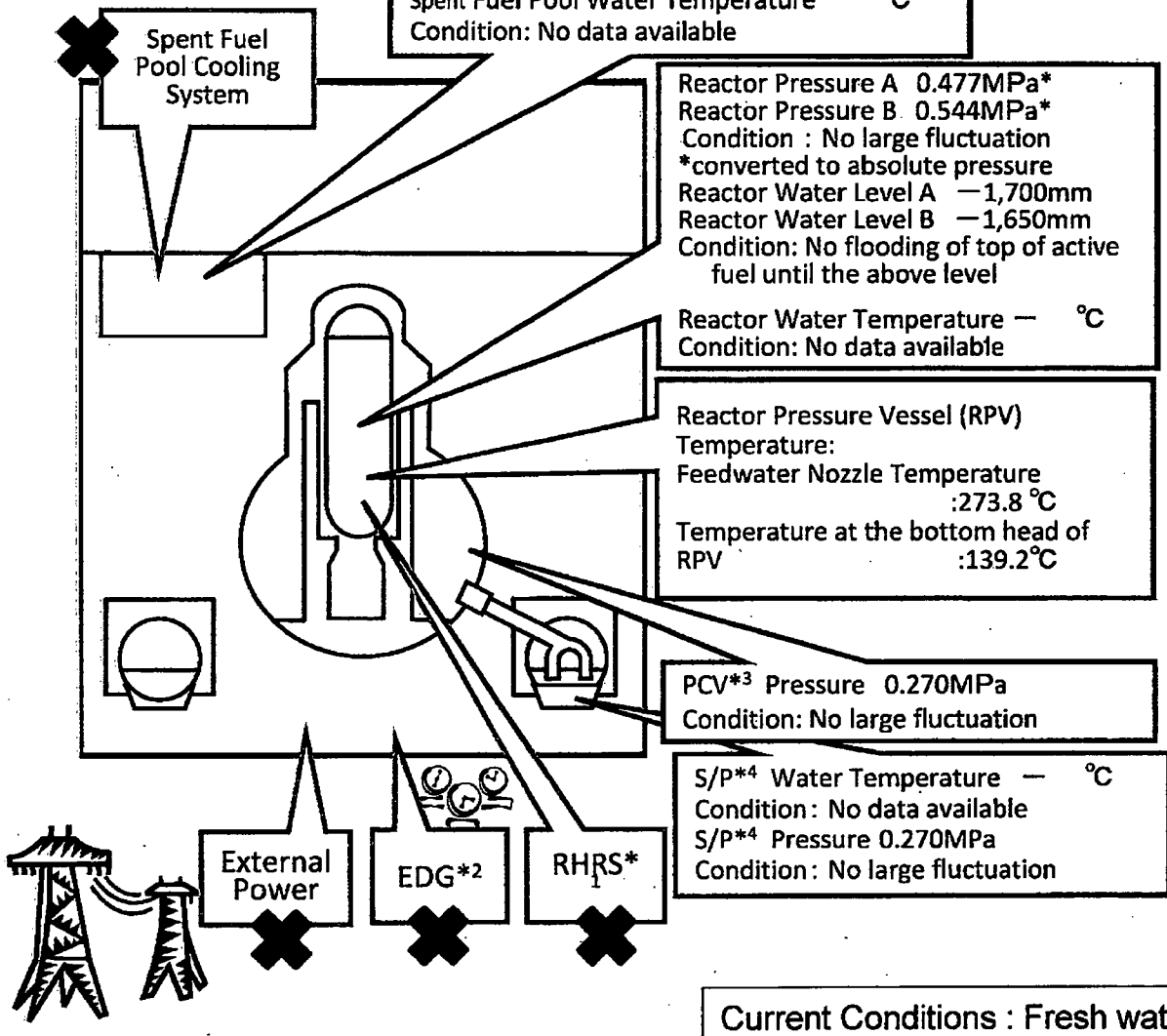
References:

(If a link does not work immediately, try clicking **refresh** in your browser)

"Follow up to Fukushima Dai'ichi Nuclear Station Fuel Damage Event" NRC Inspection Manual Temporary


14:46: NISA Emergency Preparedness HQ (Tokyo) established
1903: Japanese Gov't declares state of emergency (establishment of Gov't Nuclear Emergency Response HQ and Local Emergency Response HQ)
21:23: Evacuation of residents within 3km from Fukushima Dai-ichi Unit 1 Shelter-in-place for residents within 10km from Fukushima Dai'ichi Unit 1
Fukushima Dai-ichi accident classified as INES Level 4
1850: NRC Japan Team reports Japanese gov't request technical assistance with Fukushima Dai-ichi accident
Helicopter crews dumping water on Fukushima Dai-ichi Unit 3 report dose of 375R/hr at 300 ft
11:00: Shelter-in-place for residents within 20km - 30km of Fukushima Dai-ichi
15:55: TEPCO reports to NISA leakage of radioactive material inside reactor building to non-controlled area
Bechtel completes design for temporary emergency cooling system for Fukushima Dai-ichi
Fukushima Dai-ichi accident upgraded to INES Level 5
Fukushima Dai-ni loss of heat sink classified as INES Level 3
NRC issues IN 2011-05
Commission Meeting
Temporary cooling equipment shipments arrive subsequent shipments arrive 23 and 24 Mar.
11-Mar
12-Mar
13-Mar
14-Mar
15-Mar
16-Mar
17-Mar
18-Mar
19-Mar
20-Mar
21-Mar
22-Mar
23-Mar
24-Mar
25-Mar
22:46: NRC enters Monitoring Mode
NRC deploys team of BWR experts to U.S. Embassy in Japan
NRC deploys additional BWR experts to U.S. Embassy in Japan
05:44: Evacuation of residents within 10km of Fukushima Dai'ichi
07:45: Evacuation of residents within 3km of Fukushima Dai-ni Shelter in place for residents within 10km of Fukushima Dai-ni
17:39: Evacuation of residents within 10km of Fukushima Dai-ni
18:25: Evacuation of residents within 20km of Fukushima Dai-ichi
INPO Issues Level 1 Event Report to U.S. Licensees
NRC recommends U.S. citizens evacuate area within 50 miles of Fukushima Dai-ichi
2200: Japanese gov't accepts DOE Radiolocal Assistance Program (RAP) team assistance, which includes aerial measuring system flyovers
Gov't/Industry Team Meeting: INPO, GE Hitachi, Bechtel, AREVA, Exelon, EPRI, Babcock and Wilcox, DOE, Naval Reactors, NRC
Consular team finishes door-to-door search for U.S. citizens in Sendai
Japanese Ministry of Defense (MOD) reported to take lead in accident response activities; TEPCO would retain advisory role
NRC Issues TI 2515/183 "Followu
Daiichi Nuclear Station Fuel Dam
Commissic
NRC RST p
based on c
manageme

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 1
(As of 6:00 March 28th, 2011)



Spent Fuel Pool Water Temperature — ℃
Condition: No data available

Reactor Pressure A 0.477MPa*
Reactor Pressure B 0.544MPa*
Condition : No large fluctuation
*converted to absolute pressure
Reactor Water Level A —1,700mm
Reactor Water Level B —1,650mm
Condition: No flooding of top of active fuel until the above level

Reactor Water Temperature — ℃
Condition: No data available

Reactor Pressure Vessel (RPV) Temperature:
Feedwater Nozzle Temperature :273.8 ℃
Temperature at the bottom head of RPV :139.2℃

PCV*3 Pressure 0.270MPa
Condition: No large fluctuation

S/P*4 Water Temperature — ℃
Condition: No data available
S/P*4 Pressure 0.270MPa
Condition: No large fluctuation

Major Events after the earthquake

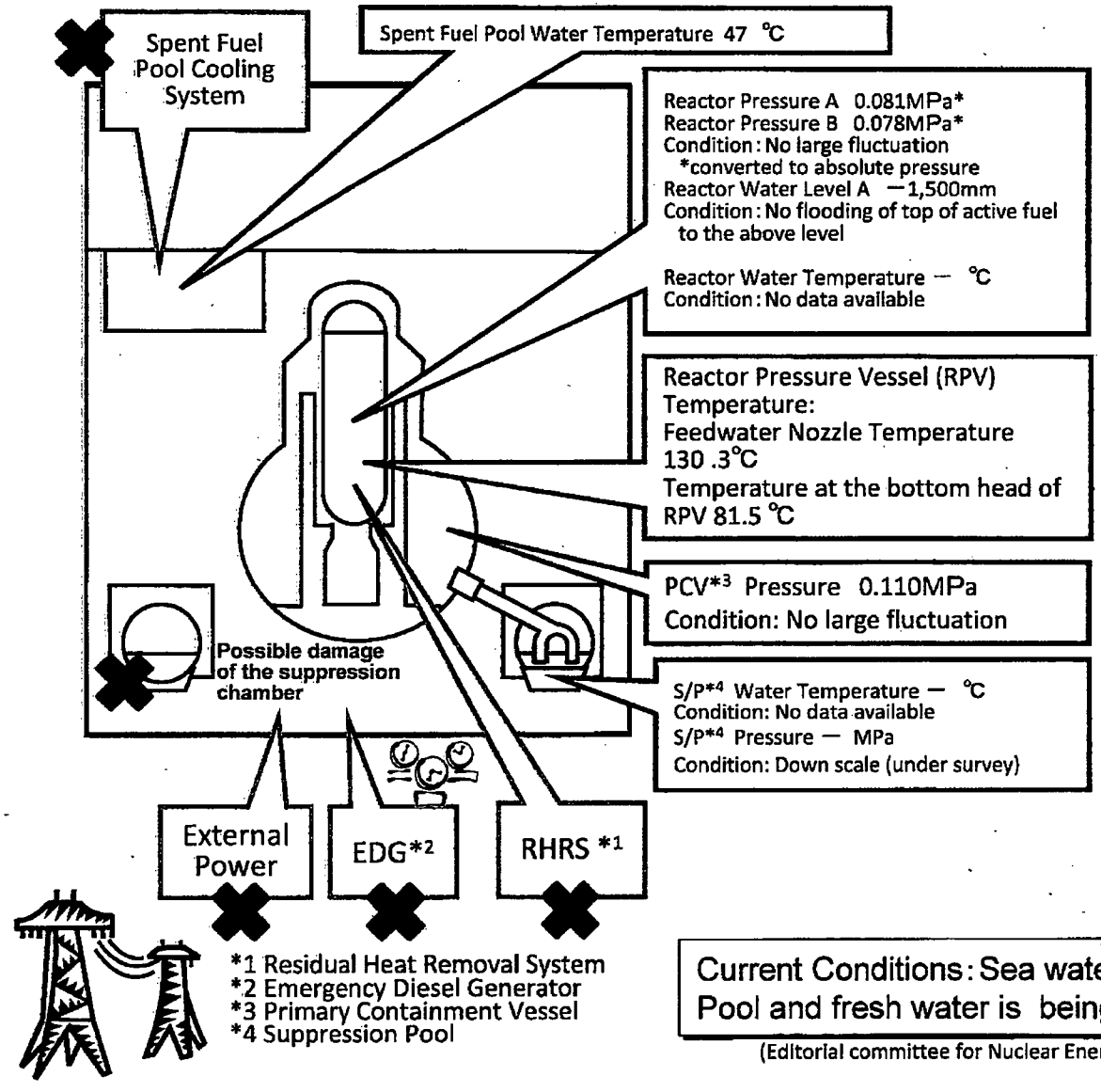
- 11th 14:46 : Under operation, Automatic shutdown by the earthquake
- 11th 15:42 : Report based on the Article 10 (Total loss of A/C power)
- 11th 16:36: Occurrence of the Article 15 event (Inability of water injection of the Emergency Core Cooling System)
- 12th 01:20 Occurrence of the Article 15 event (Unusual rise of the pressure in PCV)
- 12th 10:17 Started to vent
- 12th 15:36 Sound of explosion
- 12th 20:20 Started to inject seawater and borated water to core
- 23rd 02:33 The amount of injected water to the Rector Core was increased utilizing the Feedwater Line in addition to the Fire Extinguish Line. ($2m^3/h \rightarrow 18m^3/h$)
- 23rd 09:00 Switched to the Feedwater Line only.($18m^3/h \rightarrow 11m^3/h$)
- 24th 11:30 Lighting in the Central Control Room was recovered.
- 25th 15:37 Started fresh water injection

*1 Residual Heat Removal System
*2 Emergency Diesel Generator
*3 Primary Containment Vessel
*4 Suppression Pool

Current Conditions : Fresh water is being injected to the core

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 2
(As of 6:00 March 28th, 2011)



*1 Residual Heat Removal System
*2 Emergency Diesel Generator
*3 Primary Containment Vessel
*4 Suppression Pool

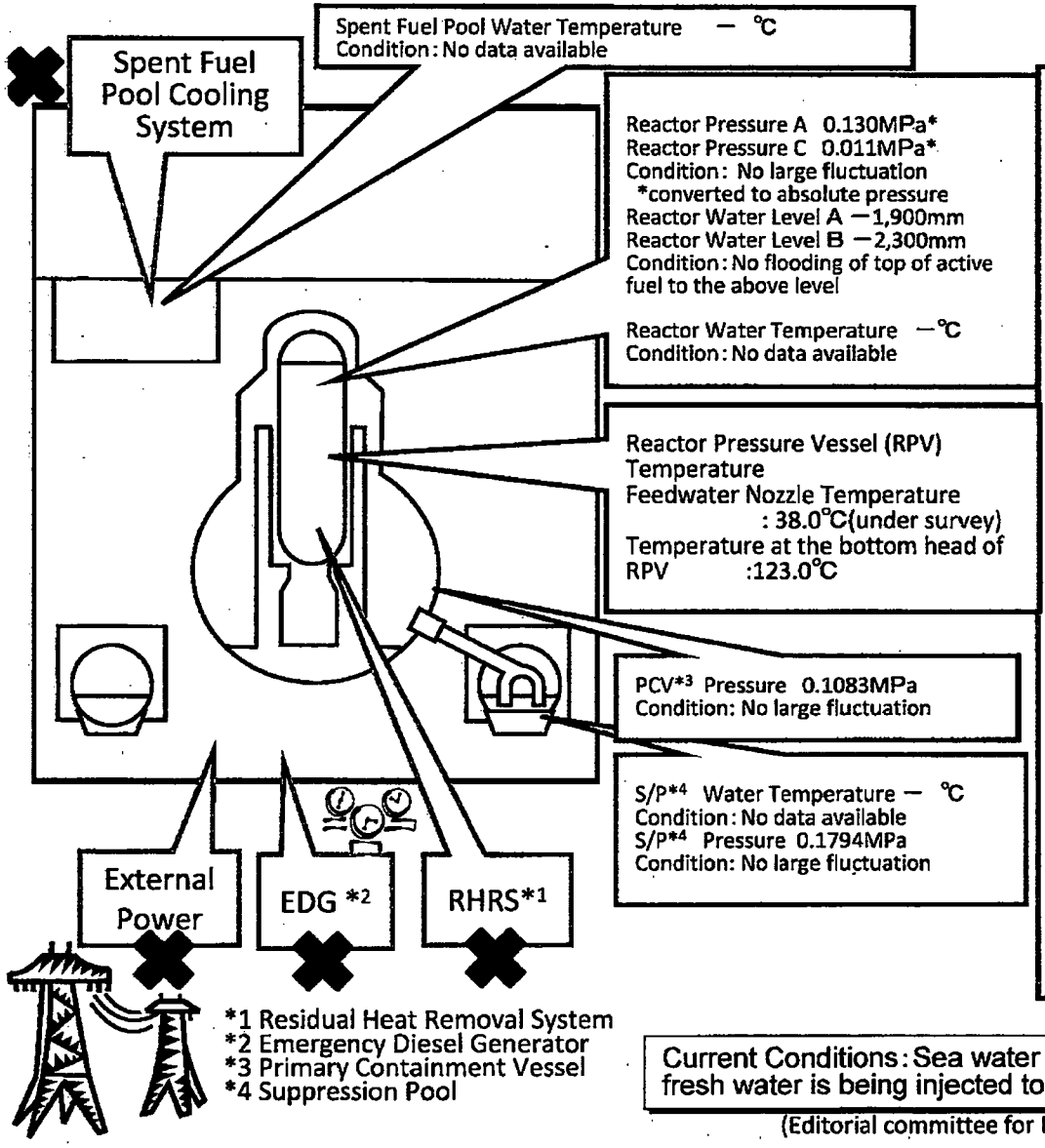
Major Events after the earthquake

- 11th 14:46 Under operation, Automatic shutdown by the earthquake
- 11th 15:42 Report based on the Article 10 (Total loss of A/C power)
- 11th 16:36 Occurrence of the Article 15 event (Inability of water injection of the Emergency Core Cooling System)
- 13th 11:00 Started to vent
- 14th 13:25 Occurrence of the Article 15 event (Loss of reactor cooling functions)
- 14th 16:34 Started to inject water to the Reactor Core
- 14th 22:50 Occurrence of the Article 15 event (Unusual rise of the pressure in PCV)
- 15th 00:02 Started to vent
- 15th 06:10 Sound of explosion
- 15th around 06:20 Possible damage of the suppression chamber
- 20th 15:05～17:20 Approximately 40 ton seawater injection to the Spent Fuel Pool (SFP) via the Fuel Pool Cooling Line (FPC)
- 20th 15:46 Power Center received electricity.
- 21st 18:22 White smoke generated. The smoke died down and almost invisible at 07:11 March 22nd.
- 22nd 16:07 Injection of around 18 tons of seawater to SFP
- 25th 10:30～12:19 Sea water injection to SFP via FPC
- 26th 10:10 Started to inject fresh water to the Reactor Core
- 26th 16:46 Lighting in the Central Control Room was recovered.
- 27th 18:31 Switched to water injection by temporary electric-powered pump

Current Conditions: Sea water is being injected to the Spent Fuel Pool and fresh water is being injecting to the core

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 3
(As of 6:00 March 28th, 2011)



*1 Residual Heat Removal System
*2 Emergency Diesel Generator
*3 Primary Containment Vessel
*4 Suppression Pool

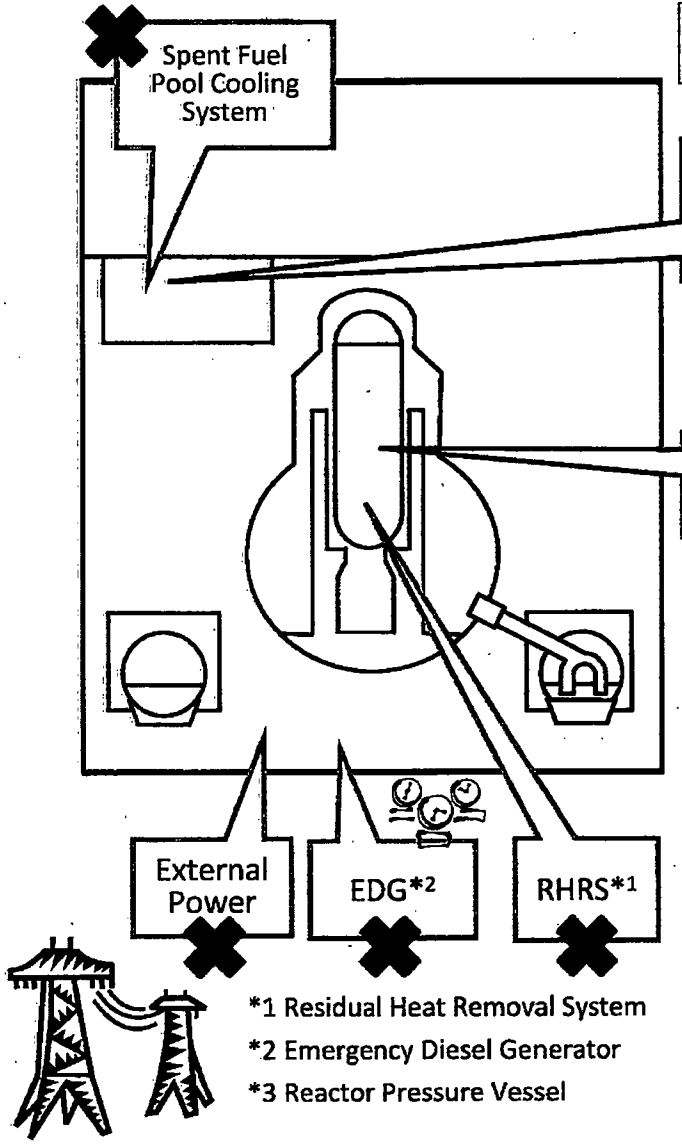
Major Events after the earthquake

11th 14:46 Under operation, Automatic shutdown by the earthquake
11th 15:42 Report based on the Article 10 (Total loss of A/C power)
12th 20:41 Started to vent
13th 05:10 Occurrence of the Article 15 event (Inability of water injection of the Emergency Core Cooling System)
13th 08:41 Started to vent
13th 13:12 Started to inject seawater and borated water to core
14th 05:20 Started to vent
14th 07:44 Occurrence of the Article 15 event (Unusual rise of the pressure in PCV)
14th 11:01 Sound of explosion
16th around 08:30 White smoke generated.
17th 09:48～10:01 Water discharge by the helicopters of Self-Defense Force
17th 19:05～20:09 Water spray from the ground by High pressure water-cannon trucks
18th before 14:00～14:38 Water spray from the ground by 6 fire engines of Self-Defense Force
18th ～14:45 Water spray from the ground by a fire engine of the US Military
19th 00:30 ～01:10 Water spray by Hyper Rescue Unit of Tokyo Fire Department
19th 14:10 ～ 20th 03:40 Water spray by Hyper Rescue Unit of Tokyo Fire Department
20th 11:00 Pressure of PCV rose(320kPa).Afterward fell.
20th 21:36 ～ 21st 03:58 Water spray by Hyper Rescue Unit of Tokyo Fire Department
21st about 15:55 Grayish smoke generated and was confirmed to be died down at 17:55.
22nd 15:10 ～16:00 Water spray by Hyper Rescue Unit of Tokyo Fire Department and Osaka City Fire Bureau.
22nd 22:46 Lighting in the Central Control Room was recovered.
23rd 11:03 ～13:20 Injection of about 35ton of sea water to the Spent Fuel Pool (SFP) via the Fuel Pool Cooling Line (FPC)
23rd around 16:20 Black smoke generated and was confirmed to died down at around 23:30 and 24th 04:50.
24th 05:35～16:05 Approximately 120 ton sea water injection to SFP via FPC
25th 13:28～16:00 Water spray by Kawasaki City Fire Bureau supported by Tokyo Fire Department
25th 18:02 Started fresh water injection to the core
27th 12:34～14:36 Water spray by Concrete Pump Truck

Current Conditions: Sea water is being injected to the Spent Fuel Pool and fresh water is being injected to the core

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 4
(As of 6:00 March 28th, 2011)



In periodic inspection outage

Spent Fuel Pool Water Temperature - ℃
Condition: Indication failure

No fuel is inside the reactor core

*1 Residual Heat Removal System
*2 Emergency Diesel Generator
*3 Reactor Pressure Vessel

Major events after the earthquake

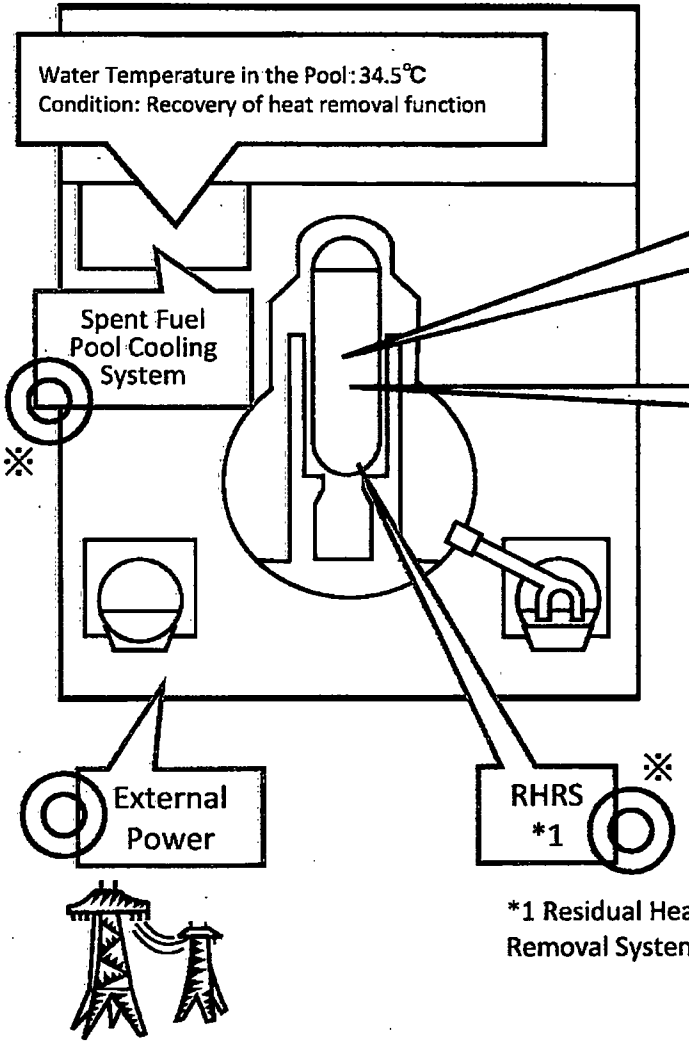
In periodic inspection outage when the earthquake occurred.
14th 04:08 Water temperature in the Spent Fuel Pool (SFP), 84℃
15th 0 6:14 Partial damage of wall in the 4th floor confirmed
15th 09:38 Fire occurred in the 3rd floor. (12:25 extinguished)
16th 05:45 Fire occurred. TEPCO couldn't confirm any fire on the ground. (06:15)
20th 08:21～09:40 Water spray over SFP by Self-Defense Force
20th around 18:30～19:46 Water spray over SFP by Self-Defense Force
21st 06:37～08:41 Water spray over SFP by Self-Defense Force
21st about 15:00 Work for laying cable to Power Center was completed.
22nd 10:35 Power Center received electricity
22nd 17:17～20:32 Water spray by Concrete Pump Truck
23rd 10:00～13:02 Water spray by Concrete Pump Truck
24th 14:36～17:30 Water spray by Concrete Pump Truck
25th 06:05～10:20 Sea water injection to SFP via the Fuel Pool Cooling Line (FPC)
25th 19:05～22:07 Water spray by Concrete Pump Truck
27th 16:55～19:25 Water spray by Concrete Pump Truck

Current Conditions: No fuel is in RPV*3.
Sea water is being injected to the Spent Fuel Pool.

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 5
(As of 6:00 March 28th, 2011)

In periodic inspection outage



*1 Residual Heat Removal System

Reactor Pressure: 0.108MPa*
Reactor Water Level: 1,948mm
Reactor Water Temperature: 57.7℃
Condition: Pressure is under control.
*converted to absolute pressure

Reactor Pressure Vessel Temperature:
Monitoring by Reactor Water Temperature

※Heat removal was carried out alternately with the water in the Reactor Core and in the Spent Fuel Pool.

Current Conditions:

20th 14:30 Cold shutdown

21st 11:36 Receiving electricity from external power supply

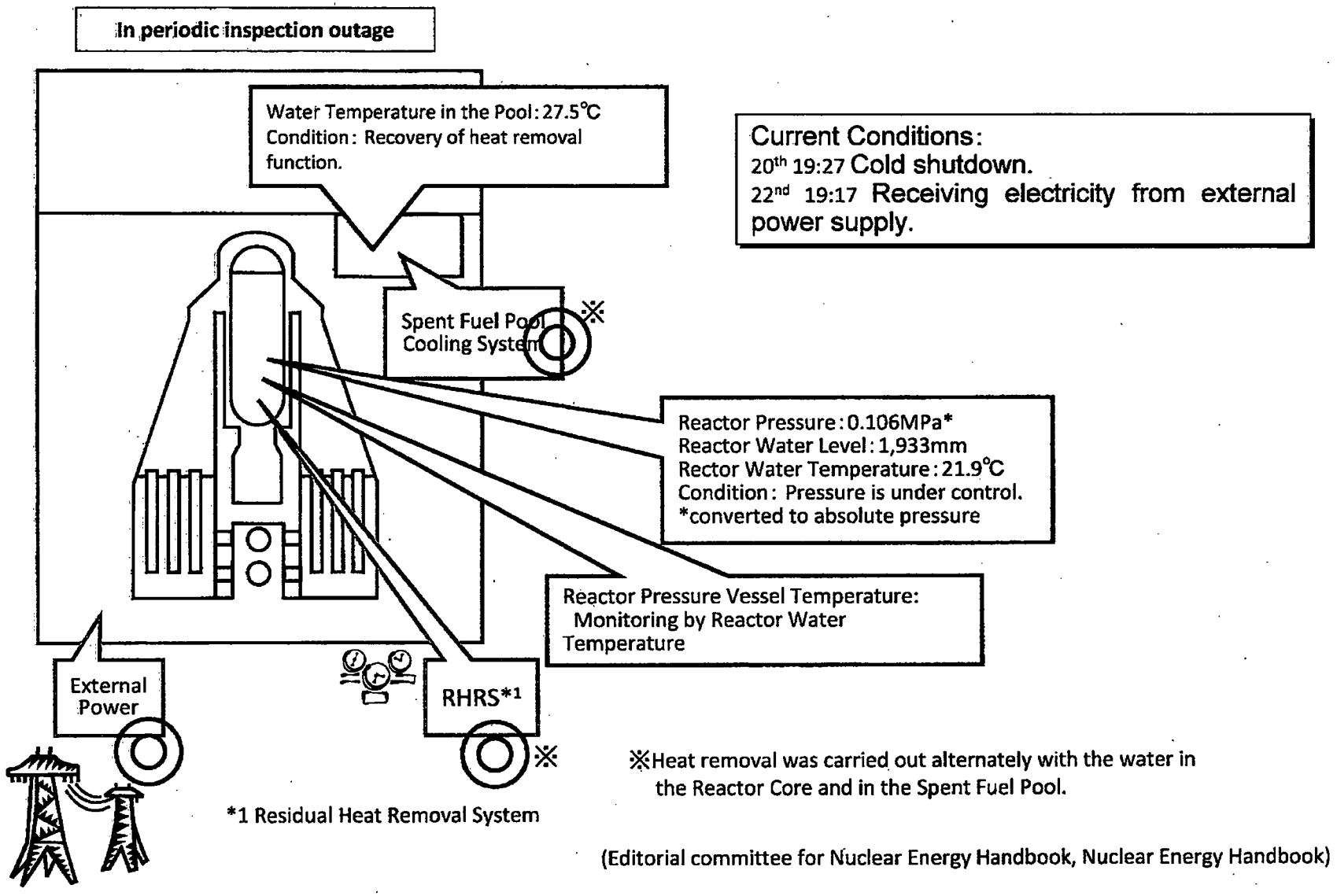
23rd 17:24 Pump for Residual Heat Removal Seawater System (RHRS) was automatically stopped when the power supply was switched from the temporary to the permanent.

24th 16:14 Repair of the RHRS pump was completed.

24th 16:35 Cooling started.

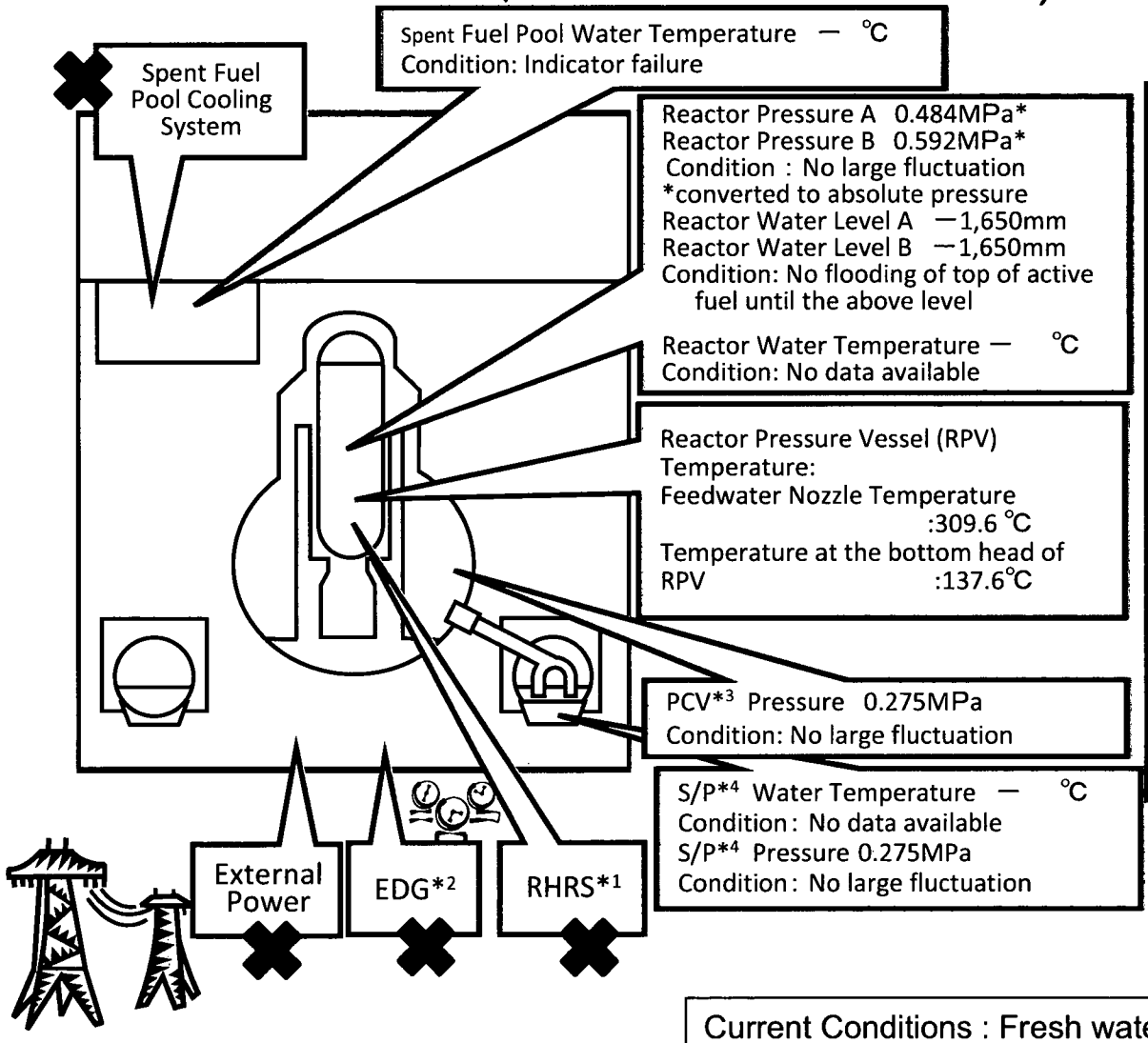
(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 6
(As of 6:00 March 28th, 2011)



(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 1
(As of 12:00 March 29th, 2011)



Major Events after the earthquake

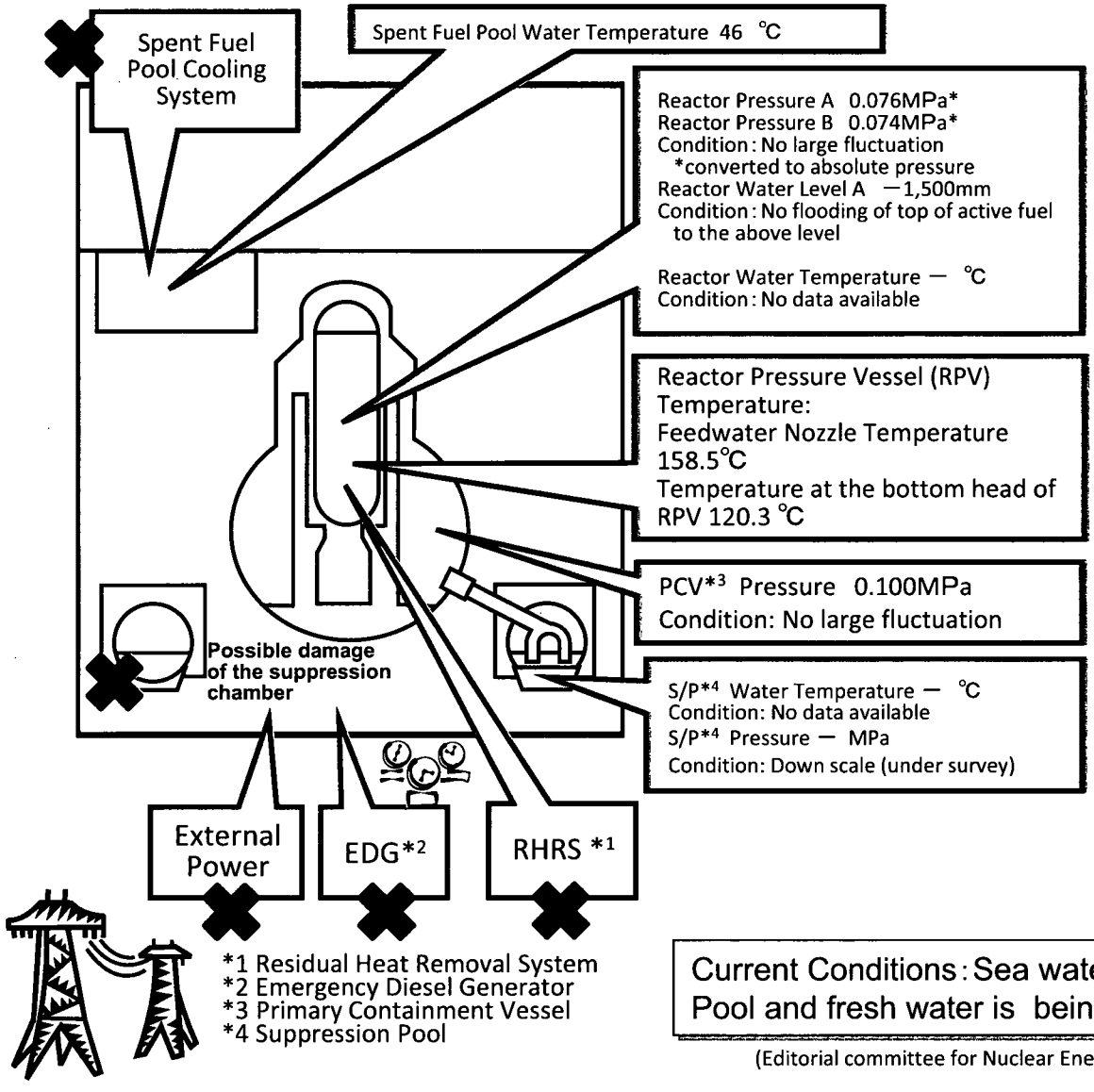
- 11th 14:46 Under operation, Automatic shutdown by the earthquake
- 11th 15:42 Report based on the Article 10 (Total loss of A/C power)
- 11th 16:36 Occurrence of the Article 15 event (Inability of water injection of the Emergency Core Cooling System)
- 12th 01:20 Occurrence of the Article 15 event (Unusual rise of the pressure in PCV)
- 12th 10:17 Started to vent
- 12th 15:36 Sound of explosion
- 12th 20:20 Started to inject seawater and borated water to core
- 23rd 02:33 The amount of injected water to the Rector Core was increased utilizing the Feedwater Line in addition to the Fire Extinguish Line. ($2m^3/h \rightarrow 18m^3/h$)
- 23rd 09:00 Switched to the Feedwater Line only.($18m^3/h \rightarrow 11m^3/h$)
- 24th 11:30 Lighting in the Central Control Room was recovered.
- 25th 15:37 Started fresh water injection
- 29th 08:32 Switched to the water injection to the core using a temporary motor-driven pump.

*1 Residual Heat Removal System
*2 Emergency Diesel Generator
*3 Primary Containment Vessel
*4 Suppression Pool

Current Conditions : Fresh water is being injected to the core

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 2
(As of 12:00 March 29th, 2011)



*1 Residual Heat Removal System
*2 Emergency Diesel Generator
*3 Primary Containment Vessel
*4 Suppression Pool

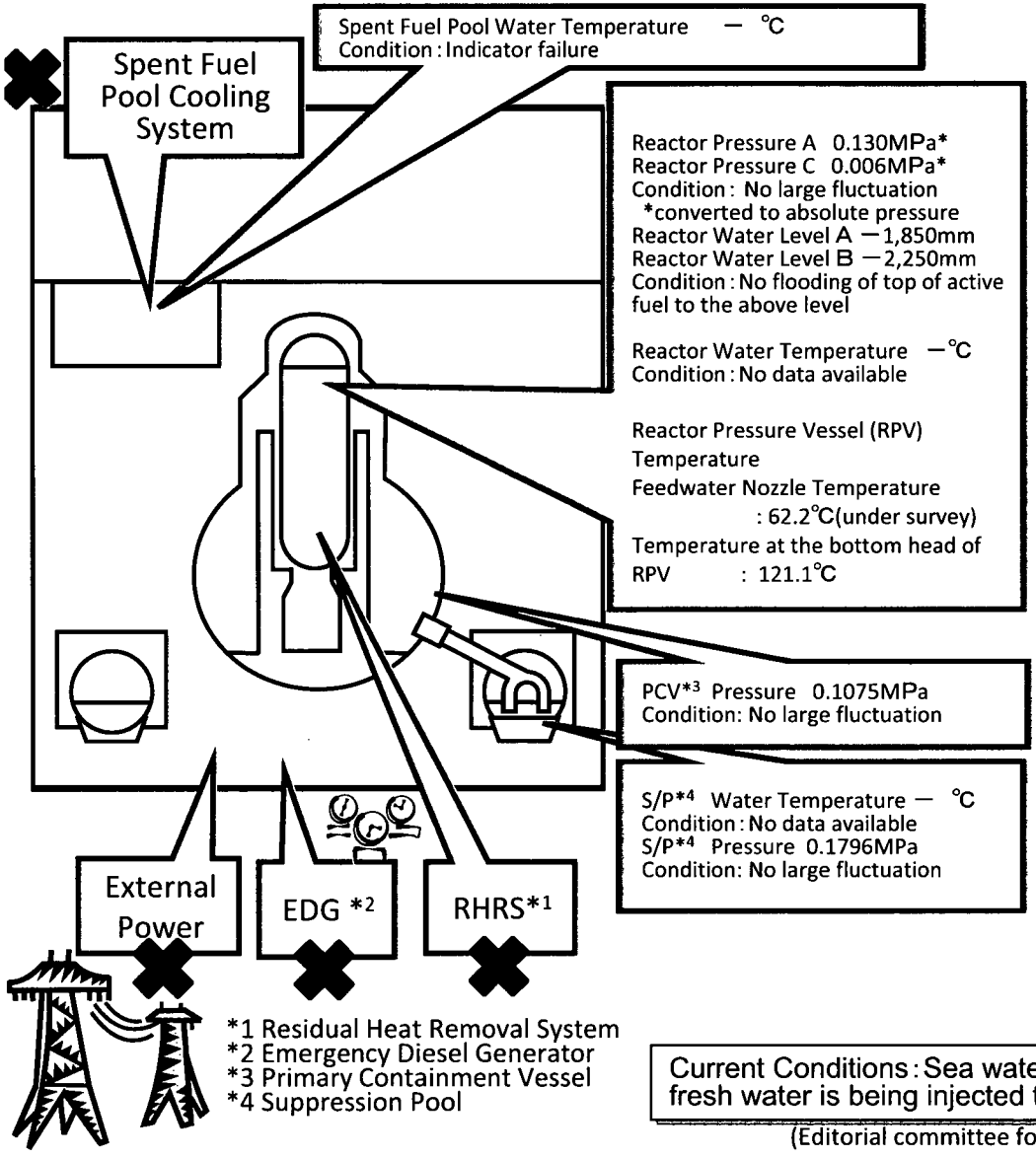
Major Events after the earthquake

- 11th 14:46 Under operation, Automatic shutdown by the earthquake
- 11th 15:42 Report based on the Article 10 (Total loss of A/C power)
- 11th 16:36 Occurrence of the Article 15 event (Inability of water injection of the Emergency Core Cooling System)
- 13th 11:00 Started to vent
- 14th 13:25 Occurrence of the Article 15 event (Loss of reactor cooling functions)
- 14th 16:34 Started to inject water to the Reactor Core
- 14th 22:50 Occurrence of the Article 15 event (Unusual rise of the pressure in PCV)
- 15th 00:02 Started to vent
- 15th 06:10 Sound of explosion
- 15th around 06:20 Possible damage of the suppression chamber
- 20th 15:05～17:20 Approximately 40 ton seawater injection to the Spent Fuel Pool (SFP) via the Fuel Pool Cooling Line (FPC)
- 20th 15:46 Power Center received electricity.
- 21st 18:22 White smoke generated. The smoke died down and almost invisible at 07:11 March 22nd.
- 22nd 16:07 Injection of around 18 tons of seawater to SFP
- 25th 10:30～12:19 Sea water injection to SFP via FPC
- 26th 10:10 Started to inject fresh water to the Reactor Core
- 26th 16:46 Lighting in the Central Control Room was recovered.
- 27th 18:31 Switched to the water injection to the core using a temporary motor-driven pump.

Current Conditions : Sea water is being injected to the Spent Fuel Pool and fresh water is being injected to the core

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 3
(As of 12:00 March 29th, 2011)



*1 Residual Heat Removal System
*2 Emergency Diesel Generator
*3 Primary Containment Vessel
*4 Suppression Pool

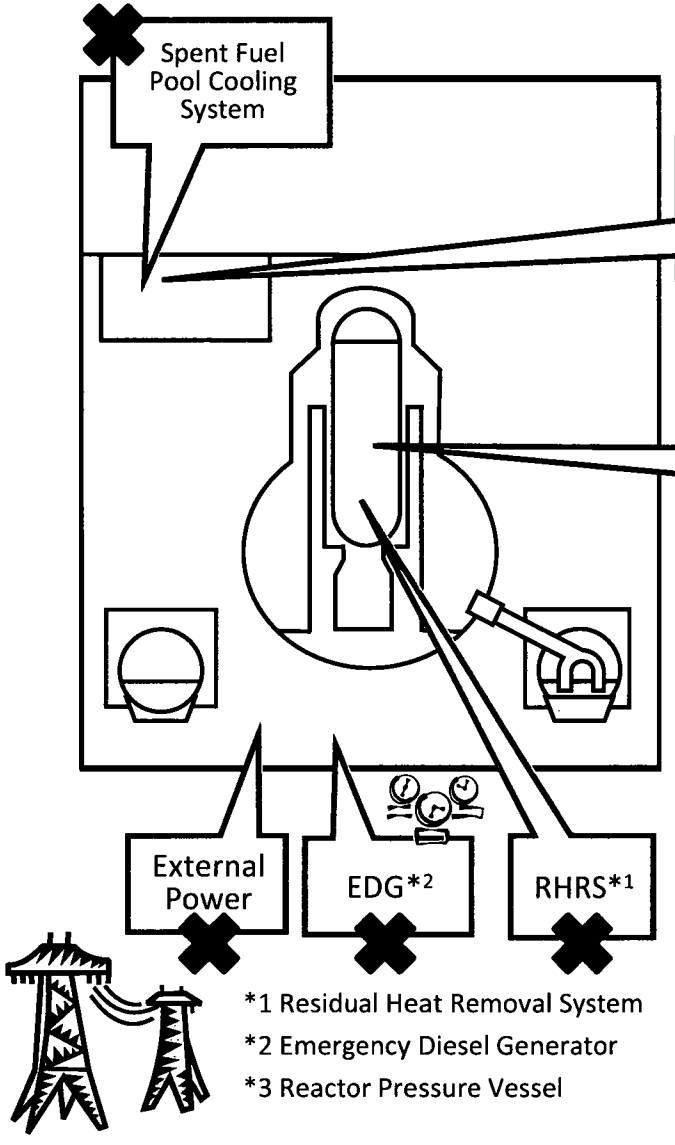
Major Events after the earthquake

- 11th 14:46 Under operation,Automatic shutdown by the earthquake
- 11th 15:42 Report based on the Article 10 (Total loss of A/C power)
- 13th 05:10 Occurrence of the Article 15 event (Inability of water injection of the Emergency Core Cooling System)
- 13th 08:41 Started to vent
- 13th 13:12 Started to inject seawater and borated water to core
- 14th 05:20 Started to vent
- 14th 07:44 Occurrence of the Article 15 event (Unusual rise of the pressure in PCV)
- 14th 11:01 Sound of explosion
- 16th around 08:30 White smoke generated.
- 17th 09:48～10:01 Water discharge by the helicopters of Self-Defense Force
- 17th 19:05～19:15 Water spray from the ground by High pressure water-cannon trucks of Police
- 17th 19:35～20:09 Water spray from the ground by fire engines of Self-Defense Force
- 18th before 14:00～14:38 Water spray from the ground by 6 fire engines of Self-Defense Force
- 18th ～14:45 Water spray from the ground by a fire engine of the US Military
- 19th 00:30 ～01:10 Water spray by Hyper Rescue Unit of Tokyo Fire Department
- 19th 14:10 ～ 20th 03:40 Water spray by Hyper Rescue Unit of Tokyo Fire Department
- 20th 11:00 Pressure of PCV rose(320kPa).Afterward fell.
- 20th 21:36 ～ 21st 03:58 Water spray by Hyper Rescue Unit of Tokyo Fire Department
- 21st about 15:55 Grayish smoke generated and was confirmed to be died down at 17:55.
- 22nd 15:10 ～16:00 Water spray by Hyper Rescue Unit of Tokyo Fire Department and Osaka City Fire Bureau.
- 22nd 22:46 Lighting in the Central Control Room was recovered.
- 23rd 11:03 ～13:20 Injection of about 35ton of sea water to the Spent Fuel Pool (SFP) via the Fuel Pool Cooling Line (FPC)
- 23rd around 16:20 Black smoke generated and was confirmed to died down at around 23:30 and 24th 04:50.
- 24th 05:35～16:05 Approximately 120 ton sea water injection to SFP via FPC
- 25th 13:28～16:00 Water spray by Kawasaki City Fire Bureau supported by Tokyo Fire Department
- 25th 18:02 Started fresh water injection to the core
- 27th 12:34～14:36 Water spray by Concrete Pump Truck
- 28th 20:30 Switched to the water injection to the core using a temporary motor-driven pump.
- 29th 14:17 Started to spray freshwater by Concrete Pump Truck

Current Conditions : Sea water is being injected to the Spent Fuel Pool and fresh water is being injected to the core

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 4
(As of 12:00 March 29th, 2011)



In periodic inspection outage

Spent Fuel Pool Water Temperature - ℃
Condition: Indicator failure

No fuel is inside the reactor core

*1 Residual Heat Removal System
*2 Emergency Diesel Generator
*3 Reactor Pressure Vessel

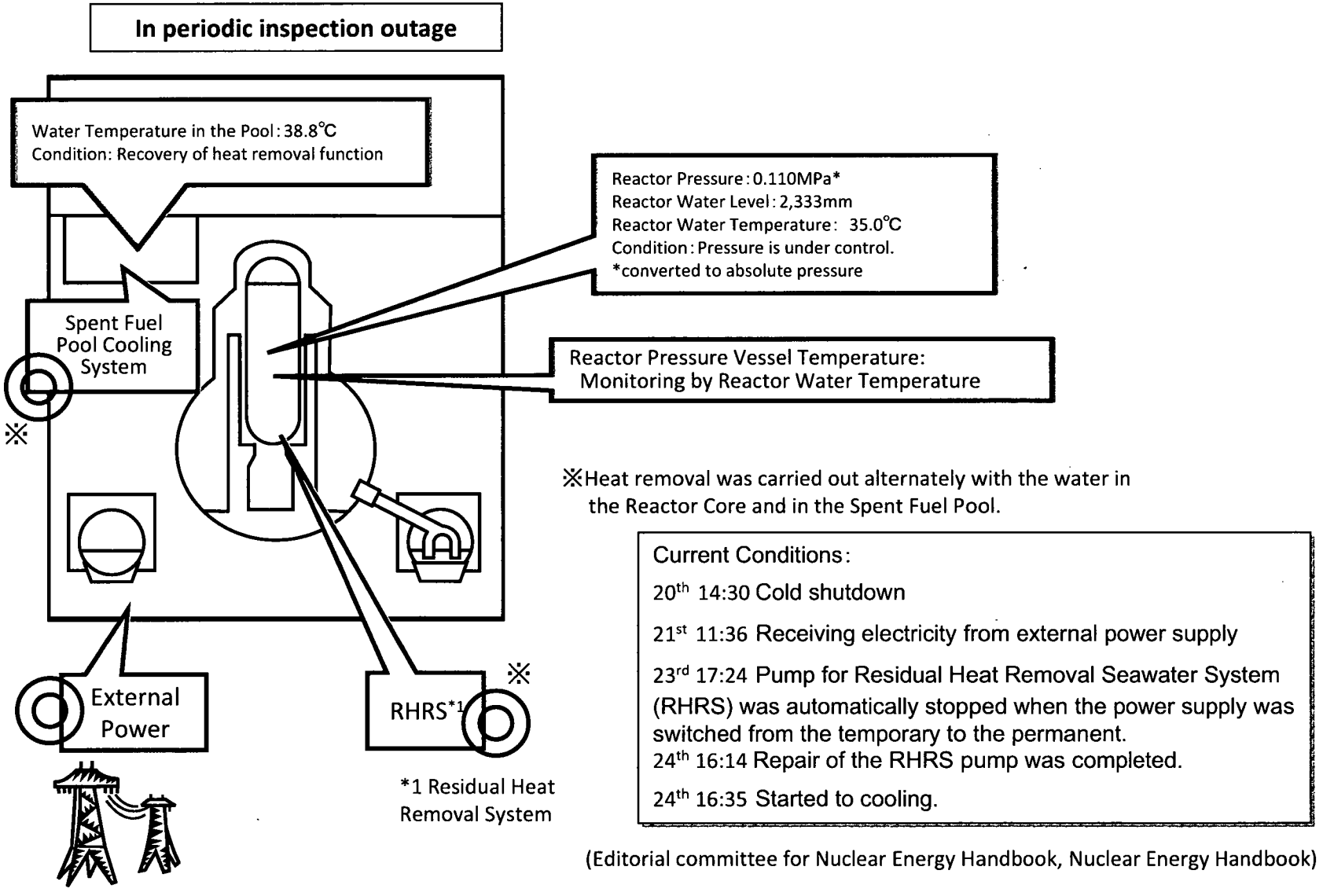
Major events after the earthquake

In periodic inspection outage when the earthquake occurred.
14th 04:08 Water temperature in the Spent Fuel Pool (SFP), 84℃
15th 06:14 Partial damage of wall in the 4th floor confirmed
15th 09:38 Fire occurred in the 3rd floor. (12:25 extinguished)
16th 05:45 Fire occurred. TEPCO couldn't confirm any fire on the ground. (06:15)
20th 08:21～09:40 Water spray over SFP by Self-Defense Force
20th around 18:30～19:46 Water spray over SFP by Self-Defense Force
21st 06:37～08:41 Water spray over SFP by Self-Defense Force
21st about 15:00 Work for laying cable to Power Center was completed.
22nd 10:35 Power Center received electricity
22nd 17:17～20:32 Water spray by Concrete Pump Truck
23rd 10:00～13:02 Water spray by Concrete Pump Truck
24th 14:36～17:30 Water spray by Concrete Pump Truck
25th 06:05～10:20 Sea water injection to SFP via the Fuel Pool Cooling Line (FPC)
25th 19:05～22:07 Water spray by Concrete Pump Truck
27th 16:55～19:25 Water spray by Concrete Pump Truck
29th 11:50 Lighting in the Central Control Room was recovered.

Current Conditions: No fuel is in RPV*3.
Sea water is being injected to the Spent Fuel Pool.

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 5
(As of 12:00 March 29th, 2011)



※Heat removal was carried out alternately with the water in the Reactor Core and in the Spent Fuel Pool.

Current Conditions:

20th 14:30 Cold shutdown

21st 11:36 Receiving electricity from external power supply

23rd 17:24 Pump for Residual Heat Removal Seawater System (RHRS) was automatically stopped when the power supply was switched from the temporary to the permanent.

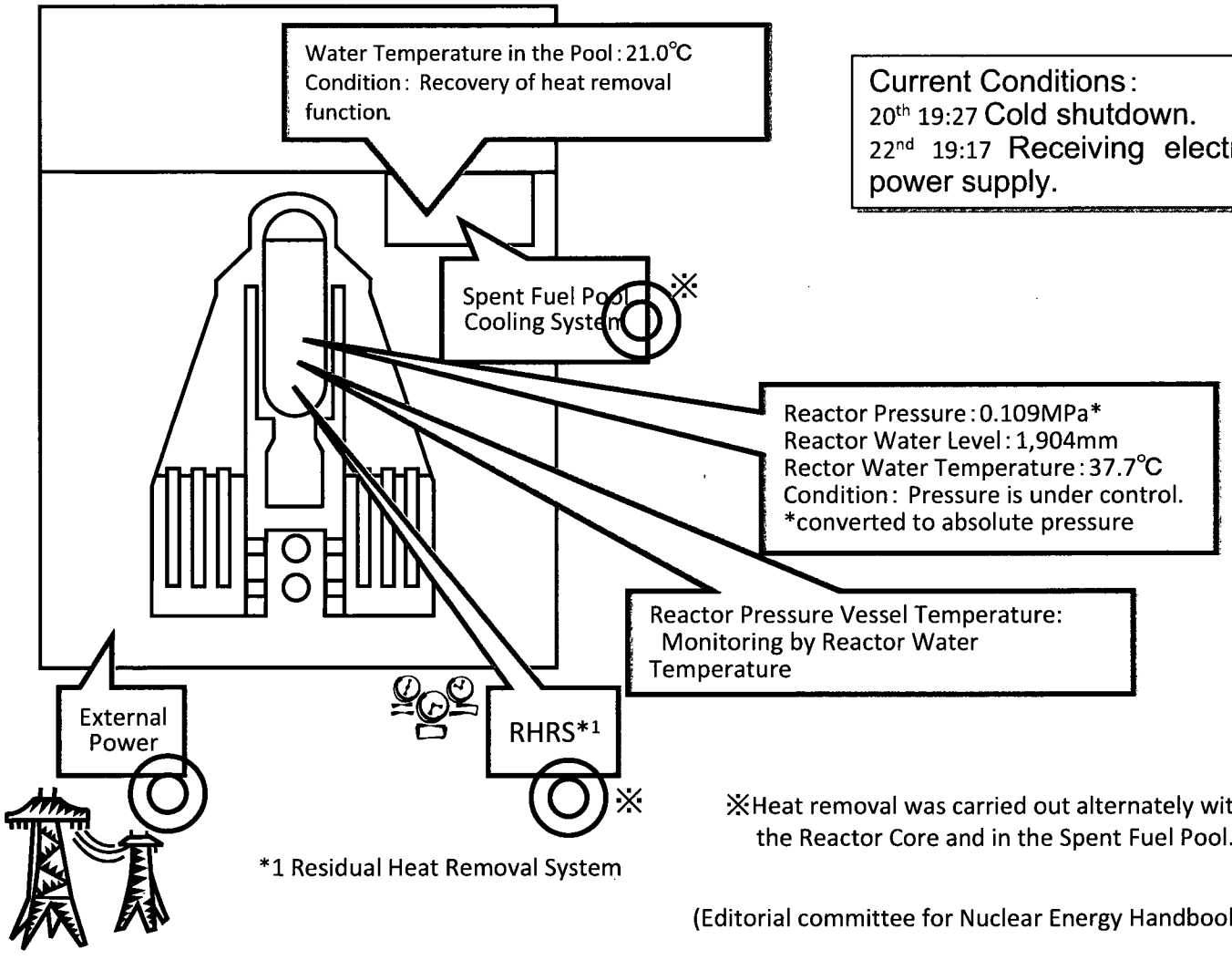
24th 16:14 Repair of the RHRS pump was completed.

24th 16:35 Started to cooling.

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 6
(As of 12:00 March 29th, 2011)

In periodic inspection outage



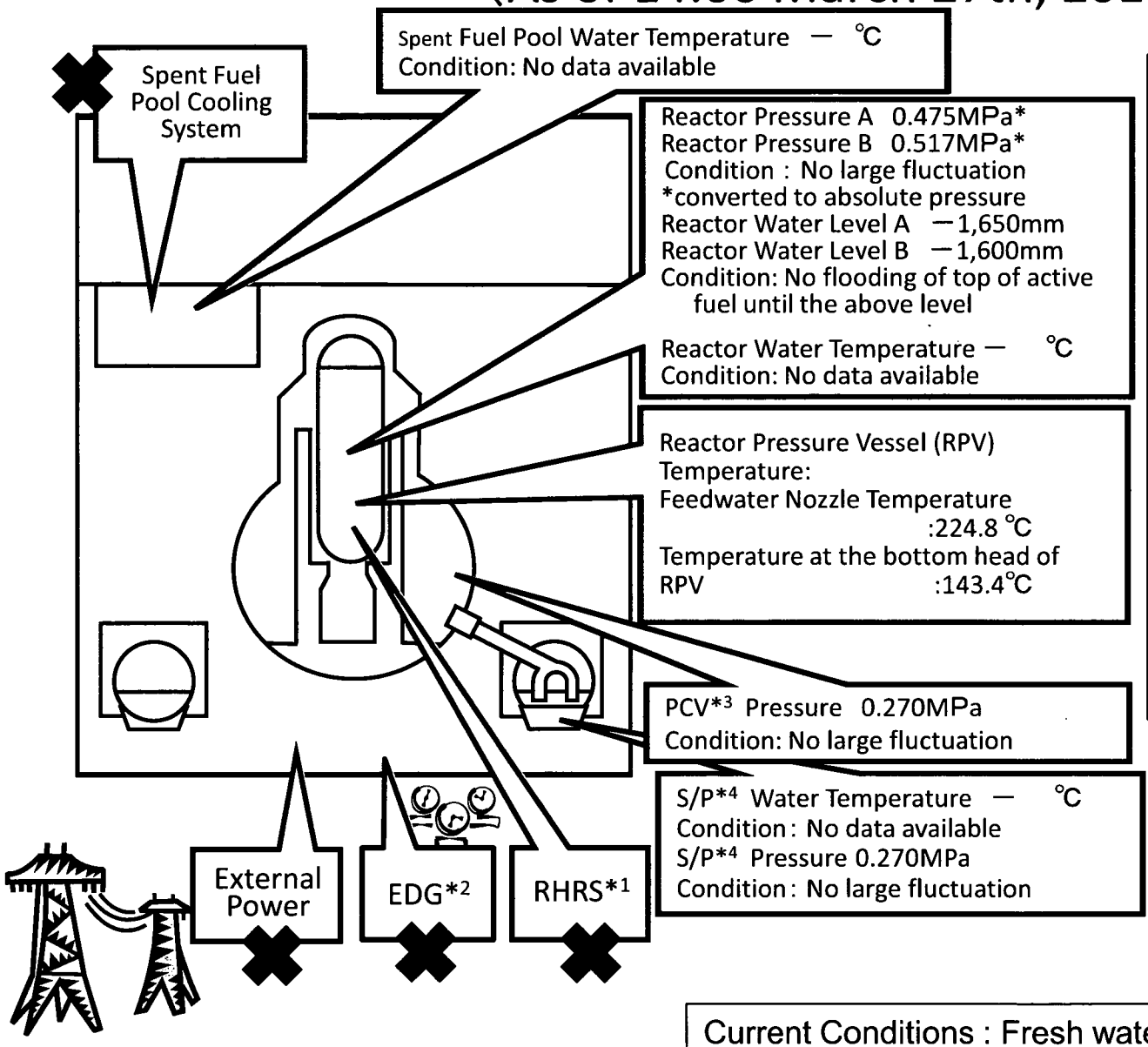
Current Conditions :
20th 19:27 Cold shutdown.
22nd 19:17 Receiving electricity from external power supply.

*1 Residual Heat Removal System

※Heat removal was carried out alternately with the water in the Reactor Core and in the Spent Fuel Pool.

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 1
(As of 14:00 March 27th, 2011)



Spent Fuel Pool Water Temperature — ℃
Condition: No data available

Reactor Pressure A 0.475MPa*
Reactor Pressure B 0.517MPa*
Condition : No large fluctuation
*converted to absolute pressure
Reactor Water Level A —1,650mm
Reactor Water Level B —1,600mm
Condition: No flooding of top of active fuel until the above level

Reactor Water Temperature — ℃
Condition: No data available

Reactor Pressure Vessel (RPV) Temperature:
Feedwater Nozzle Temperature :224.8 ℃
Temperature at the bottom head of RPV :143.4℃

PCV*3 Pressure 0.270MPa
Condition: No large fluctuation

S/P*4 Water Temperature — ℃
Condition : No data available
S/P*4 Pressure 0.270MPa
Condition : No large fluctuation

Major Events after the earthquake

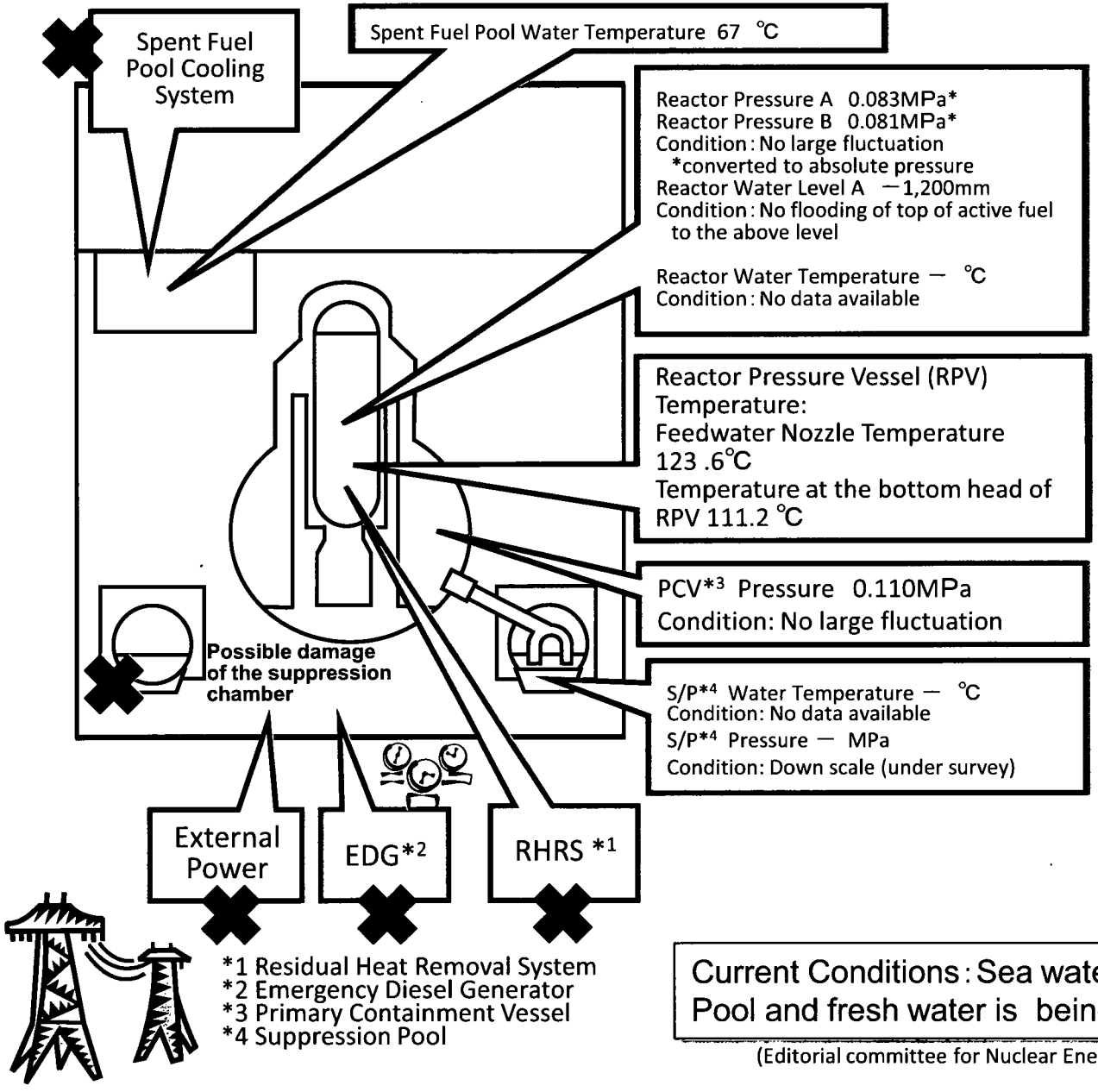
- 11th 14:46 : Under operation, Automatic shutdown by the earthquake
- 11th 15:42 : Report based on the Article 10 (Total loss of A/C power)
- 11th 16:36: Occurrence of the Article 15 event (Inability of water injection of the Emergency Core Cooling System)
- 12th 01:20 Occurrence of the Article 15 event (Unusual rise of the pressure in PCV)
- 12th 10:17 Started to vent
- 12th 15:36 Sound of explosion
- 12th 20:20 Started to inject seawater and borated water to core
- 23rd 02:33 The amount of injected water to the Rector Core was increased utilizing the Feedwater Line in addition to the Fire Extinguish Line. ($2m^3/h \rightarrow 18m^3/h$)
- 23rd 09:00 Switched to the Feedwater Line only.($18m^3/h \rightarrow 11m^3/h$)
- 24th 11:30 Lighting in the Central Control Room was recovered.
- 25th 15:37 Started fresh water injection

*1 Residual Heat Removal System
*2 Emergency Diesel Generator
*3 Primary Containment Vessel
*4 Suppression Pool

Current Conditions : Fresh water is being injected to the core

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 2
(As of 14:00 March 27th, 2011)



*1 Residual Heat Removal System
*2 Emergency Diesel Generator
*3 Primary Containment Vessel
*4 Suppression Pool

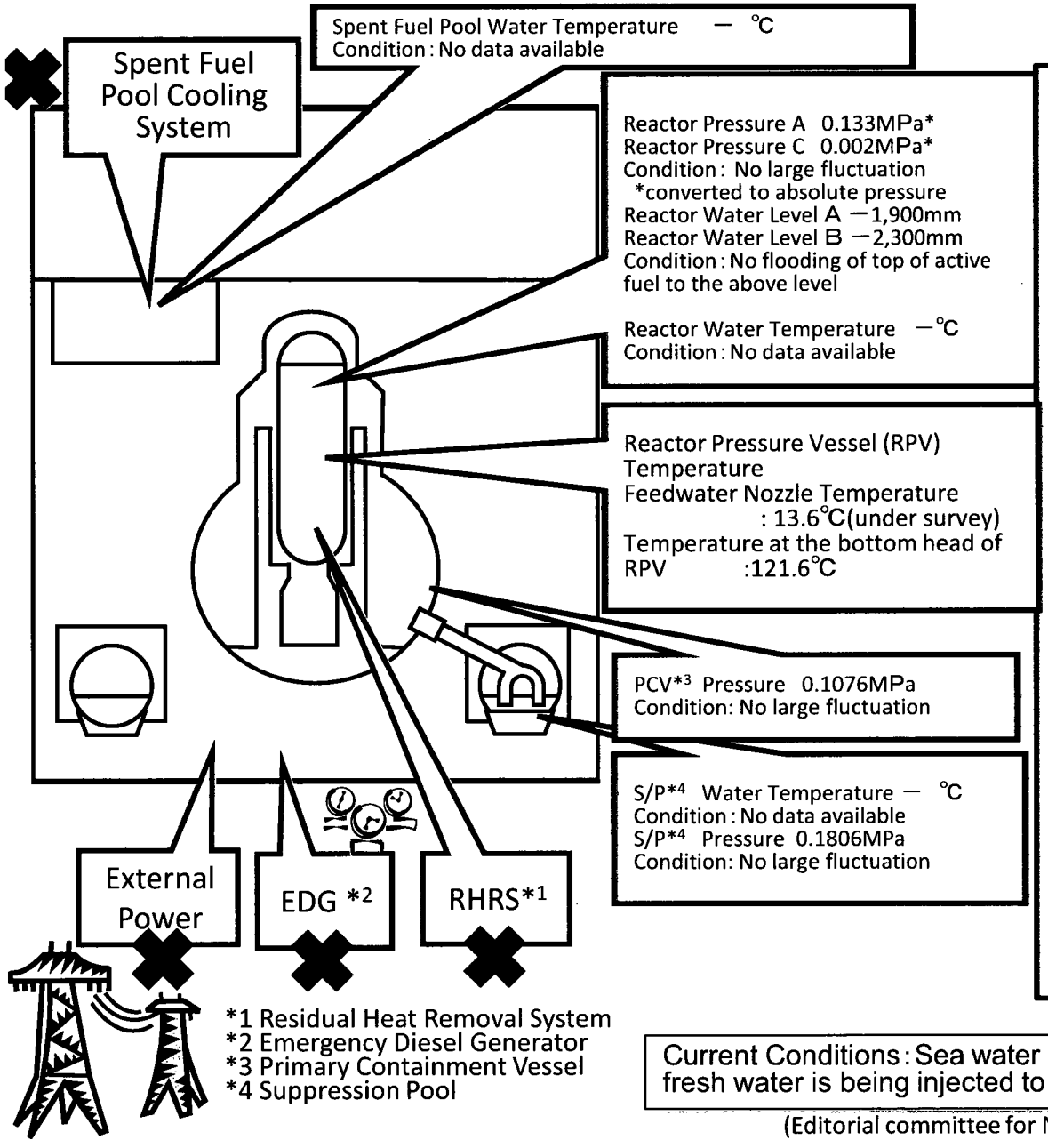
Major Events after the earthquake

- 11th 14:46 Under operation, Automatic shutdown by the earthquake
- 11th 15:42 Report based on the Article 10 (Total loss of A/C power)
- 11th 16:36 Occurrence of the Article 15 event (Inability of water injection of the Emergency Core Cooling System)
- 13th 11:00 Started to vent
- 14th 13:25 Occurrence of the Article 15 event (Loss of reactor cooling functions)
- 14th 16:34 Started to inject water to the Reactor Core
- 14th 22:50 Occurrence of the Article 15 event (Unusual rise of the pressure in PCV)
- 15th 00:02 Started to vent
- 15th 06:10 Sound of explosion
- 15th around 06:20 Possible damage of the suppression chamber
- 20th 15:05～17:20 Approximately 40 ton seawater injection to the Spent Fuel Pool (SFP) via the Fuel Pool Cooling Line (FPC)
- 20th 15:46 Power Center received electricity.
- 21st 18:22 White smoke generated. The smoke died down and almost invisible at 07:11 March 22nd.
- 22nd 16:07 Injection of around 18 tons of seawater to SFP
- 25th 10:30～12:19 Sea water injection to SFP via FPC
- 26th 10:10 Started to inject fresh water to the Reactor Core
- 26th 16:46 Lighting in the Central Control Room was recovered.

Current Conditions : Sea water is being injected to the Spent Fuel Pool and fresh water is being injecting to the core

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 3
(As of 14:00 March 27th, 2011)



*1 Residual Heat Removal System
*2 Emergency Diesel Generator
*3 Primary Containment Vessel
*4 Suppression Pool

Major Events after the earthquake

11th 14:46 Under operation,Automatic shutdown by the earthquake
11th 15:42 Report based on the Article 10 (Total loss of A/C power)
12th 20:41 Started to vent
13th 05:10 Occurrence of the Article 15 event (Inability of water injection of the Emergency Core Cooling System)
13th 08:41 Started to vent
13th 13:12 Started to inject seawater and borated water to core
14th 05:20 Started to vent
14th 07:44 Occurrence of the Article 15 event (Unusual rise of the pressure in PCV)
14th 11:01 Sound of explosion
16th around 08:30 White smoke generated.
17th 09:48～10:01 Water discharge by the helicopters of Self-Defense Force
17th 19:05～20:09 Water spray from the ground by High pressure water-cannon trucks
18th before 14:00～14:38 Water spray from the ground by 6 fire engines of Self-Defense Force
18th ～14:45 Water spray from the ground by a fire engine of the US Military
19th 00:30 ～01:10 Water spray by Hyper Rescue Unit of Tokyo Fire Department
19th 14:10 ～ 20th 03:40 Water spray by Hyper Rescue Unit of Tokyo Fire Department
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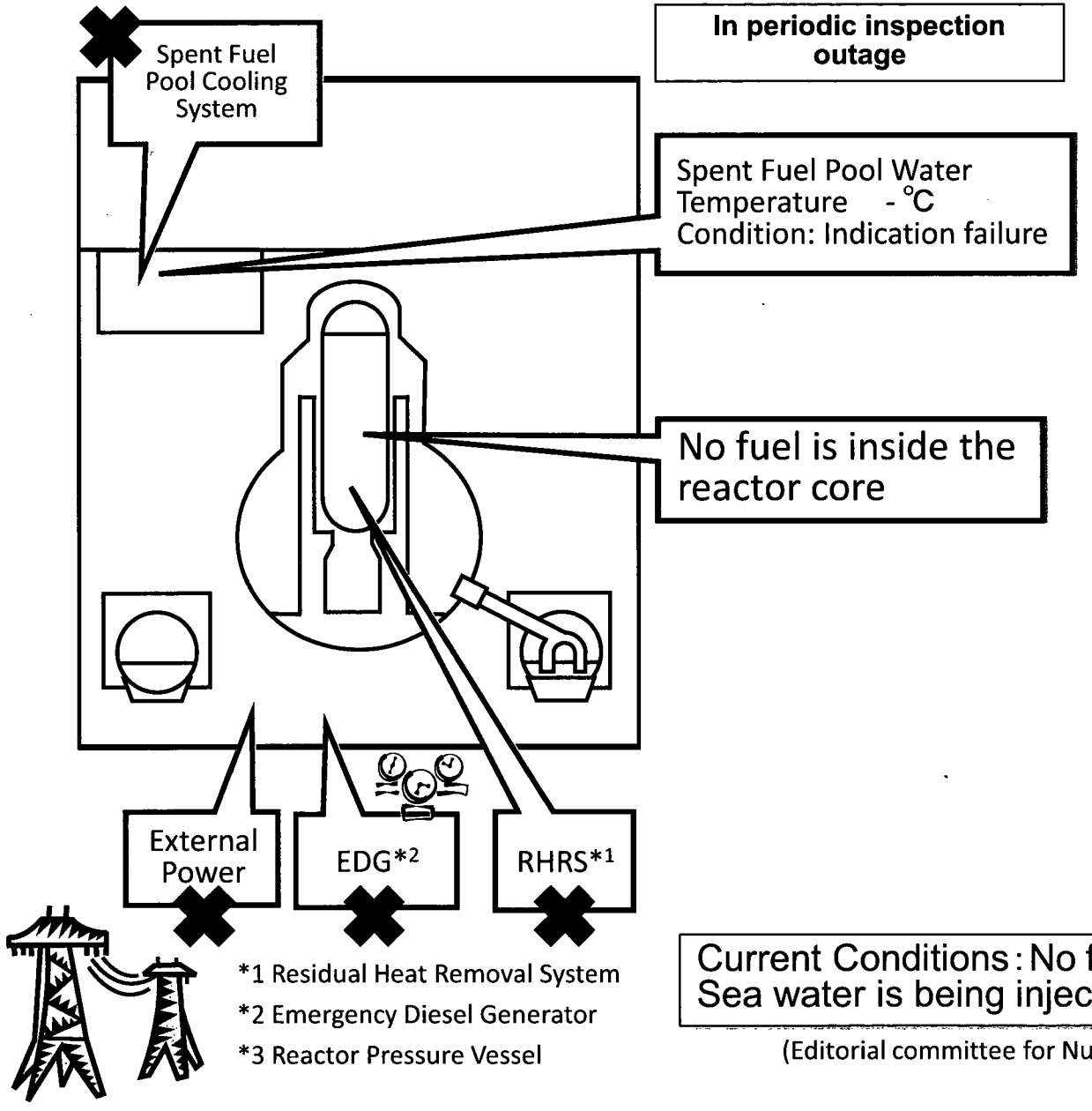
21st about 15:55 Grayish smoke generated and was confirmed to be died down at 17:55.
22nd 15:10 ～16:00 Water spray by Hyper Rescue Unit of Tokyo Fire Department and Osaka City Fire Bureau.
22nd 22:46 Lighting in the Central Control Room was recovered.
23rd 11:03 ～13:20 Injection of about 35ton of sea water to the Spent Fuel Pool (SFP) via the Fuel Pool Cooling Line (FPC)
23rd around 16:20 Black smoke generated and was confirmed to died down at around 23:30 and 24th 04:50.
24th 05:35～16:05 Approximately 120 ton sea water injection to SFP via FPC
25th 13:28～16:00 Water spray by Kawasaki City Fire Bureau supported by Tokyo Fire Department
25th 18:02 Started fresh water injection to the core
27th 12:34～14:36 Water spray by Concrete Pump Truck

Current Conditions : Sea water is being injected to the Spent Fuel Pool and fresh water is being injected to the core

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 4
(As of 14:00 March 27th, 2011)



*1 Residual Heat Removal System
*2 Emergency Diesel Generator
*3 Reactor Pressure Vessel

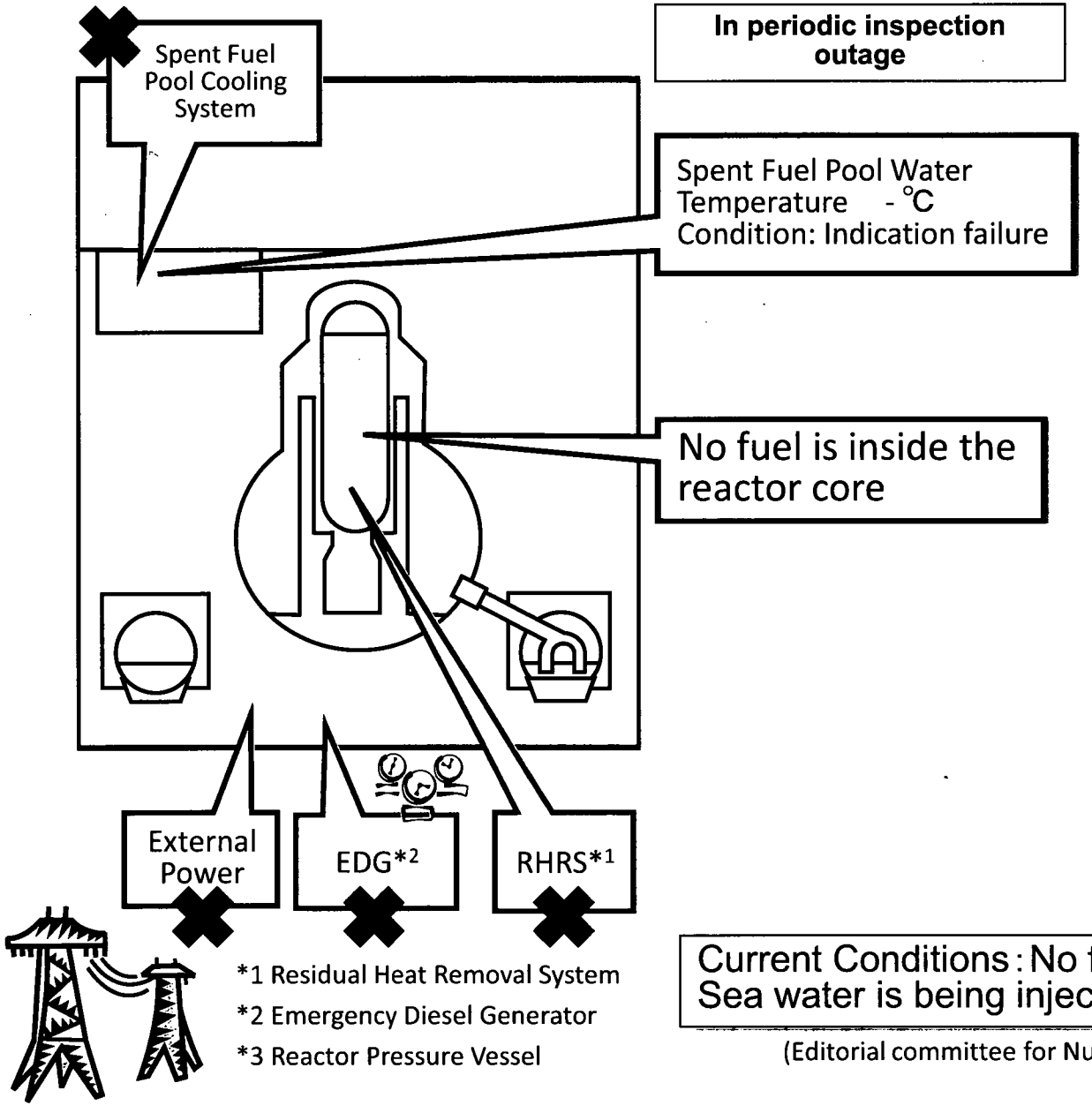
Major events after the earthquake

In periodic inspection outage when the earthquake occurred.
14th 04:08 Water temperature in the Spent Fuel Pool (SFP), 84℃
15th 0 6:14 Partial damage of wall in the 4th floor confirmed
15th 09:38 Fire occurred in the 3rd floor. (12:25 extinguished)
16th 05:45 Fire occurred. TEPCO couldn't confirm any fire on the ground. (06:15)
20th 08:21～09:40 Water spray over SFP by Self-Defense Force
20th around 18:30～19:46 Water spray over SFP by Self-Defense Force
21st 06:37～08:41 Water spray over SFP by Self-Defense Force
21st about 15:00 Work for laying cable to Power Center was completed.
22nd 10:35 Power Center received electricity
22nd 17:17～20:32 Water spray by Concrete Pump Truck
23rd 10:00～13:02 Water spray by Concrete Pump Truck
24th 14:36～17:30 Water spray by Concrete Pump Truck
25th 06:05～10:20 Sea water injection to SFP via the Fuel Pool Cooling Line (FPC)
25th 19:05～22:07 Water spray by Concrete Pump Truck

Current Conditions: No fuel is in RPV*3.
Sea water is being injected to the Spent Fuel Pool.

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 4
(As of 14:00 March 27th, 2011)



*1 Residual Heat Removal System
*2 Emergency Diesel Generator
*3 Reactor Pressure Vessel

Major events after the earthquake

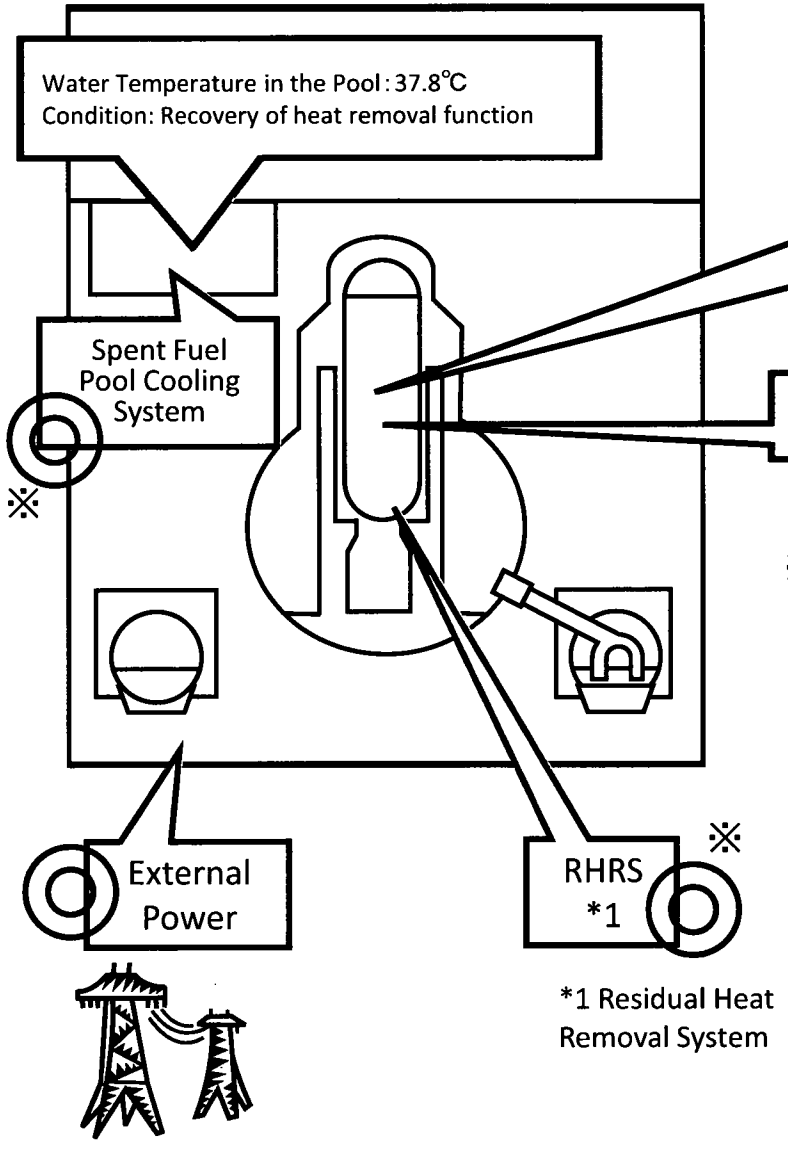
In periodic inspection outage when the earthquake occurred.
14th 04:08 Water temperature in the Spent Fuel Pool (SFP), 84℃
15th 0 6:14 Partial damage of wall in the 4th floor confirmed
15th 09:38 Fire occurred in the 3rd floor. (12:25 extinguished)
16th 05:45 Fire occurred. TEPCO couldn't confirm any fire on the ground. (06:15)
20th 08:21～09:40 Water spray over SFP by Self-Defense Force
20th around 18:30～19:46 Water spray over SFP by Self-Defense Force
21st 06:37～08:41 Water spray over SFP by Self-Defense Force
21st about 15:00 Work for laying cable to Power Center was completed.
22nd 10:35 Power Center received electricity
22nd 17:17～20:32 Water spray by Concrete Pump Truck
23rd 10:00～13:02 Water spray by Concrete Pump Truck
24th 14:36～17:30 Water spray by Concrete Pump Truck
25th 06:05～10:20 Sea water injection to SFP via the Fuel Pool Cooling Line (FPC)
25th 19:05～22:07 Water spray by Concrete Pump Truck

Current Conditions: No fuel is in RPV*3.
Sea water is being injected to the Spent Fuel Pool.

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 5
(As of 14:00 March 27th, 2011)

In periodic inspection outage



Reactor Pressure : 0.108MPa*
Reactor Water Level : 1,930mm
Reactor Water Temperature : 30.3℃
Condition : Pressure is under control.
*converted to absolute pressure

Reactor Pressure Vessel Temperature:
Monitoring by Reactor Water Temperature

※Heat removal was carried out alternately with the water in the Reactor Core and in the Spent Fuel Pool.

Current Conditions :

20th 14:30 Cold shutdown

21st 11:36 Receiving electricity from external power supply

23rd 17:24 Pump for Residual Heat Removal Seawater System (RHRS) was automatically stopped when the power supply was switched from the temporary to the permanent.

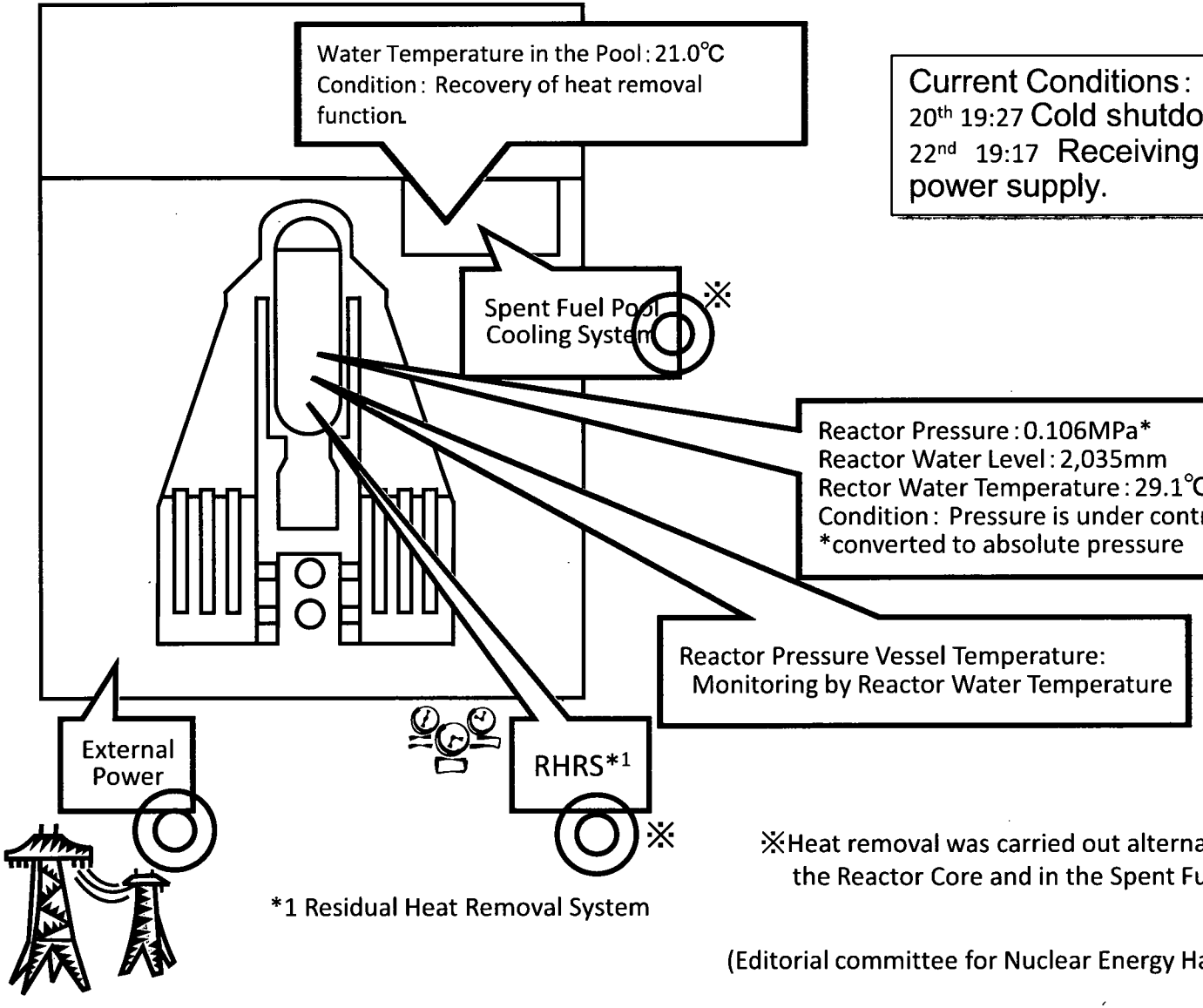
24th 16:14 Repair of the RHRS pump was completed.

24th 16:35 Cooling started.

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 6
(As of 14:00 March 27th, 2011)

In periodic inspection outage



Current Conditions:
20th 19:27 Cold shutdown.
22nd 19:17 Receiving electricity from external power supply.

*1 Residual Heat Removal System

※Heat removal was carried out alternately with the water in the Reactor Core and in the Spent Fuel Pool.

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy Handbook)

Fukushima Dai'ichi Unit Number	Reactor and Containment Type	Nuclear Steam System Supplier and Design Type	Architect-Engineer	Constructor	Initial Criticality	Commercial Operation	Net Mwe
Unit 1	BWR-3, Mark I, Isolation Condenser	GE	Ebasco	Kajima	Oct-70	Mar-71	439
Unit 2	BWR-4, Mark I, RCIC	GE	Ebasco	Kajima	May-73	Jul-74	760
Unit 3	BWR-4, Mark I, RCIC	Toshiba	Toshiba	Kajima	Sep-74	Mar-76	760
Unit 4	BWR-4, Mark I, RCIC	Hitachi	Hitachi	Kajima	Jan-78	Oct-78	760
Unit 5	BWR-4, Mark I, RCIC	Toshiba	Toshiba	Kajima	Aug-77	Apr-78	760
Unit 6	BWR-5, Mark II, RCIC	GE	Ebasco	Kajima	Mar-79	Oct-79	1067

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Unit 6	BWR-5, Mark II, RCIC	GE	Ebasco	Kajima	Mar-79	Oct-79	1067

International Atomic Energy Agency
Country Nuclear Power Profile
Department of Nuclear Energy
Division of Nuclear Power
Nuclear Power Engineering Section

JAPAN

(updated on Dec. 2004)[1]

1. ENERGY, ECONOMIC AND ELECTRICITY INFORMATION

1.1. General Overview

Situated in the far east of Asia, Japan is subject to a monsoon climate in the Temperate Zones. Japan has four distinct seasons that affect changes in the demand for energy and electric power. There are two peaks in the annual fluctuation of Japan's electric power demand: one is a summer peak due to the use of air-conditioning (cooling), and the other is a winter peak due to the use of heating.

Table 1 shows Japan's total population, its density and its rate of increase. Table 2 shows the Gross Domestic Product (GDP) in total and the growth rate. Table 3 shows the estimated energy reserves in Japan. Table 4 shows Japan's energy supply and consumption.

Japan's total primary energy supply in FY2002 was 22,977 PJ. Japan depends heavily on oil, even though its dependency has decreased from 77.4% in 1973 to 49.7% at present. The decline in oil dependency can be attributed mainly to the energy conservation efforts of Japanese industries and the development of alternative energy resources in Japan. In FY2002, Japan imported 99.8% of the oil consumed in Japan. Concerning the nuclear power, it showed a considerable drop of 7.7% in FY2002 compared with the previous year. On the other hand, fossil fuels advanced with coal (3.1%) and petroleum and natural gas (1.4% each).

A key feature of Japan's energy consumption is that the industrial sector accounts for the bulk of the total, with 47.2% in FY 2002, while the residential and commercial sector is 28.8% and the transportation sector is 24.0%. The energy consumption of the residential and commercial sector is growing constantly in recent years.

TABLE 1. POPULATION INFORMATION

	1970	1980	1990	2000	2005	2006	Average annual growth rate(%) 2000 to 2006
Population (millions)	104.3	116.8	123.5	126.9	127.8	127.6	0.1
Population density (inhabitants/km^2)	284.6	318.8	338.8	348.1	350.5	350	
Urban population (% of total)	53.2	59.6	63.1	65.2	65.8	66	
Area(1000 km^2)						364.5	

Source: World Bank World Development Indicators

TABLE 2. GROSS DOMESTIC PRODUCT (GDP)

	1970	1980	1990	2000	2005	2006	Average annual growth rate(%) 2000 to 2006
GDP (millions of current US$)	202 957.7	1 055 207.0	3 018 112.0	4 649 615.0	4 533 965.0	4 340 133.0	-1.1
GDP (millions of constant 2000 US$)	1 804 996.0	2 793 072.0	4 111 250.0	4 649 615.0	4 992 809.0	5 102 651.0	1.6
GDP per capita (current US$)	1 945.1	9 035.7	24 430.8	36 648.7	35 484.3	34 022.9	-1.2

Source: World Bank World Development Indicators

TABLE 3. ENERGY RESERVES

	Estimated energy reserves in (*) (Solid and Liquid in million tons, Uranium in metric tons, Gas in billion cubic metres, Hydro in TWhr per year)				
	Solid (1)	**Liquid (2)**	**Gas (3)**	**Uranium (4)**	**Hydro (5)**
Amount	359	9,000	51	6,600	136,000

(*) Sources: 20th WEC Survey of Energy Resources, 2004 and Uranium 2005: Resources, Production and Demand ("Red Book")
(1) Coal including Lignite: proved recoverable reserves, the tonnage within the proved amount in place that can be recovered in the future under present and expected local economic conditions with existing available technology
(2) Crude oil and natural gas liquids (Oil Shale, Natural Bitumen and Extra-Heavy Oil are not included): proved recoverable reserves, the quantity within the proved amount in place that can be recovered in the future under present and expected local economic conditions with existing available technology
(3) Natural gas: proved recoverable reserves, the volume within the proved amount in place that can be recovered in the future under present and expected local economic conditions with existing available technology
(4) Reasonably Assured Resources (RAR) under < USD 130/kgU
(5) Hydropower: technically exploitable capability, the amount of the gross theoretical capability that can be exploited within the limits of current technology

Sources: IAEA Energy and Economic Data Base

TABLE 4. ENERGY STATISTICS

Basic Energy Situation *(Energy values are in Exajoule exept where indicated)*						**Annual Average Growth Rate (%)**	
Total Energy Requirements	**1970**	**1980**	**1990**	**2000**	**2006**	**1990 to 2000**	**2000 to 2006**
Total	..	14.41	18.47	22.23	22.59	1.87	0.27
Solids	..	2.51	3.43	4.44	5.22	2.61	2.75
Liquids	..	9.67	10.31	10.57	9.72	0.25	-1.39
Gases	..	0.97	2.05	3.06	3.60	4.05	2.79
Hydro	..	0.33	0.35	0.35	0.34	0.10	-0.21
Nuclear	..	0.90	2.21	3.51	3.31	4.76	-0.99
Combustible Renewables & Waste	..	..	..	..	..	..	..
Other Renewables and Waste	..	0.02	0.12	0.30	0.39	9.35	4.42
Final Energy Consumption	**1970**	**1980**	**1990**	**2000**	**2006**	**1990 to 2000**	**2000 to 2006**
Total	..	10.33	11.70	12.57	12.71	0.71	0.19
Solids	..	1.37	1.31	0.60	0.87	-7.48	6.33
Liquids	..	5.69	6.02	6.56	5.94	0.86	-1.63
Gases	..	1.42	1.64	1.98	2.35	1.92	2.87
Electricity	..	1.84	2.73	3.41	3.53	2.23	0.60

Other	..	..	< 0.01	0.02	0.02	10.48	1.09
Combustible Renewables & Waste	..	..	..	..	..	..	..
Other	..	..	..	..	..	..	..
Net Energy Balance (Export-Import)	**1970**	**1980**	**1990**	**2000**	**2006**	**1990 to 2000**	**2000 to 2006**
Total	..	13.251	16.134	18.473	18.803	1.36	0.30
Solids	..	1.981	3.234	4.369	5.207	3.06	2.97
Liquids	..	10.377	10.928	11.150	10.144	0.20	-1.56
Gases	..	0.889	1.970	2.954	3.452	4.14	2.63
Combustible Renewables & Waste	..	..	..	..	..	..	..
Other Renewables and Waste	..	0.004	0.002	< 0.001	0.000	-46.07	-100.00

Source: IAEA Energy and Economic Databank, 2009.

1.2. Energy Policy

The two oil shocks in 1973 and 1979 had a direct impact on Japan's vulnerable energy structure and inflicted considerable damage on Japan's economy. Because of the first oil crisis, the Japanese government introduced the following emergency measures: Approval of Oil Emergency Measures (1973), Enactment of Two Emergency Laws (1973), Participation in IEA (1974), and Enactment of the Petroleum Stockpiling Law (1975). The first oil crisis prompted the Japanese government not only to formulate various emergency measures as stated above, but also to change the basic philosophy of its energy policy.

In 1975, the Advisory Committee for Energy, an advisory council for the Minister of International Trade and Industry (MITI), submitted a report suggesting that developing a stable supply of energy should be regarded as the top priority. On the basis of this report, the following five policy pillars were set up: reducing oil dependency, diversification of non-oil energy supplies, securing a stable supply of oil through petroleum reserves, exploration and development of oil by Japanese companies, promotion of energy conservation, and promotion of new energy R&D. In order to strengthen energy conservation, "The Law Concerning the Rational Use of Energy" was enacted in 1979. In 1974, the Sunshine Project was implemented to promote the development of new energy technologies such as solar energy, geothermal energy, coal liquefaction, coal gasification and hydrogen energy. Various alternative energy policy measures were introduced after the second oil crisis. In 1980, "The Law Concerning the Promotion of Development and Introduction of Alternative Energy" was enacted.

The Basic Law on Energy Policy-Making, which aims to indicate the general direction of future energy policies, was enacted in June 2002. Based on this law, the Advisory Committee of Natural Resources and Energy started examination of the Basic Plan for Energy Supply and Demand in April 2003. Considering the views and opinions of the public and of relevant administrative organs, the draft was drawn up and decided at a Cabinet meeting and reported to the Diet in October 2003. It is comprised of three basic policies: 1) Securing a stable energy supply, 2) Reducing the burden on the environment, and 3) Applying market principles. Promotion of nuclear power generation and nuclear fuel cycles is considered one measure to achieve these policies. The plan must be re-examined at least once every three years, and modified as necessary.

1.3. The Electricity System

1.3.1. Policy and Decision-Making Process

The Electricity Industry Committee, comprised of non-governmental professionals and experts including some from electric power companies, provides advice and recommendations to The Ministry of Economy, Trade and Industry (METI which was renamed from MITI) on a regular basis, regarding the basic national policies on regional network operations for the stable supply of power, promotion of demand-oriented energy-saving measures, promotion of load levelling, further development of electric power, etc. Based on this advice, METI and related Ministries and Agencies confer regularly with individual power companies to review the up-to-date demand and supply performances and to evaluate the power supply program for the future.

1.3.2. Structure of Electric Power Sector

Japan is divided into nine geographical zones with an electric power company in each zone. These are private enterprises that specialize only in electric utility operations and are the main power suppliers in each zone. Apart from these, there is also the Okinawa Electric Power Company, a smaller electric utility company operating in Okinawa Prefecture, which comprises many small islands. These power companies run their own facilities from power generation to transmission and distribution as an integrated business operation.

The Electric Power Development Company, which has its own thermal and hydro electric power stations, and the Japan Atomic Power Company, which has its own nuclear power stations, are other private enterprises that produce electric power and act as wholesalers to the nine electric power companies. However, in relation to Japan's total installed capacity, their installed capacity is relatively small.

With the amendment of the Electricity Utility Industry Law in 2000, a number of system reforms were implemented, such as partial liberalization of the retail supply to extra high-voltage customers. To improve competitiveness, the government established fair and equal rules allowing suppliers other than electric utilities (new entrants) to use power transmission lines owned by power utilities ("wheeling rules"). Also, electric utilities are obliged to notify METI of the wheeling service rates.

1.3.3. Main Indicators

TABLE 5.1. ELECTRICITY PRODUCTION AND INSTALLED CAPACITY

Electricity Situation						Annual Average Growth Rate (%)	
Electricity Generation	**1970**	**1980**	**1990**	**2000**	**2006**	**1990 to 2000**	**2000 to 2006**
Total	..	577.52	857.27	1,060.85	1,100.36	2.15	0.61
Nuclear	..	82.59	202.27	322.05	303.43	4.76	-0.99
Hydro	..	92.09	95.84	96.82	95.58	0.10	-0.21
Geothermal	..	1.09	1.74	3.35	3.08	6.76	-1.40
Wind	..	..	< 0.01	0.11	1.75	59.86	58.88
Other renewables	..	..	..	< 0.01	< 0.01	..	-10.91
Thermal	..	401.75	557.42	638.52	696.53	1.37	1.46
Installed Capacity	**1970**	**1980**	**1990**	**2000**	**2006**	**1990 to 2000**	**2000 to 2006**
Total	..	143.70	194.73	260.49	278.78	2.95	1.14
Nuclear	..	15.69	31.64	45.25	49.47	3.64	1.50
Hydro	..	29.78	37.83	46.32	47.36	2.05	0.37
Geothermal	..	0.16	0.27	0.53	0.53	7.04	-0.03
Wind	..	..	< 0.01	0.08	1.80	55.75	66.74
Other renewables	..	..	..	0.33	1.78	..	32.38
Thermal	..	98.07	124.99	167.97	177.84	3.00	0.96

Source: IAEA Energy and Economic Databank, 2009.

TABLE 5.2. ENERGY AND ELECTRICITY RATIOS

Derived Indicators	Annual Average Growth Rate (%)

	1970	1980	1990	2000	2006	1990 to 2000	2000 to 2006
Energy consumption per capita (GJ/capita)	..	123.3	150.6	177.0	179.0	1.63	0.19
Electricity per capita (KW.h/capita)	..	4,944.2	6,992.3	8,449.3	8,721.8	1.91	0.53
Nuclear/Total electricity (%)	..	14.3	23.6	30.4	27.6	2.55	-1.59
Annual capacity factor - Total (%)	..	45.9	50.3	46.5	45.1	-0.78	-0.52
Annual capacity factor - Thermal (%)	..	46.8	50.9	43.4	44.7	-1.58	0.50
Annual capacity factor - Hydro (%)	..	35.3	28.9	23.9	23.0	-1.91	-0.58
Annual capacity factor - Nuclear (%)	..	60.1	73.0	81.2	70.0	1.08	-2.45
Annual capacity factor - Wind (%)	..	..	11.4	14.8	11.1	2.64	-4.71
Annual capacity factor - Geothermal (%)	..	76.9	73.6	71.7	66.0	-0.26	-1.37
Annual capacity factor - Other renewables (%)	..	..	..	< 0.1	< 0.1	..	-32.70

Source: IAEA Energy and Economic Databank, 2009.

2. NUCLEAR POWER SITUATION

2.1. Historical Development and Current Nuclear Power Organizational Structure

2.1.1. Overview

Enactment of the Atomic Energy Law (1955) introduced the promotion of atomic energy development and utilization toward peaceful objectives in compliance with the three basic principles of Democratic Management, Voluntary Action, and Open Information. Inauguration of the Atomic Energy Commission (1956) established an advisory board for the Prime Minister on matters regarding promotion of atomic energy development and utilization.

Long-term program for Research, Development and Utilization of Nuclear Energy (Long-term Program) was formulated in 1956. Today, it is the basic program for the nation on nuclear power development and utilization. The plan is revised and updated every five years.

The MITI was reorganized in 1966 to accommodate its increasing workload. This change provided additional rules and regulations for the introduction of commercial light water reactors in Japan after 1966.

In 1974, three basic laws for the promotion of electric power development were made into law; namely, the "Law for the Adjustment of Areas Adjacent to Power-Generating Facilities," the "Electric Power Development Promotion Tax Law," and the "Special Account Law for Electric Power Promotion." These laws also advanced the appropriate siting of nuclear power stations.

In 1978, the Nuclear Safety Commission was formed as a separate entity from the Atomic Energy Commission. Safety assurance measures were enhanced in 1980 in order to reflect the lessons learned from the TMI-2 Accident (1979) and, later, the Chernobyl No. 4 Accident in 1986.

The overall appraisal of the Vision of Nuclear Power in 1986 provided long-range prospects of energy availability and electric power requirements through 2030, and a program for enhancement of safety called "Safety 21," which further reinforced safety assurance measures. In 1990, Japan revised its supply targets to include alternative energy sources to mitigate its growing demand for oil and its part in the greenhouse effect.

In 2001, the Nuclear and Industrial Safety Agency (NISA) was formed as a separate entity from the Agency of Natural Resources and Energy of the METI to hold jurisdiction over matters of nuclear and industrial safety.

2.1.2. Current Organizational Chart

Figure 2 shows Japan's organization chart in nuclear power, comprising government regulatory authorities, electric power companies and contracting engineers/suppliers.

The Japanese government carried out administrative reform in January 2001. The Atomic Energy Commission and Nuclear Safety Commission (NSC) of the Cabinet Office gives high-level independent and proper directions to other ministries and agencies.

The Ministry of Education, Culture, Sports, Science and Technology (MEXT) was created through a merger between the former Ministry of Education, Science, Sports and Culture and the Science and Technology Agency (STA). In MEXT, three Bureaus and four Divisions are in charge of nuclear energy. MEXT is responsible for the administration of nuclear energy for science and technology. Its key roles are nuclear research and development (including nuclear fuel cycle, Fast Breeder Reactor (FBR), quantum research, fusion, and accelerators), utilization of radiation and radioisotopes, nuclear liability, safety regulation and disaster prevention for nuclear reactors for testing and research, use of nuclear fuel material, and regulation for ensuring peaceful use and safeguards. It is also responsible for supervision of the National Institute of Radiological Sciences, the Japan Atomic Energy Research Institute and the Japan Nuclear Cycle Development Institute.

The Ministry of Economy, Trade and Industry (METI) will be in charge not only of those areas that it had been involved in previously - as the Ministry of International Trade and Industry (MITI) - or taken over from STA - related to the nuclear fuel cycle business (refining, enrichment, fabrication, reprocessing and waste disposal), but also regulation of nuclear reactors

including Monju that is in the research and development stage for use in generating electricity. Nuclear power-related issues will continue to be the responsibility of the Agency of Natural Resources and Energy. In addition, the Nuclear and Industrial Safety Agency (NISA), with its ten sections related to nuclear energy, was added as a special institution, to play a central role in safety regulations for industrialized nuclear power. NISA is responsible for regulating nuclear safety. The drafting of safety regulations and the licensing of milling and refining, nuclear fuel fabrication, spent nuclear fuel reprocessing and storage, disposal of radioactive waste and decommissioning of nuclear power plants, are now carried out by NISA. A double check system of safety review of nuclear facilities by NSC and NISA or MEXT is continuously adopted.

The Ministry of Foreign Affairs (MoFA) is responsible for the international aspect of nuclear energy utilization, including the implementation of the related international treaties and conventions.

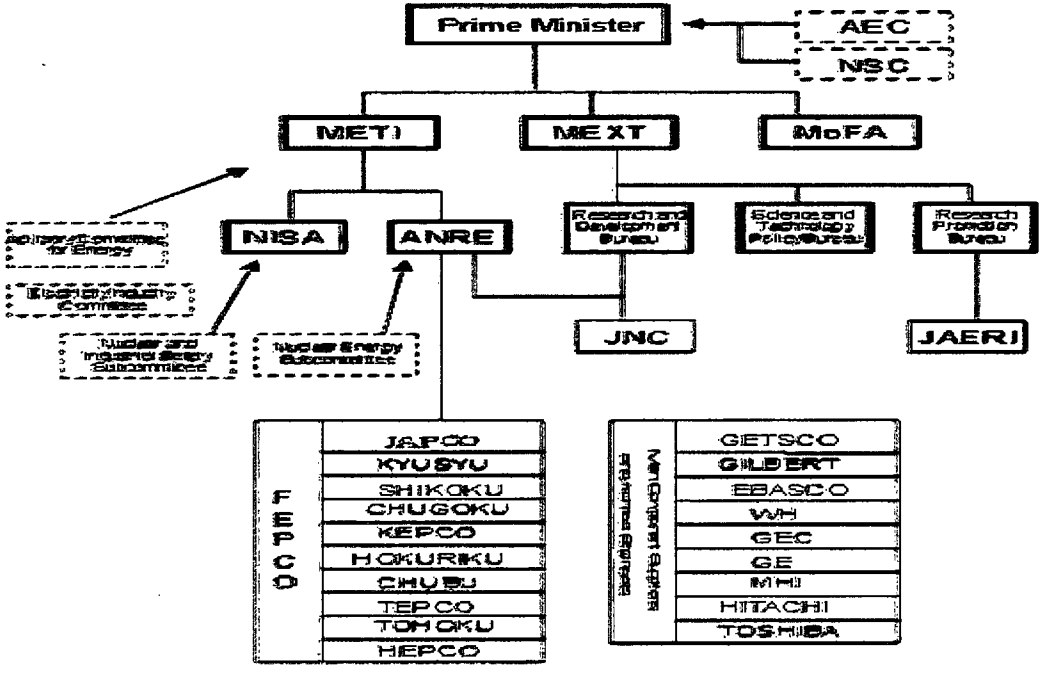


FIG.2. Japan's Organization Chart

Legend to Figure 2:

AEC:	Atomic Energy Commission
NSC:	Nuclear Safety Commission
METI:	Ministry of Economy, Trade and Industry
ANRE:	Agency of Natural Resources and Energy

NISA:	Nuclear and Industrial Safety Agency
MEXT:	Ministry of Education, Culture, Sports, Science and Technology
MoFA:	Ministry of Foreign Affairs
JAERI:	Japan Atomic Energy Research Institute
JNC:	Japan Nuclear Cycle Development Institute
FEPCO:	Federation of Electric Power Companies
HEPCO:	Hokkaido Electric Power Co.
TOHOKU:	Tohoku Electric Power Co.
TEPCO:	Tokyo Electric Power Co.
CHUBU:	Chubu Electric Power Co.
HOKURIKU:	Hokuriku Electric Power Co.
KEPCO:	Kansai Electric Power Co.
CHUGOKU:	Chugoku Electric Power Co.
SHIKOKU:	Shikoku Electric Power Co.
KYUSHU:	Kyushu Electric Power Co.
JAPCO:	The Japan Atomic Power Co.
TOSHIBA:	Toshiba Corporation
HITACHI:	Hitachi Ltd.
MHI:	Mitsubishi Heavy Industries Ltd.
GE:	General Electric Co.
GEC:	The General Electric Co. Ltd.
WH:	Westinghouse Electric Corporation
EBASCO:	Ebasco Services Incorporated
GILBERT:	Gilbert/Commonwealth International
GETSCO:	General Electric Technical Services Co.

2.2. Nuclear Power Plants: Status of and Trends in Nuclear Power

2.2.1. Status of nuclear power plants

Table 6 and Figure 3 provide lists and locations of the nuclear power plants in operation, under construction and firmly planned, together with those out of service in Japan. As of the end of the fiscal year 2002, the total capacity of nuclear power generation is 45,742 MWe. The total capacity of nuclear power generation of plants under construction and firmly planned are 3,838 MWe (three plants) and 10,290 MWe (eight plants), respectively.

TABLE 6. STATUS OF NUCLEAR POWER PLANTS

Station	Type	Net Cpacity (Mwe)	Operator	Status	Reactor Supplier	Construction Date	Criticality Date	Grid Date	Commercial Date	Shutdown Date
FUKUSHIMA-DAIICHI-1	BWR	439	TEPCO	Operational	GE/GETSC	25-Jul-67	10-Oct-70	17-Nov-70	26-Mar-71	
FUKUSHIMA-DAIICHI-2	BWR	760	TEPCO	Operational	GE/T	09-Jun-69	10-May-73	24-Dec-73	18-Jul-74	
FUKUSHIMA-DAIICHI-3	BWR	760	TEPCO	Operational	TOSHIBA	28-Dec-70	06-Sep-74	26-Oct-74	27-Mar-76	
FUKUSHIMA-DAIICHI-4	BWR	760	TEPCO	Operational	HITACHI	12-Feb-73	28-Jan-78	24-Feb-78	12-Oct-78	
FUKUSHIMA-DAIICHI-5	BWR	760	TEPCO	Operational	TOSHIBA	22-May-72	26-Aug-77	22-Sep-77	18-Apr-78	
FUKUSHIMA-DAIICHI-6	BWR	1067	TEPCO	Operational	GE/T	26-Oct-73	09-Mar-79	04-May-79	24-Oct-79	
FUKUSHIMA-DAINI-1	BWR	1067	TEPCO	Operational	TOSHIBA	16-Mar-76	17-Jun-81	31-Jul-81	20-Apr-82	
FUKUSHIMA-DAINI-2	BWR	1067	TEPCO	Operational	HITACHI	25-May-79	26-Apr-83	23-Jun-83	03-Feb-84	
FUKUSHIMA-DAINI-3	BWR	1067	TEPCO	Operational	TOSHIBA	23-Mar-81	18-Oct-84	14-Dec-84	21-Jun-85	
FUKUSHIMA-DAINI-4	BWR	1067	TEPCO	Operational	HITACHI	28-May-81	24-Oct-86	17-Dec-86	25-Aug-87	
GENKAI-1	PWR	529	KYUSHU	Operational	MHI	15-Sep-71	28-Jan-75	14-Feb-75	15-Oct-75	
GENKAI-2	PWR	529	KYUSHU	Operational	MHI	01-Feb-77	21-May-80	03-Jun-80	30-Mar-81	
GENKAI-3	PWR	1127	KYUSHU	Operational	MHI	01-Jun-88	28-May-93	15-Jun-93	18-Mar-94	
GENKAI-4	PWR	1127	KYUSHU	Operational	MHI	15-Jul-92	23-Oct-96	12-Nov-96	25-Jul-97	
HAMAOKA-1	BWR	515	CHUBU	Operational	TOSHIBA	10-Jun-71	20-Jun-74	13-Aug-74	17-Mar-76	
HAMAOKA-2	BWR	806	CHUBU	Operational	TOSHIBA	14-Jun-74	28-Mar-78	04-May-78	29-Nov-78	
HAMAOKA-3	BWR	1056	CHUBU	Operational	TOSHIBA	18-Apr-83	21-Nov-86	20-Jan-87	28-Aug-87	
HAMAOKA-4	BWR	1092	CHUBU	Operational	TOSHIBA	13-Oct-89	02-Dec-92	27-Jan-93	03-Sep-93	
HAMAOKA-5	BWR	1325	CHUBU	Operational	TOSHIBA	12-Jul-00	23-Mar-04	26-Apr-04	18-Jan-05	
HIGASHI DORI 1 (TOHOKU)	BWR	1067	TOHOKU	Operational	TOSHIBA	07-Nov-00	24-Jan-05	09-Mar-05	08-Dec-05	
IKATA-1	PWR	538	SHIKOKU	Operational	MHI	15-Jun-73	29-Jan-77	17-Feb-77	30-Sep-77	
IKATA-2	PWR	538	SHIKOKU	Operational	MHI	21-Feb-78	31-Jul-81	19-Aug-81	19-Mar-82	
IKATA-3	PWR	846	SHIKOKU	Operational	MHI	01-Nov-86	23-Feb-94	29-Mar-94	15-Dec-94	
KASHIWAZAKI KARIWA-1	BWR	1067	TEPCO	Operational	TOSHIBA	05-Jun-80	12-Dec-84	13-Feb-85	18-Sep-85	

KASHIWAZAKI KARIWA-2	BWR	1067	TEPCO	Operational	TOSHIBA	18-Nov-85	30-Nov-89	08-Feb-90	28-Sep-90	
KASHIWAZAKI KARIWA-3	BWR	1067	TEPCO	Operational	TOSHIBA	07-Mar-89	19-Oct-92	08-Dec-92	11-Aug-93	
KASHIWAZAKI KARIWA-4	BWR	1067	TEPCO	Operational	HITACHI	05-Mar-90	01-Nov-93	21-Dec-93	11-Aug-94	
KASHIWAZAKI KARIWA-5	BWR	1067	TEPCO	Operational	HITACHI	20-Jun-85	20-Jul-89	12-Sep-89	10-Apr-90	
KASHIWAZAKI KARIWA-6	BWR	1315	TEPCO	Operational	TOSHIBA	03-Nov-92	18-Dec-95	29-Jan-96	07-Nov-96	
KASHIWAZAKI KARIWA-7	BWR	1315	TEPCO	Operational	HITACHI	01-Jul-93	01-Nov-96	17-Dec-96	02-Jul-97	
MIHAMA-1	PWR	320	KEPCO	Operational	WH	01-Feb-67	29-Jul-70	08-Aug-70	28-Nov-70	
MIHAMA-2	PWR	470	KEPCO	Operational	WH	29-May-68	10-Apr-72	21-Apr-72	25-Jul-72	
MIHAMA-3	PWR	780	KEPCO	Operational	MHI	07-Aug-72	28-Jan-76	19-Feb-76	01-Dec-76	
OHI-1	PWR	1120	KEPCO	Operational	WH	26-Oct-72	02-Dec-77	23-Dec-77	27-Mar-79	
OHI-2	PWR	1120	KEPCO	Operational	WH	08-Dec-72	14-Sep-78	11-Oct-78	05-Dec-79	
OHI-3	PWR	1127	KEPCO	Operational	MHI	03-Oct-87	17-May-91	07-Jun-91	18-Dec-91	
OHI-4	PWR	1127	KEPCO	Operational	MHI	13-Jun-88	28-May-92	19-Jun-92	02-Feb-93	
ONAGAWA-1	BWR	498	TOHOKU	Operational	TOSHIBA	08-Jul-80	18-Oct-83	18-Nov-83	01-Jun-84	
ONAGAWA-2	BWR	796	TOHOKU	Operational	TOSHIBA	12-Apr-91	02-Nov-94	23-Dec-94	28-Jul-95	
ONAGAWA-3	BWR	796	TOHOKU	Operational	TOSHIBA	23-Jan-98	26-Apr-01	30-May-01	30-Jan-02	
SENDAI-1	PWR	846	KYUSHU	Operational	MHI	15-Dec-79	25-Aug-83	16-Sep-83	04-Jul-84	
SENDAI-2	PWR	846	KYUSHU	Operational	MHI	12-Oct-81	18-Mar-85	05-Apr-85	28-Nov-85	
SHIKA-1	BWR	505	HOKURIKU	Operational	HITACHI	01-Jul-89	20-Nov-92	12-Jan-93	30-Jul-93	
SHIKA-2	BWR	1304	HOKURIKU	Operational	HITACHI	20-Aug-01	26-May-05	04-Jul-05	15-Mar-06	
SHIMANE-1	BWR	439	CHUGOKU	Operational	HITACHI	02-Jul-70	01-Jun-73	02-Dec-73	29-Mar-74	
SHIMANE-2	BWR	789	CHUGOKU	Operational	HITACHI	02-Feb-85	25-May-88	11-Jul-88	10-Feb-89	
TAKAHAMA-1	PWR	780	KEPCO	Operational	WH/MHI	25-Apr-70	14-Mar-74	27-Mar-74	14-Nov-74	
TAKAHAMA-2	PWR	780	KEPCO	Operational	MHI	09-Mar-71	20-Dec-74	17-Jan-75	14-Nov-75	
TAKAHAMA-3	PWR	830	KEPCO	Operational	MHI	12-Dec-80	17-Apr-84	09-May-84	17-Jan-85	
TAKAHAMA-4	PWR	830	KEPCO	Operational	MHI	19-Mar-81	11-Oct-84	01-Nov-84	05-Jun-85	
TOKAI-2	BWR	1060	JAPCO	Operational	GE	03-Oct-73	18-Jan-78	13-Mar-78	28-Nov-78	
TOMARI-1	PWR	550	HEPCO	Operational	MHI	12-Jul-85	16-Nov-88	06-Dec-88	22-Jun-89	
TOMARI-2	PWR	550	HEPCO	Operational	MHI	08-May-86	25-Jul-90	27-Aug-90	12-Apr-91	
TSURUGA-1	BWR	340	JAPCO	Operational	GE	24-Nov-66	03-Oct-69	16-Nov-69	14-Mar-70	
TSURUGA-2	PWR	1110	JAPCO	Operational	MHI	06-Nov-82	28-May-86	19-Jun-86	17-Feb-87	
TOMARI-3	PWR	866	HEPCO	Under Construction	MHI	18-Nov-04			01-Dec-09	
MONJU	FBR	246	JAEA	Long-term Shutdown	T/H/F/M	10-May-86	05-Apr-94	29-Aug-95		
FUGEN ATR	HWLWR	148	JAEA	Permanent Shutdown	HITACHI	10-May-72	20-Mar-78	29-Jul-78	20-Mar-79	29-Mar-03

JPDR	BWR	13	JAEA	Permanent Shutdown	GE	01-Dec-60	22-Aug-63	26-Oct-63	15-Mar-65	18-Mar-76
TOKAI-1	GCR	159	JAPCO	Permanent Shutdown	GEC	01-Mar-61	04-May-65	10-Nov-65	25-Jul-66	31-Mar-98

Source: IAEA Power Reactor Information System as of 31 December 2006.

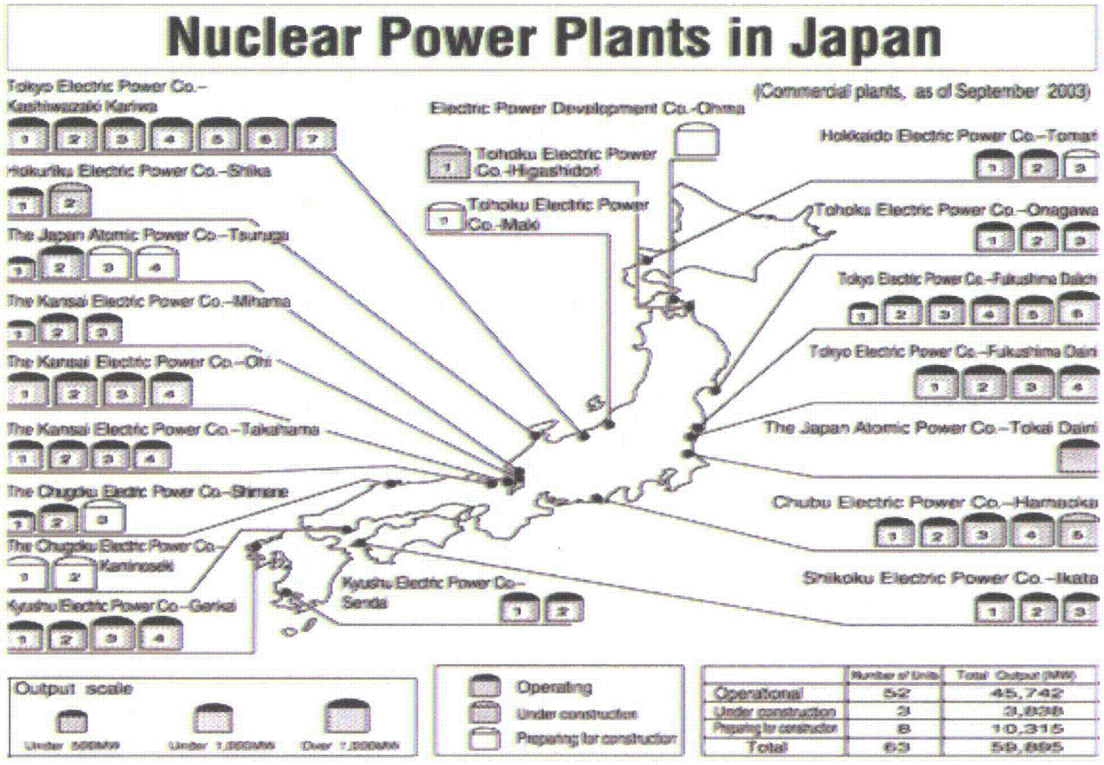


FIG.3. Nuclear Power Stations in Japan

2.2.2. Performance of NPPs

Table 7 shows trends in the capacity factor by reactor type.

TABLE 7. TREND OF CAPACITY FACTOR

(%)

	1988	1990	1995	2000	2001	2002	2003
Reactor Type							
-BWR	72.9 (19)	72.9 (21)	82.5 (26)	79.9(28)	78.6 (29)	61.9 (29)	39.0 (29)
-PWR	69.9 (16)	72.6 (17)	77.6 (22)	84.1 (23)	82.9 (23)	89.1 (23)	87.9 (23)
-GCR	57.9 (1)	65.3 (1)	60.4 (1)				
( ): number of operating reactors							
Average	71.4 (36)	72.7 (39)	80.2 (49)	81.7 (51)	80.5 (52)	73.4 (52)	59.7 (52)

Source: METI Nuclear Data (August 2004)

2.2.3. Plant upgrading and plant life management

In April 1996, MITI announced the "Basic Concepts on Aging of Nuclear Power Plants," which comprised two ideas: 1) MITI had the outlook that existing plants could be operated for a long term after MITI had made a technical evaluation of instruments as crucial factors in long-term operations; the instruments were important from the viewpoint of safety, but not easy to replace or repair, and 2) MITI requested that power companies should carry out technical evaluation and make long-term maintenance plans for each instrument including replaceable ones in plants by 30 years from the start of their operations.

MITI adjusted these concepts as specific measures in February 1999. According to these, electric companies reported to METI technical evaluations and long-term maintenance plans in 1999 and 2001, and METI judged the report to be appropriate.

In October 2003, NISA of METI added the Aging Management Review in the provisions of "Periodic Evaluation of Nuclear Reactor Facilities" to "the Rules for the Commercial Power Reactors" and provided as one of the requirement in the Operational Safety Program to implement Measures for Aging Management.

Aging Management Review to be implemented at the time within 30 years after commissioning, are:

a. analyze the impacts of technically conceivable aging phenomena on structures and components of nuclear power stations with safety functions, and technically evaluate the possibility for revention of the loss of function of the components and structures due to aging phenomena under the present maintenance activities provided to them,
b. extract new maintenance measures from the technical evaluation results to make a plan of ten-year maintenance program.
c. re-evaluate this ten-year maintenance program with ten-year interval

NISA requested license holders to report the newly extracted maintenance measures in the ten-year maintenance program of "Measures for Aging Management" to reflect the results on inspections, such as the Periodic Inspection, as necessary. Licence holders should materialize methods of maintenance management, frequency and time, etc. of the maintenance measures into ten-year maintenance program. Licence holders should implement those in accordance with Operational Safety Program.

Since the "Measures for Aging Management" was defined as a requirement of the regulation, more rational and standardized Measures for Aging Management will be investigated and will be provided as academic and association standards etc. in the future based on recipe to aging in abroad and on the latest knowledge.

NISA evaluates the technical evaluation and ten-year maintenance program conducted by license holders with the incorporation of the of specialists' opinion, as well as the lessens learned from operating experiences in and outside Japan and the latest knowledge, and experimental results.

Technical evaluation and planning of the ten-year maintenance program in relation with the aging were implemented for nine out of fifty-two units as of June 2004. (See to Table 2.2.3-1)

Table 2.2.3-1 Implementation Status of Measures for ageing Management

The 1st Time (announced in February 1999) Unit 1 of the Tsuruga PS (The Japan Atomic Power Co., Inc.: BWR) Unit 1 of the Fuskushima Daiichi NPS (Tokyo Electric Power Co., Inc.: BWR) Unit 1 of the Mihama PS (The Kansai Electric Power Co., Inc.: PWR)

The 2nd Time (announced in June 2001
Unit 2 of the Fuskushima Daiichi NPS (Tokyo Electric Power Co., Inc.: BWR)
Unit 2 of the Mihama PS (The Kansai Electric Power Co., Inc.: PWR)

The 3rd Time (announced in February 1999)
Unit 1 of the Takahama PS (The Kansai Electric Power Co., Inc.: PWR)
Unit 2 of the Takahama PS (The Kansai Electric Power Co., Inc.: PWR)
Unit 1 of the Shimane NPS (Chugoku Electric Power Co., Inc.: BWR)
Unit 1 of the Genkai NPS (Kyushu Electric Power Co., Inc.: PWR)

2.2.4. Nuclear power development projections and plans

The development of light-water reactors in Japan began with PWRs from Westinghouse and BWRs from G.E. As nuclear power technologies are incorporated by the domestic industry, successive expansion projects of nuclear power plants are of Japanese design and construction. Today, Toshiba, Hitachi and Mitsubishi Heavy Industries have emerged as Japan's representative suppliers of nuclear steam supply systems (NSSS). Construction of nuclear power plants is made possible by an industrial system with one or more of the above-mentioned three companies acting as the prime contractor (s), and forming a joint venture with contract engineers or construction companies as subcontractors.

The development of the Advanced Boiling Water Reactor (ABWR) started in 1978 as a project of international co-operation among five BWR vendors. The resulting conceptual design plan was highly evaluated by TEPCO and other Japanese utilities, and as a result, the ABWR was included in the third standardization program starting in 1981. The preliminary design and numerous development and verification tests were carried out by Toshiba, Hitachi and GE together with six Japanese utilities and the Japanese government. Two ABWRs, the Kashiwazaki-Kariwa Units 6 and 7, were ordered by TEPCO and began successful commercial operation in November 1996 and July 1997, respectively. Two more ABWRs are under construction at Hamaoka-5 and Shika-2, another ABWR is under licensing review at Ohma-1, and eight more ABWRs are in the planning stage. These eight future ABWRs will achieve a significant reduction in generation costs compared to the current ABWRs. The cost reduction is to be obtained by the following means: standardization, design modifications, and improvements in project management. In addition, all of the experience of the ABWRs currently operating will contribute to cost reduction.

2.2.5. Decommissioning information and plans

It is Japan's fundamental policy to dismantle and remove decommissioned nuclear power generation facilities that have completed their service life, while ensuring complete safety in that process. Based on this fundamental policy, the standard

procedure (standard work schedule) is one of "safe storage plus disassembly/removal". It is appropriate to choose a safe storage period of five to ten years and a disassembly/removal period of three to four years.

The estimated cost of reactor decommissioning in Japan (referring to precedents in other countries), is approximately 30 billion yen (1984 prices) for a 1,100 MW-class nuclear power plant, when its safe storage period is five years. The Agency of Natural Resources and Energy is implementing verification tests of reactor decommissioning technology such as techniques of decommissioning waste processing, and techniques of reactor remote dismantling, which are important in ensuring better safety and reliability.

2.3. Supply of NPPs

In Japan, five companies have provided steam generators for nuclear power plants: for BWRs these are Toshiba, Hitachi, G.E., and G.E. and Toshiba jointly, while for PWRs these are Mitsubishi, Westinghouse, and Westinghouse and Mitsubishi jointly.

Many companies are capable of supplying equipment and services to Japan's nuclear power industry. These range from the suppliers of major equipment and machinery to those supplying ordinary equipment or offering engineering services. They also include firms related to the nuclear fuel cycle or nuclear fuel recycling.

2.4. Operation of Nuclear Power Plants

Figure 2 shows the nine electric power companies which operate commercial light water reactors, and one company which is a producer and wholesaler of electricity from nuclear power in Japan.

Regarding nuclear power plant operator training in Japan, both the BWR and PWR groups have their own training centres. These were financed, built and utilized jointly by the member companies of each group, comprising electric power companies and contracted engineering firms. In addition, each electric power company has its own training facility. Engineering qualification tests for operator certification are conducted at training centres operated jointly by the member companies.

The representative suppliers of Japan's maintenance services are Toshiba, Hitachi and Mitsubishi. The electric power companies make contracts with these maintenance service companies.

2.5. Fuel Cycle and Waste Management Service Supply

Fuel cycle activities in Japan comprise enrichment, conversion, fuel fabrication, zircaloy cladding, reprocessing and radioactive waste activities. Figure 4 shows the enterprises involved.

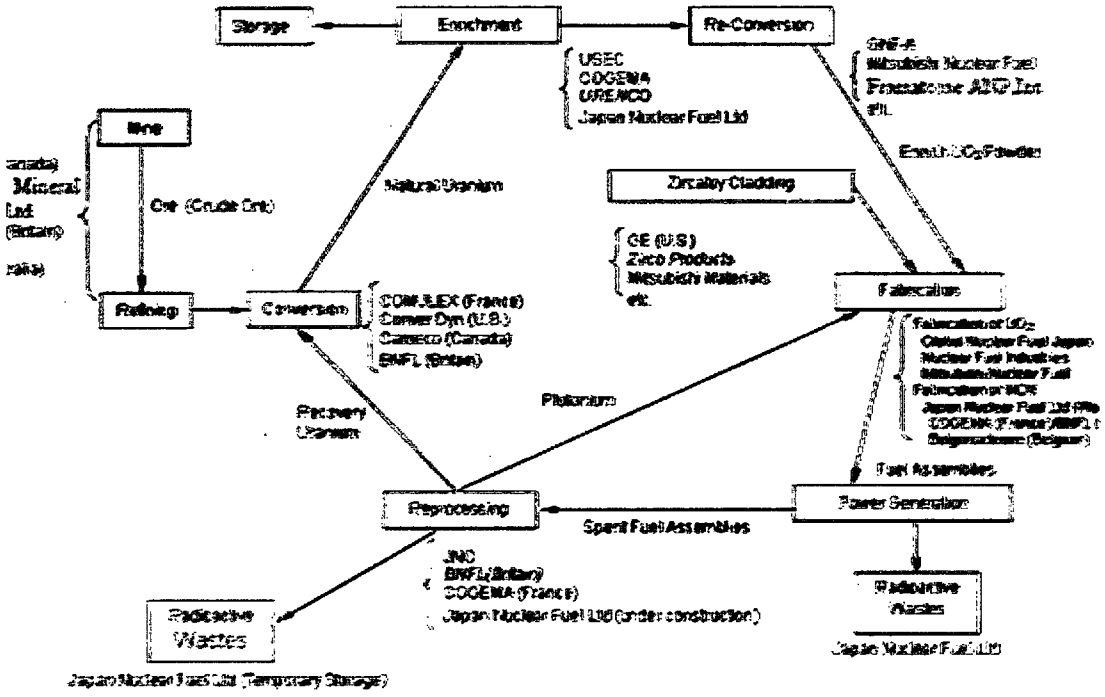


FIG 4 Nuclear Fuel Cycle Diagram

FIG. 4. Nuclear Fuel Cycle Diagram

2.6. Research and Development

In promoting the research and development of nuclear energy, the government should play a leading role in implementing research and development projects that require long-term commitments, specifically those aimed at identifying and commercializing potential capabilities of nuclear power as a promising energy option in the years ahead; and basic and generic research and development activities to acquire diverse knowledge and information as the intellectual assets of humankind. When any research and development project achieves results that should be put to practical use, it is important for the government to assist highly-motivated private corporations in carrying on their activities for the commercialization of such

results. Another important task of the government is to jointly work with private corporations - prospective users of new technologies in future markets - from the viewpoint of efficiently promoting research and development projects and smoothly implementing the transfer of technologies in the years ahead.

In leading the world in the area of nuclear energy research and development through these projects, it is important for Japan to promote creative research and development in a competitive research climate and to steadily carry out these projects with diverse options and sufficient flexibility to properly respond to the latest information and ever-changing social requirements. For this purpose, the government should timely and properly assess research activities and have its findings properly reflected in subsequent research and development programs and in the allocation of available research resources. Concerning, in particular, research and development projects that are closely related to social needs, it is important to undertake these projects with the specific users in mind.

2.6.1. R&D Organizations and Institutes

The Atomic Energy Commission (AEC), amongst other responsibilities, advises on R&D. The long-term program for the development and use of nuclear energy is revised by the AEC every five years; the latest revision was published in November 2000. Government responsibilities for R&D are shared between the Ministry of Education, Culture, Sports, Science and Technology (MEXT) and the Ministry of Economy, Trade and Industry (METI).

MEXT is responsible for planning and administration regarding nuclear energy for science and technology. It has three bureaus, each with several divisions. MEXT plays a key role in nuclear research and development of many areas, including the nuclear fuel cycle, FBR, fusion research and accelerators. MEXT supervises the work of the Japan Nuclear Cycle Development Institute (JNC), which was established in 1998 as a successor organization of Power Reactor and Nuclear Fuel Development Corporation (PNC), and also that of the Japan Atomic Energy Research Institute (JAERI), established in 1956. JNC is the main channel for the development of advanced reactors and establishment of the fuel cycle. JAERI actively engages in developing nuclear energy, radiation application and the research on nuclear safety. Those two organizations have a close collaboration with the private sector, including shared funding on some projects. Since 1985, the Nuclear Ship Research and Development Agency has been integrated in JAERI.

The Agency of Natural Resources and Energy carries out various activities, which include studies of improvements in reactor design and approval of design modifications proposed by utilities, and decommissioning.

2.6.2. Development of advanced and new-generation nuclear reactor systems

In addition to the LWRs for power production, Japan is active in developing other types of reactors, such as HTGRs and FBRs. Toshiba Corporation and the Tokyo Institute of Technology are developing a natural circulation, simplified LSBWR with passive safety systems and a long operating cycle: within 100 - 300 MWe power capacity and 15 years core life.

HTGR development is at the stage of operation and testing of a test reactor. The principal focus of Japan's HTGR development program is the High-Temperature Engineering Test Reactor (HTTR) in the JAERI at Oarai site, Ibaraki Pref. Initial criticality of the HTTR was achieved in November 1998. This 30 MW (th) helium-cooled reactor is being utilized to establish and upgrade the technology of advanced HTGR, and to demonstrate the effectiveness of selected high-temperature heat utilization systems. The HTTR accomplished a full power operation of 30 MWth and a gas temperature of 950 ? at the reactor outlet in April 2004.Also, a project has been initiated to develop a 600 MWth gas turbine HTGR design for electricity generation.

JNC is conducting research and development (R&D) on FBRs and nuclear fuel reprocessing technology to establish an economical nuclear fuel cycle. The experimental fast reactor (JOYO) operated from 1982 to 2000 with the MK-II core (100 MWt). The reactor and its cooling system was upgraded to the MK-III core (140 MWt) and attained its initial criticality in July 2003. At present, various irradiation tests of fuels and materials to be applied to the fast reactor are in progress. The prototype Liquid Metal-cooled Fast Breeder Reactor (LMFBR) MONJU with a capacity of 280 MW(e) reached initial criticality in April 1994, and was connected to the grid in August 1995. The reactor operation was interrupted in December 1995 due to sodium leak in the non-radioactive secondary cooling system. Legal application for improvement of the MONJU plant, mainly for countermeasures against sodium leakage, was permitted in December 2002. The MONJU reactor is considered the core of R&D activities for FBR cycle technology and considerable effort is being made to resume its operation. In addition to these development works, "Feasibility Study on Commercialized Fast Breeder Reactor Cycle Systems" undertaken by JNC with the cooperation of electric utilities and other interested parties is in progress with the objective of presenting an optimal commercialization vision of FBR technologiy and a research and development program toward that end.

2.7. International Co-operation and Initiatives

Bilateral nuclear power co-operation agreements have been concluded for the purpose of promoting the peaceful use of nuclear power while ensuring that nuclear power equipment and materials, including nuclear materials, have solely peaceful applications. Japan has concluded such bilateral nuclear power co-operation treaties with six nations: the United States, Britain, France, Canada, Australia and the People's Republic of China. Under these agreements, the parties exchange expertise and information on the peaceful use of nuclear power, and provide and receive nuclear equipment, materials and services.

Japan cooperates with Asian and developing nations through the Forum for Nuclear Cooperation in Asia, under the framework of the Regional Cooperative Agreement for Research, Development and Training Related to Nuclear Science and Technology, and under various bilateral co-operation agreements.

Japan, together with some Western countries, provides technology safety assistance to former USSR nations, and Middle and Eastern Europe nations, under bilateral or multilateral frameworks.

2.8. Human Resources Development

Research, development and utilization of nuclear energy, while securing safety, requires the nurturing and retention of the best people - the best human resources.

Japan's universities, which are at the core of human resource development, must therefore take the initiative in this effort, in cooperation with organizations such as research and development institutes and private nuclear operators, and with an international perspective as well. At the same time, hands-on experience can be effectively provided at advanced, cutting-edge research and development facilities.

Developing, maintaining and continuing high levels of technology and human resources are best achieved through on-going manufacturing activities. The nuclear power industry thus makes continual efforts to introduce the latest technology. At the same time, nuclear operators are expected to improve their own education and training, evolve their accumulated technology still further on their own, and pass that technology on steadily to future generations.

It is also important for national research institutes and private nuclear operators to establish methods to facilitate mutual exchanges of personnel and technology, such as joint research and assignments, and to work to strengthen the human-resources and technological positions of Japan as a whole.

In order, moreover, for nuclear energy to attract and inspire promising individuals it is important to demonstrate to them the importance of nuclear energy to Japan and the role nuclear energy can play toward achieving international peace and stability. It is just as important that research and development activities cover a wide range of possibilities, be challenging, and fire hopes and dreams among the young. Scientists and engineers involved in nuclear energy should take every opportunity to speak enthusiastically to the public.

3. NATIONAL LAWS AND REGULATIONS

3.1. Safety Authority and the Licensing Process

Figure 5 shows the process of approval of or permission for nuclear power plants in Japan.

3.2. Main National Laws and Regulations Concerning Nuclear Power

Figure 6 shows the main laws controlling nuclear power plants in Japan. For the installation of a commercial nuclear power plant, it is necessary to go through licensing procedures based on more than 30 laws. Many of the laws also apply to general industrial facilities.

The main nuclear-related laws and regulations are systematized according to organization, research and development, regulations, and compensation based on the Atomic Energy Laws, as shown in Fig. 6. Among them, laws concerning the safety regulations of reactors are the Law for Regulation of Nuclear Source Materials, Nuclear Fuel Materials and Reactors (hereafter called LRNR) and the Electricity Utilities Industry Law (hereafter called EUIL). The purpose of the LRNR is to enforce regulations based on the potential danger of nuclear reactors and nuclear substances, whereas EUIL aims to provide a good supply of electricity, ensuring the safety of hydroelectric power plants, thermoelectric power plants and power transmission lines as well as nuclear power plants, with a view to a stable supply of electricity. Thus, the two laws stand on different viewpoints.

The main nuclear-related laws and regulations are as follows:

1. The Atomic Energy Basic Law (1955.12.19 - Publications)

The research, development and use of nuclear energy shall be limited to peaceful purposes only, to ensure safety. The Act prescribes three principles:

1. Under democratic management
2. Voluntarily
3. Freely available information

Nuclear-related laws and regulations are enacted based on the spirit of the Act.

2. The Law for the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors (1957.6.10 - Publications)

The Law, usually abbreviated as LRNR, prescribes regulations necessary for the installation and operation of reactors, refining, processing, and disposal of nuclear waste. Following are the main regulations concerning the installation and operation of reactors:

- Permission for reactor installation (basic design)
- Permission for construction plan (detailed design)
- Pre-use inspection
- Notification of operation plan
- Measures taken for safety
- Approval of safety regulations

- Appointment of Chief Reactor Engineer
- Periodical inspections

LRNR excludes permission for a construction plan, pre-use inspection and periodical inspection, for which the Electricity Utilities Industry Law applies.

3. The Electricity Utilities Industry Law (1964.7.11 - Publications)

The Law intends to protect benefits, ensure safety, and facilitate sound development of electricity utilities for users of electricity:

- Main regulations for nuclear power plants
- Permission for construction plan (detailed design)
- Pre-use inspection
- Periodical inspections
- Appointment of Chief Electric Engineer and Boiler and Turbine Engineers
- Decree of conformity with technical standards (and subordinate rules specifying technical standards)

4. The Law concerning Prevention of Radiation Hazards due to Radioisotopes, etc. (1957.6.10 - Publications)

The Law intends to prevent radiation hazards by regulating the use and disposal of radioisotopes and the use of radiation producers. In a nuclear power plant, the Law applies when neutron sources are used or radioisotopes are employed for calibration of equipment.

5. The Special Law for Nuclear Disaster Measures (1999.12.17 - Publications)

- Taking quick initial action and ensuring integrated co-operation from the governments of the nation, prefectures and municipalities
- Strengthening the national emergency preparedness system for response to nuclear disaster
- Clarification of undertaker's role in preventing nuclear disasters

6. The Law on Compensation for Nuclear Damage (1961.6.17 - Publication)

Nuclear energy enterprises (electric power companies) owe no-fault liability for compensation to the injured when nuclear damage is caused by the operation of nuclear reactors and the like. In such cases, liability focuses on the nuclear energy enterprises concerned.

Nuclear energy enterprises are compelled to deposit a fixed amount of money (60 billion yen at the most) to cover the cost of measures taken to implement compensation for damage:

- To make insurance contracts for compensation for damage with private insurers
- To execute an indemnity contract with the government

When damage is more than the deposited amount for compensation, the government will assist if necessary.

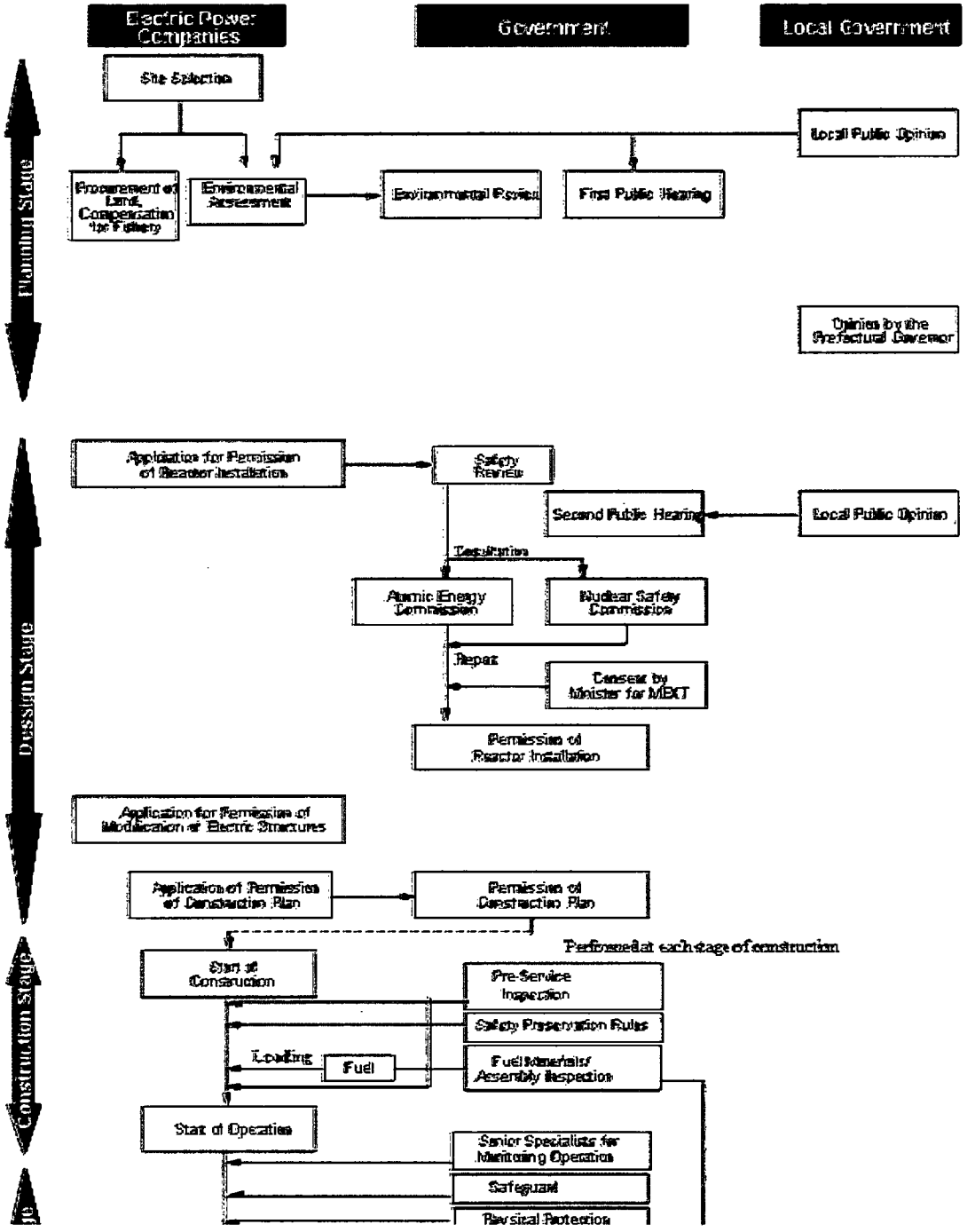
7. Electric Power Development Promotion Laws:
(1974.6.6 - Publications)

- Electric Power Development Promotion Tax Law
- Special Account Law for Electric Power Development Promotion
- Law for the Adjustment of Areas Adjacent to Power-Generating Facilities
- Law on Special Measures Concerning Promotion of the Development of Nuclear Power Site Regions

These Laws intend to promote electric power development by returning benefits gained for the whole country from a stable supply of electricity through the siting of a power plant, to the local area. The Electric Power Development Promotion Tax Law is for collecting the tax of the promotion for Electric Power Development (according to electric power sold), the Special Account Law for Electric Power Development Promotion is for clarifying the government accounts of the uses of the tax revenue, the Law for the Adjustment of Areas Adjacent to Power-Generating Facilities is for smoothly setting up generating facilities by the promotion of public institutions, and the Special Account Law for Electric Power Development Promotion is to promote the development of nuclear power plant site regions by giving financial assistance and so on, focusing especially on protection against the spread of nuclear accidents.

8. Specified Radioactive Waste Final Disposal Act (2000.6.7 - Publications)

The law prescribes, mainly, the establishment of implementation for disposal, a funding mechanism for securing disposal costs, and a three-step site selection process.


Electric Power Companies
Government
Local Government
Planning Stage
Site Selection
Local Public Opinion
Procurement of Land, Compensation for Fishery
Environmental Assessment
Environmental Report
First Public Hearing
Opinion by the Prefectural Governor
Design Stage
Application for Permission of Reactor Installation
Safety Review
Second Public Hearing
Local Public Opinion
Consultation
Atomic Energy Commission
Nuclear Safety Commission
Report
Consent by Minister for MEXT
Permission of Reactor Installation
Application for Permission of Modification of Electric Structures
Application of Permission of Construction Plan
Permission of Construction Plan
Performed at each stage of construction
Start of Construction
Pre-Service Inspection
Safety Preservation Rules
Loading
Fuel
Fuel Materials/ Assembly Inspection
Start of Operation
Senior Specialists for Monitoring Operation
Safeguard
Physical Protection

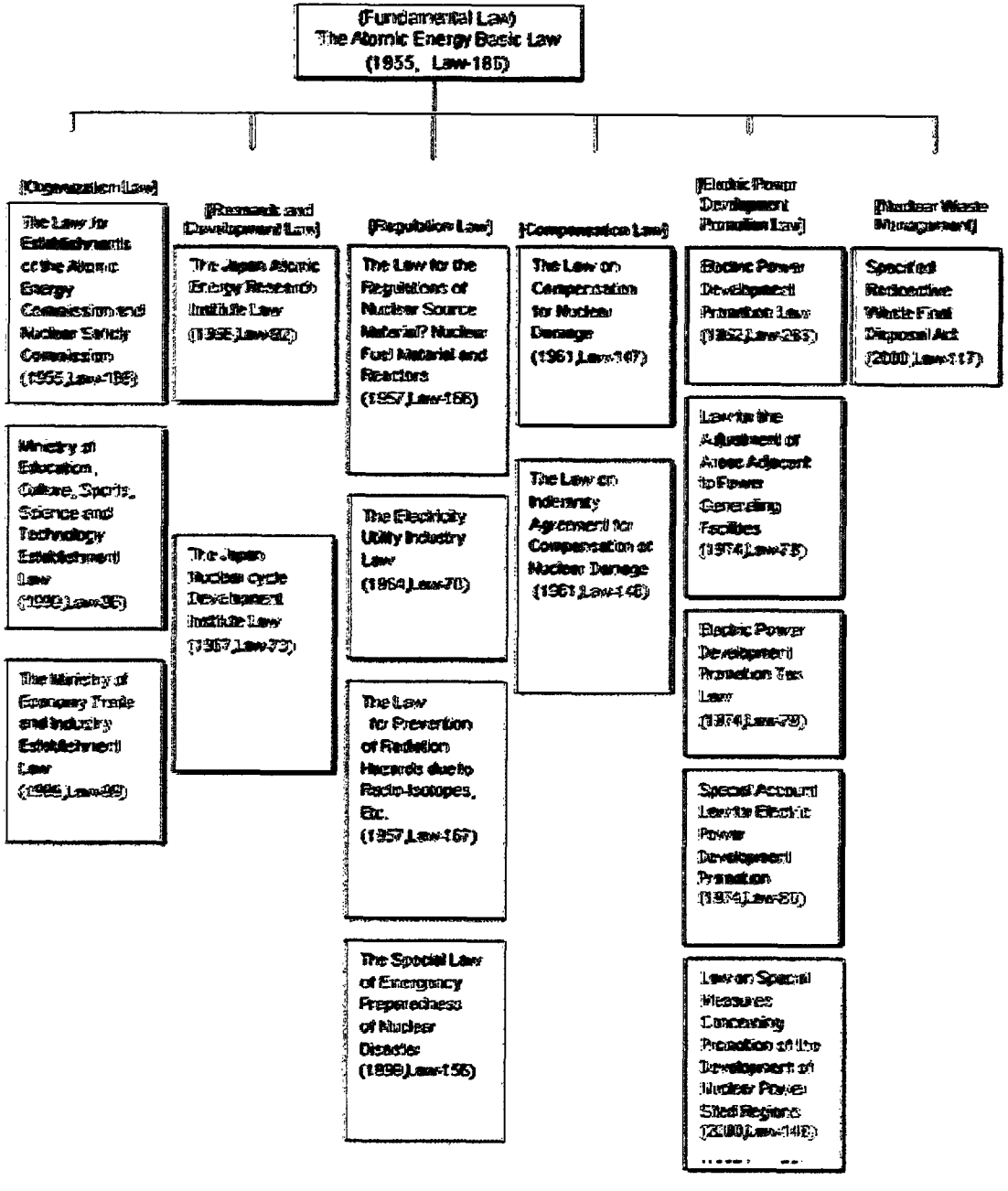


FIG. 6. Scheme Diagram of major Nuclear Laws in Japan

4. CURRENT ISSUES AND DEVELOPMENTS IN NUCLEAR POWER

4.1. Energy Policy

Japanese society, economic structure and energy demand-supply structure have been undergoing tremendous changes. Based on this recognition, producing an outlook for energy demand and supply from the broader perspective is crucial.In order to show the long-term, quantitative prospects, since December 2003 the Energy Supply and Demand Subcommittee, Advisory Committee for Natural Resources and Energy has been amending (revising) the Long-term Energy Supply and Demand Outlook, looking to 2003. In October 2004, the Interim Report was compiled.

In the interim draft, the economy, society and energy supply-and-demand structure up until 2030, and the steps along the way, are envisioned and qualitatively studied and compiled in several scenarios. The energy supply-and-demand structure of Japan in 2030 is shown quantitatively, and sensitivity analyses performed based on these scenarios. Keeping observance of the Kyoto Protocol in mind, the energy supply-and-demand structure in 2010 is also estimated. Furthermore, mid- and long-term energy strategies based on the outlook for 2030 are also examined.

Looking ahead to 2030, if current trends continue, growth in energy demand will slow after peaking in FY 2021, and then decline, due to changes in population, the economy, and the social structure. In the sensitivity analysis, the possibility that energy saving will progress through a change in consciousness of people and companies and through technical innovation, and the possibility that new supply means including fuel cells will be realized are shown. To realize a desirable energy supply-and-demand structure, four mid- and long-term energy strategies are proposed.

1. Establishment of an International Energy Strategy with the Expectation of an Increase in Energy Demand in Asia

2. Realization of a Virtuous Cycle of Energy-Saving and Environmental Protection Efforts by the Public and the Industrial Community

3. Ability to Respond to Changes Due to Distribution and Diversification of Energy Supply

4. Realization of a Flexible and Robust Energy Supply System That Breaks Down the Walls Between Different Sectors of the Energy Industry

In the Outlook for Energy Demand and Supply in 2010, CO2 emissions are expected to significantly exceed the target values set out in the Guideline for Measures to Prevent Global Warming. The possibility of achieving the target by taking additional

measures on the energy supply side, such as streamlining the environment or measures beyond the domain of the industrial sector, towards rationalization of energy use, and on the energy demand side, additional measures such as reduction of the CO2 emissions of the electric power industry, and promoting the introduction of new forms of energy, was indicated.

4.2. Privatization and deregulation

To investigate future reform of the electricity sector, a series of meetings of the Advisory Committee for the Natural Resources and Energy Agency's Electricity Industry Committee were held from November 2001 to February 2003. Finally, the Committee issued the "Framework of the Desirable Future Electricity Industry System" Report in February 2003, which indicates the framework and directions of the electricity industry reform.

Based on the Report, the Government of Japan amended the Electricity Utility Industry Law in June 2003 and is now examining in detail measures to implement new regulations and systems. In this reform, the scope of liberalisation will be extended (from 2004 for high-voltage over 500kW customers and from 2005 for all high-voltage customers), and new regulations will be introduced in order to ensure fairness and neutrality of the transmission/distribution segment: for example, introduction of conduct regulations (account unbundling, information firewalls and prohibition of discriminatory treatment) and establishment of a neutral transmission system organisation. Furthermore, a nationwide wholesale power exchange will be created in order to establish an investment environment for electric power source development, and "pancaking" will be abolished for vitalization of the nationwide power trade.

4.3. Safety issues and Waste Management Issues

(Safety issues)

On August 9, 2004 at the Mihama Power Station Unit 3 (PWR, 826MWe) of the Kansai Electric Power Co., Inc. (KEPCO), the main condensate water pipe ruptured and high temperature secondary water blew out into the turbine building when the reactor was in full power operation. In the turbine building, there were many workers preparing for the periodic inspection which was to commence on August 14. Workers who were close to the break were seriously exposed to the flashed water that killed five by scalding.

The Japanese government set up an Investigation Committee on the Pipe Rupture Accident immediately after the accident and conducted an on-the spot inspection. Through these steps, the government investigated the causes of the accident and took measures to prevent a recurrence. On September 27, the Interim Report of the Investigation Committee was published. The government decided to immediately implement necessary measures for the prevention of recurrence in response to comments of this report.

(Waste Management Issues)

The Japan Nuclear Cycle Development Institute is undertaking two underground laboratory projects, one in Mizunami with the geological media of crystalline rock and the other in Horonobe with sedimentary rock, to enhance both technical reliability and public confidence in HLW geological disposal. At Mizunami, excavation of the main and ventilation shafts began in July 2003 and reached to the depth of about 50m in December 2004. At Horonobe, surface-based investigation started in March 2001 and the site for the URL construction was chosen in March 2002. At present, site preparation work is in progress aiming at the start of shaft excavation in the summer of 2005.

REFERENCES

[1] The New Long-Range Plan for Development and Utilisation of Nuclear Energy (Revised in November 2000)

[2] IAEA Energy and Economic Data Base (EEDB)

[3] IAEA Power Reactor Information System (PRIS)

[4] Organization and Staff of Electric Utilities and Related Corporations, Japan Electric Association

[5] Nuclear Power Yearbook, Japan Atomic Industrial Forum, Inc.

Appendix 1

INTERNATIONAL (MULTILATERAL AND BILATERAL) AGREEMENTS

AGREEMENTS WITH THE IAEA

• Amendments to Articles VI & XIV of the Agency Statute	Ratified:	31 May 2000(Art. VI) 29 June 2004 (Art. XIV)
• Agreement on privileges and immunities	Entry into force:	18 April 1963

• NPT-related safeguards agreement INFCIRC/255	Entry into force:	2 December 1977
• Additional Protocol	Entry into force:	16 December 1999
• Regional Cooperative Agreement for Research, Development and Training Related Nuclear Science and Technology (RCA)	Entry into force:	4 June 2002

MAIN INTERNATIONAL TREATIES

• Non-Proliferation Treaty	Entry into force:	8 June 1976
• Convention on physical protection of nuclear material	Entry into force:	27 November 1988
• Convention on early notification of a nuclear accident	Entry into force:	10 July 1987
• Convention on assistance in the case of a nuclear accident or radiological emergency	Entry into force:	10 July 1987
• Vienna Convention on civil liability for nuclear	Non-Party	

damage

• Protocol to amend the Vienna Convention on civil liability for nuclear damage	Not signed	
• Convention on supplementary compensation for nuclear damage	Not signed	
• Convention on nuclear safety	Entry into force:	24 October 1996
• Joint convention on the safety of spent fuel management and on the safety of radioactive waste management	Entry into force:	24 November 2003

OTHER RELEVANT UNDERTAKINGS

• Zangger Committee	Member	(Since 22 August 1974)
• Nuclear Suppliers Group	Member	(Since 11 January 1978)
• CTBT	Ratified	(8 July 1997)

BILATERAL AGREEMENTS

• Japan/Australia	Entry into force	17 August 1982
• Japan/Canada	Entry into force	2 September 1980
• Japan/China	Entry into force	10 July 1986
• Japan/France	Entry into force	19 July 1990
• Japan/United Kingdom	Entry into force	12 October 1998
• Japan/USA	Entry into force	17 July 1989

Table 8 shows Japan's co-operation with major international organisations.

Organization	Outline of co-operation
IAEA	Promotion of peaceful uses of atomic energy (safety-related co-operation, technical aid to developing countries and R&D), and provision of safeguards to ensure that nuclear activities are not transformed for military purposes. Japan participates positively in INSAG (International Nuclear Safety Advisory

	group), NUSSAC (Nuclear Safety Standard Advisory Committee), ASSET (Assessment of Safety Significant Event Team), OSART and special studies to evaluate the safety of reactors in the former USSR. Japan made an Extra-budgetary Contribution to the IAEA for 1) the Expanded program of public understanding of nuclear energy (EPPUNE), 2) Nuclear Safety and 3) Waste Management and Disposal.
OECD/NEA	The purpose is to provide useful information to member countries through technological study and mutual co-operation regarding common problems in nuclear energy use in advanced countries. Japan participates actively in CNRA (Committee for Nuclear Regulatory Activities), CSNI (Committee for Safety of Nuclear Installation), RWMC (Radioactive Waste Management Committee) and NDC (Committee for Technical and Economic Studies on Nuclear Energy Development and the Fuel Cycle).

Appendix 2

DIRECTORY OF THE MAIN ORGANIZATIONS, INSTITUTIONS AND COMPANIES INVOLVED IN NUCLEAR POWER RELATED ACTIVITIES

NATIONAL NUCLEAR ENERGY AUTHORITIES

Atomic Energy Commission (AEC)
c/o Cabinet Office
Central Government Building No. 4, 7F
3-1-1 Kasumigaseki, Chiyoda-ku
Tokyo, Japan

Tel: +81-3 3581 6690
Fax: +81-3 3581 9827
http://aec.jst.go.jp

Nuclear Safety Commission (NSC)
Cabinet Office
Central Government Building No,4,7F
3-1-1 Kasumigaseki, Chiyoda-ku
Tokyo, Japan

Tel: +81-3-3581-9919
Fax: +81-3-3581-9835
http://www.nsc.go.jp

GOVERNMENT ORGANIZATIONS

Ministry of Education, Culture, Sports,
Science and Technology (MEXT)
2-5-1 Marunouchi, Chiyoda-ku
Tokyo, Japan

Tel: +81-3 6734 4161
Fax: +81-3 6734 4162
http://www.mext.go.jp

Ministry of Economy, Trade
and Industry (METI)
1-3-1 Kasumigaseki, Chiyoda-ku
Tokyo, Japan

Tel: +81-3 3501 1991
Fax: +81-3 3508 8447
http://www.meti.go.jp

Ministry of Foreign Affairs (MoFA)
2-2-1 Kasumigaseki, Chiyoda-ku
Tokyo, Japan

Tel: +81-3 5501-8227
Fax: +81-3 5501-8230
http://www.mofa.go.jp

CORPORATIONS RELATED TO NUCLEAR POWER

Japan Atomic Energy Research Institute (JAERI)
Office of Planning
14-1, Suehiro-cho, Kashiwa-shi, Chiba Prefecture

Tel: +81-4-7142-2400
Fax: +81-4-7142-2419
http://www.jaeri.go.jp

Japan Nuclear Cycle Development Institute (JNC)
Executive Office for Policy Planning and Administration
4-49, Muramatsu
Tokai-Mura
Naka-Gun, Ibaraki Prefecture

Tel: +81-29-282-1122
Fax: +81-29-282-4917
http://www.jnc.go.jp

Nuclear Power Engineering Corporation (NUPEC)
Safety Information Research Center
1-8, Toranomon 4-Chome
Minato-ku, Tokyo

Tel: +81-3-4512-2500
Fax: +81-3-4512-2600
http://www.nupec.or.jp

Japan Atomic Industrial Forum Inc. (JAIF)
Department of Information & Research
2-13, Shiba-daimon 1-Chome
Minato-ku, Tokyo

Tel: +81-3-5777-0750
Fax: +81-3-5777-0760
http://www.jaif.or.jp

Japan Nuclear Energy Safety Organization (JNES)
Fujita Kanko Toranomon Bldg., 3-17-1
Toranomon, Minato-ku, Tokyo

Tel: +81-3-4501-1111
http://www.jnes.go.jp

OWNERS/OPERATORS

The Federation of Electric Power Companies (FEPCO)
Nuclear Power Department
9-4, Otemachi 1-Chome
Chiyoda-ku, Tokyo

Tel: +81-3-3279-2187
Fax: +81-3-3241-1780
http://www.fepc.or.jp

Hokkaido Electric Power Co., Inc. (HEPCO)
Higashi 1-Chome, Ohdori
Chuoku, Sapporo

Tel: +81-11-251-1111
http://www.hepco.co.jp

Tohoku Electric Power Co., Inc. (TOHOKU)
7-1, Ichibancho 3-Chome
Aoba-ku, Sendai

Tel: +81-22-225-2111
http://www.tohoku-epco.co.jp

Tokyo Electric Power Co., Inc. (TEPCO)
1-3, Uchisaiwai-cho
1-Chome, Chiyoda-ku, Tokyo

Tel: +81-3-3501-8111
http://www.tepco.co.jp

Chubu Electric Power Co., Inc. (CHUBU)
Ichibanchi Toshin-Cho,
Higashi-ku, Nagoya

Tel: +81-52-951-8211
http://www.chuden.co.jp

Hokuriku Electric Power Co., Inc. (HOKURIKU)
15-1, Ushijima, Toyama

Tel: +81-76-441-2511
http://www.rikuden.co.jp

Kansai Electric Power Co., Inc. (KEPCO)
3-22, Nakanoshima 3-chome
Kita-ku, Osaka

Tel: +81-66-441-8821
http://www.kepco.co.jp

Chugoku Electric Power Co., Inc. (CHUGOKU)
4-33, Komachi
Naka-ku, Hiroshima

Tel: +81-82-241-0211
http://www.energia.co.jp

Shikoku Electric Power Co., Inc. (SHIKOKU)
2-5, Marunouchi,
Takamatsu

Tel: +81-87-821-5061
http://www.yonden.co.jp

Kyushu Electric Power Co., Inc. (KYUSHU)
2-1-82, Watanabe-Dori,
Chuo-ku, Fukuoka

Tel: +81-92-761-3031
http://www.kyuden.co.jp

Japan Atomic Power Co., Inc. (JAPCO)
6-1, 1-Chome, Otemachi,
Chiyoda-ku, Tokyo

Tel: +81-3-3201-6631
http://www.japc.co.jp

Central Research Institute
of Electric Power Industry (CRIEPI)

http://criepi.denken.or.jp

World Association of Nuclear Operators (WANO)

http://www.wano-tc.or.jp

FUEL CYCLE

Japan Nuclear Cycle Development Institute (JNC)
4-49, Muramatsu, Tokai-Mura, Naka-Gun,
Ibaraki Prefecture

Tel: +81-29-282-1122
http://www.jnc.go.jp

---

[1]The statistical tables (4,5 and 6) in this profile have been updated with data as of July 2009 from IAEA databases and Energy and Economic Data Bank (EEDB, 2009).

From: Morales, Russell A
To: Taylor, Robert
Subject: FW: Link: Fukushima Daiichi Nuclear Plant Hi-Res Photos
Date: Monday, April 04, 2011 8:01:52 PM

A start on some photos from the site...

Russ

This email is UNCLASSIFIED

-----Original Message-----
From: Ulses, Anthony [mailto:Anthony.Ulses@nrc.gov]
Sent: Tuesday, April 05, 2011 3:00 AM
To: Trapp, James; Morales, Russell A; 'russ@earthmobi.com'
Subject: FW: Link: Fukushima Daiichi Nuclear Plant Hi-Res Photos

Some good shots from earlier.

Tony

-----Original Message-----
From: Rutz, Wayne
Sent: Monday, April 04, 2011 1:03 PM
To: Stapleton, Bernard; Mangefrida, Michael; Parsons, Darryl
Cc: Melendez, Israel; Ulses, Anthony
Subject: FW: Link: Fukushima Daiichi Nuclear Plant Hi-Res Photos

An additional link to some photos of the plants in Japan.

Wayne

-----Original Message-----
From: aaronad@nctc.gov [mailto:aaronad@nctc.gov]
Sent: Monday, April 04, 2011 12:28 PM
To: Rutz, Wayne; English, Lance; Whitney, James; Warren, Roberta
Subject: Link: Fukushima Daiichi Nuclear Plant Hi-Res Photos

This is better than commercial imagery, and in color.

Fukushima Daiichi Nuclear Plant Hi-Res Photos

http://cryptome.org/eyeball/daiichi-npp/daiichi-photos.htm

W/346

Fields, Leslie

From: Astwood, Heather NRR
Sent: Monday, April 04, 2011 9:56 AM
To: Leeds, Eric; Boger, Bruce; Cheok, Michael; Blount, Tom; Azeem, Almas; Cartwright, William; Cusumano, Victor; Fields, Leslie; Heida, Bruce; Meighan, Sean; Nguyen, Quynh; Roquecruz, Carla; Susco, Jeremy; Titus, Brett; Valentine, Nicholee
Cc: Miller, Charles; Grobe, Jack; Holahan, Gary; Hopkins, Jon
Subject: Information: DG Amano's opening statement at CNS

FYI- The Chairman and the EDO are in Vienna this week at the Convention of Nuclear Safety meeting. Here is the opening address by the Director General of IAEA.

Heather Astwood
International Team Leader
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
301-415-1075

From: Hopkins, Jon NRR
Sent: Monday, April 04, 2011 8:54 AM
To: Cullingford, Michael; Astwood, Heather
Subject: DG Amano's opening statement at CNS

http://www.iaea.org/newscenter/statements/2011/amsp2011n009.html

"The accident at Fukushima Daiichi is a matter of concern for all IAEA Member States, not just for the Contracting Parties to the Convention on Nuclear Safety. Japan and the IAEA are co-sponsoring a side event on the accident, and the initial response from safety regulators around the world, at 18.30 this evening. This will include presentations by specialists from the Japanese safety agency NISA and the operating company TEPCO, as well as from the United States and Europe. This event will be open to all IAEA Member States."

W/347

Statements

4 April 2011 | Vienna, Austria
Fifth Review Meeting of Contracting Parties to Convention of Nuclear Safety (http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=40687)

Introductory Statement to Fifth Review Meeting of Contracting Parties to Convention on Nuclear Safety (CNS)

by IAEA Director General Yukiya Amano

Ladies and Gentlemen, Dear Colleagues,

I am pleased to address this *5th Review Meeting of the Convention on Nuclear Safety*.

I would like to begin by expressing - on behalf of the IAEA Secretariat and all of you - our condolences to the people of Japan over the earthquake and tsunami on 11 March, which devastated much of the country.

I also pay tribute to the bravery of the workers and rescue teams who have worked so hard to try to minimize the impact of the accident at the Fukushima Daiichi nuclear power plant and alleviate the concerns of people in Japan and throughout the world.

I know you will agree with me that the crisis at Fukushima Daiichi has enormous implications for nuclear power and confronts all of us with a major challenge. We cannot take a "business as usual" approach.

Although the crisis has still not been overcome, this Review Meeting provides a first formal opportunity for Contracting Parties to the *Convention* to share their preliminary thoughts on the accident and the lessons that need to be learned.

As you know, the key objective of the *Convention* is to achieve and maintain a high level of nuclear safety worldwide through the enhancement of national measures and international cooperation. This is done principally through the peer review mechanism established under the *Convention*.

I understand that you will be discussing issues relating to safety management and safety culture, international cooperation and networking on emergency management. In view of the events in Japan, the President has also invited you to consider some additional topics arising from the Fukushima accident.

The accident at Fukushima Daiichi is a matter of concern for all IAEA Member States, not just for the Contracting Parties to the *Convention on Nuclear Safety*. Japan and the IAEA are co-sponsoring a side event on the accident, and the initial response from safety regulators around the world, at 18.30 this evening. This will include presentations by specialists from the Japanese safety agency NISA and the operating company TEPCO, as well as from the United States and Europe. This event will be open to all IAEA Member States.

Ladies and Gentlemen,

The situation at Fukushima Daiichi remains very serious. The immediate priority is to overcome the crisis and stabilise the reactors. But we must also begin the process of reflection and evaluation.

The worries of millions of people throughout the world about whether nuclear energy is safe must be taken seriously. Rigorous adherence to the most robust international safety standards and full transparency, in good times and bad, are vital for restoring and maintaining public confidence in nuclear power.

The IAEA has been working at full stretch since 11 March to help Japan overcome the crisis.

Agency experts in the field of boiling water reactors are now in the country.

In the next few days, they will visit the on-site emergency control room at the Fukushima Daiichi plant to get first-hand information.

As soon as the situation at Fukushima Daiichi permits, the Agency would like to send an international expert mission to conduct an assessment of the accident, upon request from Japan. I believe this should include an element of peer review.

It is clear that more needs to be done to strengthen the safety of nuclear power plants so that the risk of a future accident is significantly reduced.

As you may know, I have invited our Member States to an *IAEA Ministerial Conference on Nuclear Safety* from June 20 to 24 in Vienna.

The Conference will consider policy and technical issues, including improving the protection of nuclear power plants against multiple hazards, preparedness for prolonged power blackouts, enhancing emergency power supply and protecting spent fuel under accident conditions.

The equally important aspects of effective regulatory oversight, emergency preparedness and response, and accident management generally, will also be discussed, as will the future status of IAEA safety standards and the Agency's role in nuclear safety and security.

It is already clear that arrangements for putting international nuclear experts in touch with each other quickly during a crisis need to be improved.

Ladies and Gentlemen,

As of the end of 2010, more than 60 IAEA Member States had informed the Agency that they were considering introducing nuclear power programmes. Almost all of the 29 countries which already had such programmes planned to expand them.

In the light of the Fukushima Daiichi accident, some countries have announced reviews of their plans for nuclear power.

However, the basic drivers behind the interest in nuclear power have not changed as a result of Fukushima. These include rising global energy demand as well as concerns about climate change, volatile fossil fuel prices and energy security.

Nuclear power has contributed to expanding the supply of energy and has also reduced greenhouse gas and other emissions.

The IAEA will continue to work closely with both established users and newcomers to ensure that nuclear power is used efficiently, safely and securely, and without proliferation of nuclear weapons.

In the light of the Fukushima accident, we will redouble our efforts to help newcomer countries to put an effective nuclear safety infrastructure in place well before the first reactor starts up.

I encourage all newcomer countries to become Contracting Parties to the *Convention on Nuclear Safety* and other relevant conventions.

Established users of nuclear power, for their part, must ensure the highest level of nuclear safety and effective regulation.

Ladies and Gentlemen,

I am confident that valuable lessons will be learned from the Fukushima Daiichi accident which will result in substantial improvements in nuclear operating safety, regulation and the overall safety culture.

You have important work before you at this *Fifth Convention on Nuclear Safety Review Meeting*. Your deliberations will assist us, and all IAEA Member States, as we consider how best to strengthen the role of the IAEA, its safety standards and the global nuclear safety regime more generally.

With these thoughts, I wish you a successful meeting.

Related Resources

- Video: Director General Statement (http://domain.com/newscenter/multimedia/videos/safety/cns/040411/index.html)
- Audio: Director General Statement (http://domain.com/newscenter/multimedia/audio/mp3/dg-cns040411.mp3) [.mp3]
- Photo Gallery (http://www.flickr.com/photos/iaea_imagebank/sets/72157626301014523/) , *Flickr*
- Related Story (http://domain.com/newscenter/news/2011/safety_convention.html)
- Director General's Statements (http://domain.com/newscenter/statements/)
- Director General's Corner (http://domain.com/About/dg/index.html)
- Director General's Biography (http://domain.com/About/dg/amano/biography.html)

Responsible/Contact: Division of Public Information (mailto:webeditor@iaea.org?subject=Feedback) | Last Updated: 21.4.2011

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Departments

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- Nuclear Safety and Security (http://www-ns.iaea.org/)
- Nuclear Sciences and Applications (http://www-naweb.iaea.org/na/index.html)
- Safeguards (http://domain.com/OurWork/SV/Safeguards/index.html)
- Technical Cooperation (http://www-tc.iaea.org/tcweb/default.asp)

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- Safeguards & Additional Protocols (http://domain.com/OurWork/SV/Safeguards/sg_protocol.html)

Policymaking

- General Conference (http://domain.com/About/Policy/GC/)
- Board of Governors (http://domain.com/About/Policy/Board/)
- Member States (http://domain.com/About/Policy/MemberStates/)

Data Portals

- Nucleus Knowledge Portal (http://nucleus.iaea.org/)
- Publications Catalogue (http://www-pub.iaea.org/MTCD/publications/publications.asp)
- International Nuclear Information System (INIS) (http://domain.com/inis/)
- Power Reactor Information System (http://www.iaea.org/programmes/a2/)
- Nuclear Data Service (http://www-nds.iaea.org/)
- General Conference Archive (http://domain.com/About/Policy/GC/)

International Atomic Energy Agency (http://domain.com/)
Vienna International Centre, PO Box 100
A-1400 Vienna, Austria
Telephone: (+431) 2600-0, Facsimile (+431) 2600-7
E-mail: Official Mail (mailto:Official.Mail@iaea.org?subject=Show Feedback)

(http://jigsaw.w3.org/css-validator/validator?uri=http://www.iaea.org/index.html) 

(http://validator.w3.org/check?uri=http://www.iaea.org/index.html)

Fields, Leslie

From: EUCI Events [events@eucievents.com]
Sent: Thursday, April 07, 2011 11:19 AM
To: Fields, Leslie
Subject: The Lessons of Fukushima Daiichi: An In-Depth Technical Analysis Webinar

The Lessons of Fukushima Daiichi:
An In-Depth Technical Analysis

April 26, 2011 :: 12:00 - 1:30 PM Eastern Time

As the events at the Fukushima Daiichi Nuclear Power Plant continue to unfold, this webinar will address:

- The design of the plant, including its safety systems
- Damage to the plant caused by the earthquake and tsunami
- What it means to safely shut down a nuclear reactor
- How hydrogen gas is generated and the resulting explosions
- A timeline of events that occurred at Fukushima
- How different countries and agencies have responded to these events, including the U.S. NRC
- How the Fukushima event will impact the nuclear power industry in the U.S. and worldwide

As this is an ongoing event, the latest information and detail available will be incorporated into the webinar.

PDF Brochure | Pricing and Registration

Topics Include

- The water-steam relation inside the BWR reactor
- What it means when the heat sink is lost by a combination of tripping the turbine and the loss of both normal and emergency core cooling capability
- The steam-pressure build-up inside the reactor vessel, resulting in uncovering the nuclear fuel
- The subsequent oxidation of the zircalloy fuel cladding
- The attempts to relieve the pressure, which also released explosive hydrogen gas
- Release of volatile radioactive fission products
- The design of the spent fuel pool and why it became another challenge to maintain it within its design basis

Full Agenda

Instructed By

Howard L. Sobel, PE, Nuclear Consultant

Instructor Bio

Browse All Events By Category

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From: Robert Taylor
To: Taylor, Robert
Subject: Word Assessment
Date: Tuesday, April 05, 2011 12:40:38 AM
Attachments: NRC Daily Assessment of Daiichi - 4-4-11.docx

w/348

NRC's Daily Assessment of Conditions at Fukushima Daiichi Nuclear Power Plant

Unit 1		Today	Yesterday
Vessel	Cooling	Challenged	Challenged
		↓	↔
	Integrity	Intact	Intact
		↔	↔
Containment	Flooding	Inc./Needed	Inc./Needed
		↔	↔
	Integrity	Challenged	Challenged
		↔	↓
Spent Fuel Pool	Cooling/Level	Adequate	Adequate
		↔	↔
	Integrity	Intact	Intact
		↔	↔

Unit 2		Today	Yesterday
Vessel	Cooling	Challenged	Challenged
		↔	↔
	Integrity	Failed	Failed
		↔	↔
Containment	Flooding	Inc./Needed	Inc./Needed
		↔	↔
	Integrity	Failed	Failed
		↔	↔
Spent Fuel Pool	Cooling/Level	Adequate	Adequate
		↔	↔
	Integrity	Intact	Intact
		↔	↔

Unit 3		Today	Yesterday
Vessel	Cooling	Adequate	Adequate
		↔	↔
	Integrity	Failed	Failed
		↔	↔
Containment	Flooding	Challenged	Challenged
		↔	↔
	Integrity	Failed	Failed
		↔	↔
Spent Fuel Pool	Cooling/Level	Challenged	Challenged
		↔	↔
	Integrity	Challenged	Challenged
		↔	↔

Unit 4		Today	Yesterday
Spent Fuel Pool	Cooling/Level	Challenged	Challenged
		↔	↑
	Integrity	Failed	Failed
		↔	↔

		Today	Yesterday
Protective Measures	Exposure Risk	Low	Low
		↔	↔

Methodology for Developing the Fukushima Daiichi Daily Assessment Report

PURPOSE: The report is prepared to provide a qualitative high level assessment of daily conditions at Fukushima Daiichi that the U.S. Ambassador can use to assess the safety of American citizens in Japan.

DISCLAIMER: The development of the daily assessment report includes a number of inputs. Some of these are objective, such as plant data provided by TEPCO, while others are subjective, such as engineering insights from the NRC's reactor and protective measures specialists in Japan. It should be recognized that there are many unknowns and uncertainties associated with having a complete understanding of conditions in each of the Daiichi reactors and spent fuel pools. As such, this tool represents the collective judgment of the NRC staff in Japan based on all available data.

For each of the major plant parameters listed below, the NRC staff assesses its status daily and bins it into one of the three categories listed. The staff uses the listed plant information and conditions in making its assessment. The arrows on the report indicate the relative trend in plant conditions from the previous day.

1. Reactor Pressure Vessel
    a. Cooling – Adequate, Challenged, or Inadequate.
        i. Flow or Injection Rate
        ii. Reliability of Injection
        iii. Source of Water
    b. Integrity – Intact, Challenged, or Failed.
        i. Temperature indications
        ii. Pressure readings
2. Primary Containment
    a. Flooding Status – Complete/Not needed, Challenged, or Incomplete/Needed.
        i. Water Level
        ii. Sources
        iii. Injection capacity/rate
    b. Integrity - Intact, Challenged, or Failed.
        i. Pressure readings
        ii. Bypass evaluations
        iii. Temperature indications
3. Spent Fuel Pools
    a. Cooling/Level – Adequate, Challenged, or Inadequate.
        i. Flow or Injection Rate
        ii. Reliability of Injection
        iii. Source of Water
    b. Integrity – Intact, Challenged, or Failed. Due to limited available data, this assessment relies strongly on the NRC team's engineering judgment.
4. Protective Measures – Exposure Risk to American citizens in Japan outside the U.S. government's recommended 50-mile evacuation zone.
    a. Low – 50-mile recommendation remains sufficient
    b. Medium – New information has raised questions regarding the sufficiency of the 50-mile recommendation.
    c. High – 50-mile recommendation is no longer sufficient due to changing plant condition

From: Taylor, Robert
To: Giessner, John
Subject: Structural Assessment Executive Summary.docx
Date: Wednesday, April 06, 2011 5:03:00 AM
Attachments: Structural Assessment Executive Summary.docx

Here you go.

w/349

In response to the events at Fukushima Daiichi, the NRC dispatched two structural engineers to be part of its team at the U.S. Embassy in Tokyo. While there, the engineers performed analyses of the structural integrity of the primary containments buildings and the Unit 4 spent fuel pool, as well as providing input to a number of other activities described in the report. Each of these analyses were challenged by the limited data available. Nonetheless, to the extent practical, the results of these analyses were incorporated into the work of the Consortium and appropriately considered during the development of the assessment papers that were provided to the Government of Japan.

From: Weber, Michael (EDO)
To: Taylor, Robert
Subject: RESPONSE - NRC"s Daily Assessment of Conditions at Fukushima Daiichi
Date: Wednesday, April 06, 2011 7:06:01 PM

Outstanding!

From: Taylor, Robert (NRR)
Sent: Wednesday, April 06, 2011 7:03 PM
To: Weber, Michael
Subject: RE: RESPONSE - NRC's Daily Assessment of Conditions at Fukushima Daiichi

With Nitrogen inerting starting, we are hoping that water injection rates to the reactors will increase. Hopefully, some up arrows will be needed in the near future.

From: Weber, Michael (EDO)
Sent: Wednesday, April 06, 2011 6:55 PM
To: Taylor, Robert
Subject: RESPONSE - NRC's Daily Assessment of Conditions at Fukushima Daiichi

Another day, another down arrow! Thanks, Rob

From: Taylor, Robert (NRR)
Sent: Wednesday, April 06, 2011 2:32 AM
To: Jaczko, Gregory
Cc: Borchardt, Bill; Weber, Michael; Virgilio, Martin; Casto, Chuck; Leeds, Eric; RST01 Hoc
Subject: NRC's Daily Assessment of Conditions at Fukushima Daiichi

Dear Chairman,

Attached please find the NRC Japan Team's Daily Assessment of conditions at the Fukushima Daiichi nuclear power plants and spent fuel pools.

There is only one change of note for today. The NRC Japan Team continues to monitor TEPCO's make-up water additions to each for the Daiichi SFPs. Over the last few days, the makeup to the Unit 4 SFP has not been sufficient to offset TEPCO's calculated losses from steaming. This is reflected by a down arrow in the attached for cooling and level of the Unit 4 SFP. We will continue to discuss this issue with NISA and TEPCO.

If you have any questions, please don't hesitate to ask.

Best regards,
Rob Taylor
NRC Japan Team

W/350

From: EUCI Events
To: Taylor, Robert
Subject: The Lessons of Fukushima Daiichi: An In-Depth Technical Analysis Webinar
Date: Thursday, April 07, 2011 11:47:19 AM

The Lessons of Fukushima Daiichi:
An In-Depth Technical Analysis

April 26, 2011 :: 12:00 - 1:30 PM Eastern Time

As the events at the Fukushima Daiichi Nuclear Power Plant continue to unfold, this webinar will address:

- The design of the plant, including its safety systems
- Damage to the plant caused by the earthquake and tsunami
- What it means to safely shut down a nuclear reactor
- How hydrogen gas is generated and the resulting explosions
- A timeline of events that occurred at Fukushima
- How different countries and agencies have responded to these events, including the U.S. NRC
- How the Fukushima event will impact the nuclear power industry in the U.S. and worldwide

As this is an ongoing event, the latest information and detail available will be incorporated into the webinar.

PDF Brochure | Pricing and Registration

Topics Include

- The water-steam relation inside the BWR reactor
- What it means when the heat sink is lost by a combination of tripping the turbine and the loss of both normal and emergency core cooling capability
- The steam-pressure build-up inside the reactor vessel, resulting in uncovering the nuclear fuel
- The subsequent oxidation of the zircalloy fuel cladding
- The attempts to relieve the pressure, which also released explosive hydrogen gas
- Release of volatile radioactive fission products
- The design of the spent fuel pool and why it became another challenge to maintain it within its design basis

Full Agenda

Instructed By

Howard L. Sobel, PE, Nuclear Consultant

Instructor Bio

Browse All Events By Category

- Generation
- Natural Gas
- Nuclear
- Coal
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- Solar
- Biomass
- Hydro
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- Metering Technologies
- Demand Response, Energy Efficiency
- Environmental and Emissions
- Markets and Trading
- Risk Management
- Rates, Finance and Accounting
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- Communications/Marketing
- Utility Business and Management
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- Regulatory, Policy and Legal Issues

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Imboden, Andy

From: Imboden, Andy NRR
Sent: Monday, April 11, 2011 9:34 AM
To: Brandon, Lou
Subject: Operations Center Lessons Learned - Japanese Earthquake/Tsunami Event

- PMT01 should be assigned to the PMT lead, not the meteorologist. Emails come in sometimes and need to be redirected.
- The NRC and RASCAL recognize atmospheric stability classes A, B, C, D, E, F, and G. Most of the rest of the Federal government (NARAC, etc.) only use A, B, C, D, E, and F. The PMT-Meteorologist position should be given instructions on when to change an F to a G.

Andy Imboden
Chief, Environmental Review Branch
NRR/DLR
301-415-2327

R

W/352

Cheok, Michael

From: Cheok, Michael NRR
Sent: Monday, April 11, 2011 10:23 AM
To: 'Cheok, Geraldine S. Ms.'
Subject: RE: Fukushima presentation

Thanks – I think I have see previous versions of this.

Mike

From: Cheok, Geraldine S. Ms. [mailto:cheok@nist.gov]
Sent: Monday, April 11, 2011 9:37 AM
To: Cheok, Michael
Subject: Fukushima presentation

You probably already have better presentations but I thought the graphics and animations were good to help a lay person understand what was going on.

http://www.seyth.com/ressources/quake/AREVA-Document.pdf

Gerry

R

W/353

From: Taylor, Robert
To: Russ Morales; Ulses, Anthony; Trapp, James
Subject: RE: NOVA: Japan"s Killer Quake
Date: Monday, April 11, 2011 9:57:00 AM

I saw it. Very good, but limited discussion of the NPPs.

From: Russ Morales [mailto:russ@earthtabi.com]
Sent: Monday, April 11, 2011 9:51 AM
To: Taylor, Robert; Ulses, Anthony; Trapp, James
Subject: NOVA: Japan's Killer Quake

Did you guys see this one? It was pretty good. Hard to watch, but a good show and so soon afterward. You can watch the full episode online at the link below if you have not seen it yet...

Russ

http://www.pbs.org/wgbh/nova/earth/japan-killer-quake.html

W/354

From: Sheikh, Abdul
To: Taylor, Robert
Subject: Japan Video
Date: Monday, April 11, 2011 7:44:32 AM

Do you still have the video which shows the damage to Fukushima plant. If so, can I make a copy.

Abdul
415-6004

From: Russ Morales
To: Taylor, Robert; Ulses, Anthony; Trapp, James
Subject: NOVA: Japan"s Killer Quake
Date: Monday, April 11, 2011 9:50:42 AM

Did you guys see this one? It was pretty good. Hard to watch, but a good show and so soon afterward. You can watch the full episode online at the link below if you have not seen it yet...

Russ

http://www.pbs.org/wgbh/nova/earth/japan-killer-quake.html

W/354

Thompson, John

From: Giantelli, Joseph NRR
Sent: Monday, April 11, 2011 8:13 AM
To: NRR_DIRS_IOEB Distribution
Subject: YouTube Video of Wave - TEPCO Confirms 15 Meter Waves Hit Fukushima Daiichi

http://www.youtube.com/watch?v=Uw0zVoktJXw

http://www.youtube.com/watch?v=nJ3IgHQuCBM

Joe Giantelli
Reactor Systems Engineer
Operating Experience Branch
NRR/ADRO/DIRS/IOEB
301-415-0504
joseph.giantelli@nrc.gov

W/357

Pedersen, Roger

From: Garry, Steven NRR
Sent: Tuesday, April 12, 2011 12:32 PM
To: Bonser, Brian; Brock, Terry; Bush-Goddard, Stephanie; Carson, Louis; Cassidy, John; Clemons-Webb, Candace; Conatser, Richard; Dickson, Billy; Dickson, Elijah; Dionne, Bruce; Dykes, Carmen; Furia, Joseph; Garry, Steven; Go, Tony; Graves, Chris; Greene, Natasha; Griffis, Jeff; Hamilton, Ruben; Henderson, Pamela; Jimenez, Manuel; Kellner, Robert; Kuzo, George; LaVera, Ronald; Lewis, Doris; Loo, Wade; Lynn, Henry; Mahlahla, Latonya; Mitchell, Mark; Moslak, Thomas; Nielsen, Adam; Nimitz, Ronald; Noggle, James; Pedersen, Roger; Phalen, Martin; Pursley, William; Ricketson, Larry; Rivera, Jonathan; Roach, Edward; Rolph, Ronald; Saba, Mohammad; Schaffer, Steven; Shaffer, Vered; Shoop, Undine; Stearns, Don; Sun, Casper; Tomon, John; Werner, Greg
Subject: video of dose rates near Fukushima

Here's a 12 minute, YouTube video of a car (possibly a news crew) entering the evacuation zone with a dose rate meter that Manny Jimenez found. It shows steady state dose rates at 30 km is 0.1 mrem/hr and at 1.5 km is 11 mrem/hr.

Some of this might be upwind, downwind, etc. we don't know.

http://www.youtube.com/watch?v=yp9iJ3pPuL8

W/358

Weaver, Tonna

From: Miranda, Samuel
Sent: Tuesday, April 12, 2011 8:58 AM
To: Martin, Robert
Subject: RE:

THE WALL STREET JOURNAL.
WSJ.com

- BUSINESS
- APRIL 7, 2011

Business Leader Slams Japan's Electricity Plan

By CHESTER DAWSON

TOKYO—The head of Japan's leading big-business lobby on Wednesday sharply criticized a government proposal to avoid massive blackouts this summer by cutting the supply of electricity to industry by 25%, calling instead for businesses to come up with their own energy-saving plans in ways that keep more Japanese factories humming amid a crippling power shortage.

"The government had been drafting a plan to cut demand by 25% across the board, but we raised immediate objections," Hiromasa Yonekura, chairman of Nippon Keidanren, the Japan's top industry association, said in an interview with The Wall Street Journal.

Bloomberg News

Hiromasa Yonekura, chairman of Nippon Keidanren, urges businesses to propose their own energy-saving plans.

W/359

Japan's trade minister, Banri Kaieda, told reporters Tuesday that it would be "necessary" to place restrictions on electricity supplies, but he said that would likely exempt households—thereby targeting businesses. That came as the government floated a trial balloon about a plan to impose a 25% cut on industrial use of electricity, which was expected to be announced by week's end, according to Japanese media reports.

Much of eastern and northern Japan, including the capital city of Tokyo, faces a large gap between the expected demand and supply of power during the peak summer months after the March 11 earthquake knocked out several electricity-generation facilities, including a nuclear-power plant. The Japanese government has scrambled to prevent uncontrolled power outages since then through rolling blackouts, but this has disrupted production schedules at manufacturers.

Japan's large-lot industrial users make up about 40% of total electricity demand, and its household sector accounts for an additional 30%, with the remainder coming from service businesses. Tokyo Electric Power Co. estimates it will be able to lift the supply of electricity to 50 million kilowatts over the next several weeks from 46.5 million kilowatts currently by bringing damaged or mothballed generation capacity back online. But Tepco expects demand to reach 55 million kilowatts this summer. Last year, it peaked at 60 million kilowatts during a midsummer heat wave.

The Nippon Keidanren and other business groups have bristled at the government's top-down approach to saving electricity. Instead, corporate Japan has asked to be allowed to take the initiative by coming up with its own energy-saving strategies such as running plants on weekends, when electricity demand is lower, and spreading out traditional summer holidays. Mr. Yonekura, who also serves as chairman of Sumitomo Chemical Co., said that one of his company's plants outside Tokyo can supply itself with its own generators, even though they cost more to run than tapping into the electricity grid.

The lack of a stable supply of electricity is expected to weigh heavily on the Japanese economy this year. Overall damage from the earthquake and its aftermath will likely total some ¥14 trillion to ¥15 trillion ($165 billion-$177 billion) and push down Japan's already low economic growth by about one percentage point, Mr. Yonekura estimated.

Before the quake occurred, the government had expected the gross domestic product to increase 1.5% on a real-term basis in the year that started April 1.

Mr. Yonekura defended the embattled Tepco's management, and its response to—and responsibility for—the crisis at the Fukushima Daiichi nuclear plant, which has been leaking radiation. Critics say Tepco failed to properly prepare for a large quake and tsunami, even though Japan sits astride an active fault zone and the plant was built directly on the Pacific coast.

"Tepco is also a victim in all of this," Mr. Yonekura said, noting two of its employees died in the tsunami and others have toiled without rest since then. "They built their plants strictly in line with government standards. It's not the least bit true they have been too lax," he said.

As a result of the continuing crisis at the Daiichi plant, Prime Minister Naoto Kan and other officials have indicated that the country may need to revisit its strategic energy policies, which call for increased reliance on nuclear power. The country's Basic Act on Energy Policy envisions adding nine new nuclear plants by 2020, which would raise nuclear power's share of total electricity output from the current 30% to nearly 50%.

Mr. Yonekura said that schedule may be postponed while the cause of the Daiichi crisis is investigated and new supplemental safety measures are implemented at existing plants. But he scoffed at the notion of abandoning those longer-term goals to promote nuclear power and said that Japan would still be able to meet its commitments to reduce carbon-dioxide emissions by cutting the use of fossil fuels.

Mr. Yonekura also welcomed the recent weakening of the Japanese currency to a six-month low of ¥85 against the dollar, describing it as a return to normalcy after a spike following the March 11 earthquake. The Japanese currency rose to a postwar high of ¥76.25 to the U.S. dollar on March 17.

From: Martin, Robert
Sent: Tuesday, April 12, 2011 8:54 AM
To: Miranda, Samuel
Subject:

Do you have the following article electronically? I think its from April 4 wsj.
BY CHESTER DAWSON

TOKYO—The head of Japan's leading big-business lobby on Wednesday sharply criticized a government proposal to avoid massive blackouts this summer by cutting the supply of electricity to industry by 25%, calling instead for businesses to come up with their own energy-saving plans in ways that keep more Japanese factories humming amid a crippling power shortage.

"The government had been drafting a plan to cut demand by 25% across the board, but we raised immediate objections," Hiromasa Yonekura, chairman of Nippon Keidanren, the Japan's top industry association, said in an interview with The Wall Street Journal.

Japan's trade minister, Banri Kaieda, ...

Dube, Donald

From: Dube, Donald
Sent: Wednesday, April 13, 2011 1:20 PM
To: Hasselberg, Rick
Subject: clarifications
Attachments: Document (3)_dad.pdf

Rick, I'm not sure where the original Word file lies anymore but I thought it was important enough to add these clarifying comments on the sequence of events. Some may misconstrue the statement of reactor pressure vessel breach at Unit 2 as a full breach, whereas what is really meant is the possibility of localized breach in one or more CRD penetrations. Likewise, we need to be cautious regarding the conclusion that molten core/concrete interaction (MCCI) has or has not taken place. There are several possible explanations for the pressure surges in the drywell, none of which are really encouraging, however.

Don

WP360

Fukushima Dai Ichi Unit 2 Accident Description

Subsequent to the earthquake and resulting tsunami on March 11, 2011, all power was lost to Unit 2 (among others) and there was no way to provide makeup water to remove the decay heat following reactor shutdown at 14:46. All ac power sources were lost at 15:42, and a high-pressure station blackout situation resulted. The RCIC system was activated shortly thereafter, and water level was controlled in the RPV until all backup battery were exhausted, at about noon on March 14th. From then on, a severe accident began, during which the core was uncovered, the drywell was pressurized and vented, the RPV was breached, and a hydrogen burn likely occurred in the reactor building, possibly damaging the torus. Timing of the significant events is shown in Table 1.

Event	Day	Hour	Remarks
Reactor shut down	3/11	14:46	
All ac power lost	3/11	15:42	
RCIC initiated	3/11	15:42	
RCIC lost	3/14	10:30	Water level starts dropping at this time.
TAF uncovered	3/14	16:20	
Sea water injection initiated	3/14	16:34	
S/RV opened	3/14	17:52	Approximate time. The RPV pressure drops rapidly from 7350 kPag to 540k Pag by 20:02
Water 4 meters below TAF	3/14	19:00	This time is approximate.
First pour of core debris into lower plenum	3/14	20:32	Steam spike results in RPV, to 1440 kPag
Second pour into lower plenum	3/14	22:50	RPV pressure peaks at 3150 kPag
Drywell pressure reaches 750 kPaa	3/14	23:45	Pressure is about 110 psia (125 psig)
Drywell vent opened	3/14	24:00	Venting to avert catastrophic containment failure.
Third pour into lower plenum	3/15	0:08	A vessel breach may have occurred here, because the RPV pressure and drywell pressure wer the same after the steam spike ended.
High radiation in drywell	3/15	1:53	This is a signal that the RPV was breached. The radiation level then dimished, probably because airborne fission products were venting into the reactor building.
Abnormal sound in reactor building near suppression pool	3/15	6:00	This was probably due to a hydrogen burn in the reactor building.
Drywell pressure begins to drop	3/15	11:25	Pressure dropped to aboud 1.6 bars.
Temporary pressure increase in drywell (radiation level jumps)	3/15	13:00	Radiation level had dropped after initial jump at 1:53. Following 13:00, it remained high. The vessel probably was breached at this time, because the RPV pressure quickly dropped to atmospheric levels and remained

			there at least to 3/24.. The pressure rose to about 4 bars and then decreased to 2.4 bars.
Another temporary pressure increase in drywell	3/16	5:35	More core debris poured out, this time all the way into the pedestal region. The 2.1 bar pressure spike to 4.5 bars was probably caused by molten core/water interactions.

Date (m/d)		Reactor water level (fuel zoneA)[mm]	Reactor water level (fuel zone B)[mm]	Reactor water level (wide range)[mm]	Reactor pressureA [Mpag]	Reactor pressure A[KPag]	Reactor pressure B [KPag]	D/W Pressure [KPaa]	D/W Pressure [KPag]	S/C Pressure [KPaa]	S/C Pressure [KPag]	CAMS (D/W) [Sv/h]	CAMS (S/P) [Sv/h]	Water supply nozzle Temperature	Pressure vessel lower part Temperature	Note
3月12日	12:55				6.1	6100	6100									
3月12日	14:10	3800	3800				0									
3月12日	14:50	3600	3600				0									
3月13日	1:00	3650	3650		6.3	6300	6300									
3月13日	7:00	3650	3650		6.12	6120	6120									
3月13日	8:55	3700	3700		6.08	6080	6080	360	258.7							
3月13日	9:25	3700	3700		6.08	6080	6080	360	258.7							
3月13日	10:55	3700	3700				0									
3月13日	11:25	3700	3700				0									
3月13日	11:55	3750	3750				0									
3月13日	15:00		3750				0	395	293.7							
3月13日	17:30	3750	3750				0	410	308.7							
3月13日	18:45	3800	3750				0	410	308.7							
3月13日	19:00	3800	3800				0	420	318.7							
3月13日	21:00	3800	3800				0									
3月13日	21:30						0	425	323.7							
3月13日	22:30	3850	3900				0	430	328.7							
3月13日	23:30	3850	3900				0	435	333.7							
3月14日	0:00	3850	3900				0	435	333.7							
3月14日	2:00	3850	3900				0	440	338.7							
3月14日	3:00	3850	3900		5.45	5450	5450									
3月14日	4:00	3850	3900		5.42	5420	5420									
3月14日	4:30	3850	3900		5.4	5400	5400									
3月14日	5:30	3900	3900		5.4	5400	5400			467	365.7					
3月14日	6:30	3900	3900		5.355	5355	5355			469	363.7	0.001	0.008			
3月14日	8:00	3950	3950		5.31	5310	5310	455	353.7	474	372.7	0.001	0.01			
3月14日	10:30	3850	3850		5.648	5648	5648	460	358.7	485	383.7					ドーム
3月14日	12:00	3100	3400		6.008	6008	6008	460	358.7	485	383.7	0.001	0.012			
3月14日	14:00	2000	2000		7.583	7583	7695	460	358.7							
3月14日	15:00	1200	1200		7.268	7268	7515	440	338.7			0.001	0.13			
3月14日	15:50	500			7.43	7130		420	318.7							
3月14日	16:00	300			7.45	7450		420	318.7							
3月14日	16:20	0			7	7000		420	318.7							16:35 SRVOR
3月14日	16:47	-520			6	6000										
3月14日	17:30	-1100			6.97	6970										
3月14日	17:35				6.98	6980										
3月14日	17:52	-1500			7.35	7350										
3月14日	18:06	-1100			[illegible]	[illegible]										18:06 SRV
3月14日	18:12				7.47	7470										
3月14日	18:13	-3400			7.18	7180		395	293.7							
3月14日	18:14	-3500			7.97	7970		395	293.7							
3月14日	18:17	-3500			1.64	1610		395	293.7							
3月14日	18:18	-3600			1.51	1510		100	298.7							
3月14日	18:19	-3600			1.46	1460		100	298.7							
3月14日	18:20	3600			1.4	1490		400	298.7							
3月14日	18:29				0.833	833										
3月14日	18:58	3900			0.563	563										
3月14日	19:03				0.63	630										
3月14日	19:22				0.65	650		395	293.7							
3月14日	19:38				0.61	610		395	293.7							
3月14日	19:59				0.56	560		455	353.7							
3月14日	20:03				0.54	540		410	308.7							
3月14日	20:10				0.54	540		418	316.7							
3月14日	20:15				0.54	540		420	318.7							
3月14日	20:20				0.563	563		420	318.7							
3月14日	20:32				0.608	608		420	318.7							
3月14日	20:37				0.81	810		421	319.7							
3月14日	20:54				1.17	1170		421	319.7							
3月14日	21:09				1.44	1440		418	316.7							
3月14日	21:20	-3400			0.883	883		470	368.7							
3月14日	21:55	-1800			0.405	405		480	378.7							
3月14日	22:00	1600			0.405	405		480	378.7							
3月14日	22:10	-1600			0.405	405		480	378.7							
3月14日	22:20	1400			0.405	405		480	378.7							
3月14日	22:30	-1200			0.405	405		482	380.7							
3月14日	22:40	-700			0.428	428		482	380.7							
3月14日	22:50	1600			1.82	1820		540	438.7							
3月14日	23:00	1700			2.07	2070		580	478.7							
3月14日	23:06	-1700				2070		620	518.7							
3月14日	23:30					3150		700	598.7							
3月14日	23:36					1730		740	638.7							
3月14日	23:45					675		750	648.7							
3月14日	23:54					653		745	643.7	340	238.7					
3月15日	0:06					675		740	638.7							
3月15日	0:08					788		740	638.7							
3月15日	0:10					833		740	638.7							
3月15日	0:16					1040		740	638.7							
3月15日	0:22					1170		735	633.7							
3月15日	0:28					1350		730	628.7							
3月15日	0:32					1490		725	623.7							
3月15日	0:41					1710		720	618.7							
3月15日	1:17					675		730	628.7							
3月15日	1:20					653		730	628.7	450	328.7					
3月15日	1:31					630		730	628.7							
3月15日	1:54					630		725	623.7	440	318.7	30				

3月15日	2:26					675		740	638.7	340	238.7					
3月15日	2:39					653		750	648.7	330	228.7					
3月15日	2:45					653		750	648.7	320	218.7					
3月15日	2:50					653		750	648.7	330	228.7					
3月15日	3:20					653		750	648.7	330	228.7					
3月15日	3:40					653		750	648.7	330	228.7	51.2	5.87			
3月15日	4:10					653		750	648.7	330	228.7	51.9	5.72			
3月15日	4:20					637		750	648.7	310	208.7	53.2	5.65			
3月15日	4:30					632		750	648.7	300	198.7	54.4	5.58			
3月15日	4:45					632		750	648.7	310	208.7					
3月15日	5:00					626		750	648.7	300	198.7					
3月15日	5:15					623		740	638.7	300	198.7					
3月15日	5:20					621		730	628.7	310	208.7	62.7	4.8			
3月15日	5:30					621		730	628.7	310	208.7	59.5	5.08			
3月15日	6:00					614		730	628.7	270	168.7	61.6	4.89			
3月15日	7:20	-2500				612		730	628.7							
3月15日	11:25	1200				270		415	213.7			0.461	5.79			
3月15日	11:42	1400				315		155	53.7			0.461	5.53			
3月15日	11:58	-1350				428		155.7	53.7			0.465	5.57			
3月15日	13:00	-1700				608		415	313.7			0.477	4.62			
3月15日	15:25	-1950				113		275	173.7			135	6.92			
3月15日	15:50	-1800				117		276	174.7							
3月15日	16:10	-1800				119		270	168.7			138	6.94			
3月15日	18:43	1200				99		250	148.7			122	4.4			
3月16日	1:24	-1400				-23		340	138.7			103	3.68			
3月16日	1:54	-1400				23		240	138.7			103	3.65			
3月16日	5:35	-1500				41		220	118.7			70	24.3			
3月16日	6:55	-1400				-43		350	348.7			97.2	3.37			
3月16日	12:25	-1400						100	298.7							
3月16日	23:50	-1400				-63	79	75	-26.3							
3月17日	3:10	-1400				-65	-79	75	-26.3			87	2.65			
3月17日	11:30	-1800				-29	-47	115	13.7			84.6	25			
3月17日	12:50	-1800				-27	45	110	8.7			84.4	2.43			
3月17日	21:50	-1400						130	28.7			########	2.41			
3月18日	2:50	1400				-16	-32	130	28.7			########	2.4			
3月18日	7:55	1400				-14	-29	130	28.7			########	2.37			
3月18日	16:00	-1400				2	18	139	37.7			########	2.34			
3月18日	20:55	-1400				-2		140	38.7			########	2.33			
3月18日	21:10	-1400				5	-20	140	38.7			########	2.32			
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3月19日	22:30	-1350				9	23	130	28.7			########	2.2			
3月20日	0:00	-1300				7	23	130	28.7			########	2.2			
3月20日	5:00	-1300				11	23	130	28.7			########	15			
3月20日	11:00	-1400				-16	-20	125	23.7			########	15			
3月20日	15:00	1400				16	-20	125	23.7			########	2.11			
3月20日	20:00	-1400				18	-20	120	18.7			########	2.11			
3月21日	3:00	1350				-18	20	120	18.7			########	########			
3月21日	8:00	-1350				20	-20	120	18.7			########	########			
3月21日	13:30	1350				-20		120	18.7			########	2.04			
3月21日	14:00	-1350				-23		120	18.7			########	2.03			
3月21日	14:25	1350				-23	25	120	18.7			########	2.03			
3月22日	0:15	-1400				-25	-27	110	8.7			########	1.99			
3月22日	6:00	-1350				5	-29	110	8.7			########	1.95			
3月22日	11:20	-1350				-18	-18	110	8.7			########	1.93	105	109	
3月22日	15:30	-1300				-29	32	110	8.7			########	1.9	100	105	
3月22日	17:00	-1350				-27	-32	110	8.7			########	1.88	102	111	
3月22日	23:00	-1350				20	13	110	8.7			50.8	1.83	105	106	
3月23日	4:20	1300				-25	25	110	8.7			52	1.8	102	109	
3月23日	9:00	-1300				-23	-23	110	8.7			51.4	1.76	105	105	
3月23日	14:00	-1350				-36	-36	110	8.7			50.7	1.67	101	102	
3月23日	21:00	-1300				-36	-36	110	8.7			########	1.53	100	103	
3月24日	1:00	-1300				-25	-25	105	3.7			49.3	1.49	102	109	
3月24日	9:00	-1150				-135	-38	110	8.7			48.4	1.4	100	105	
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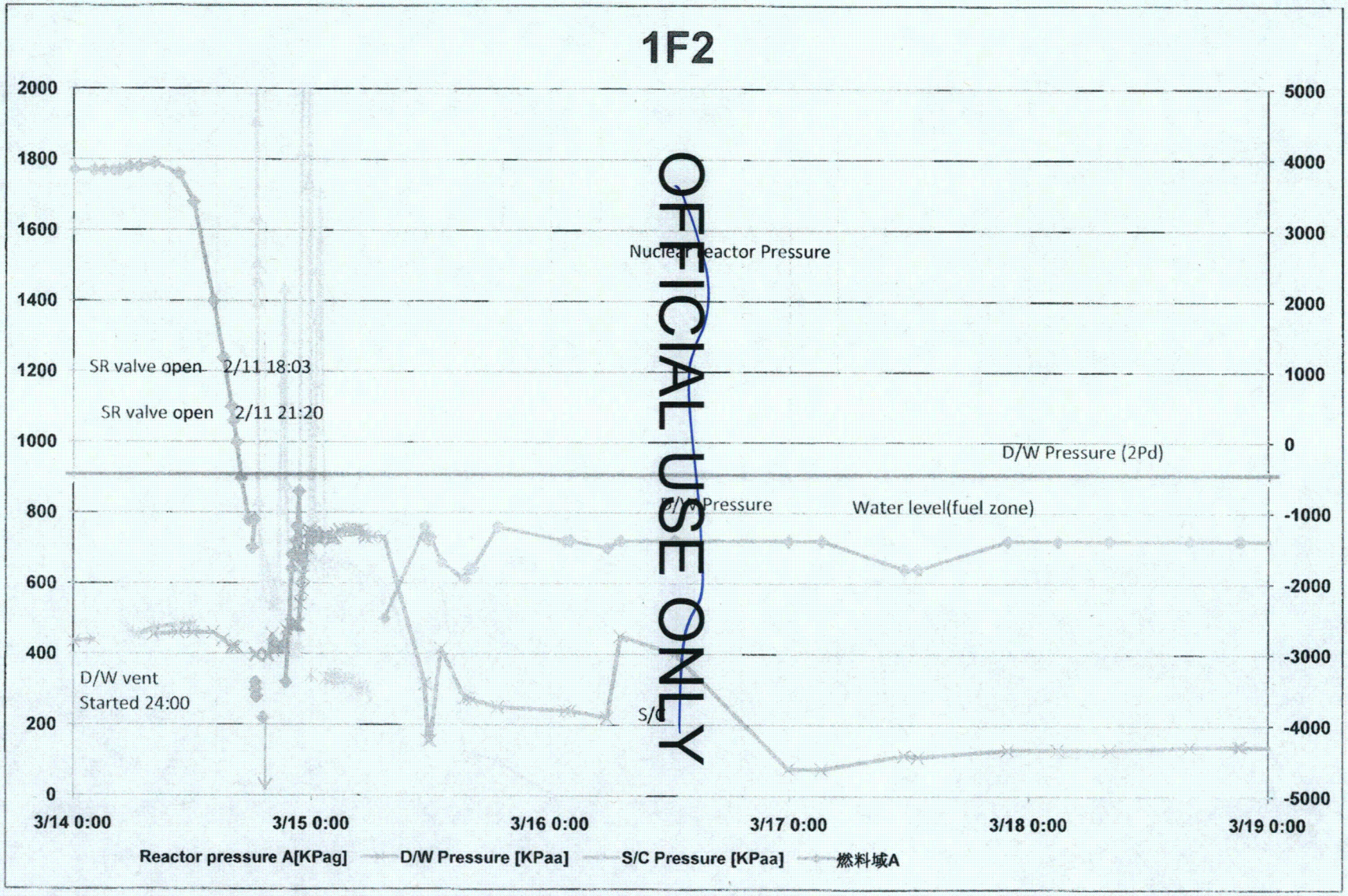

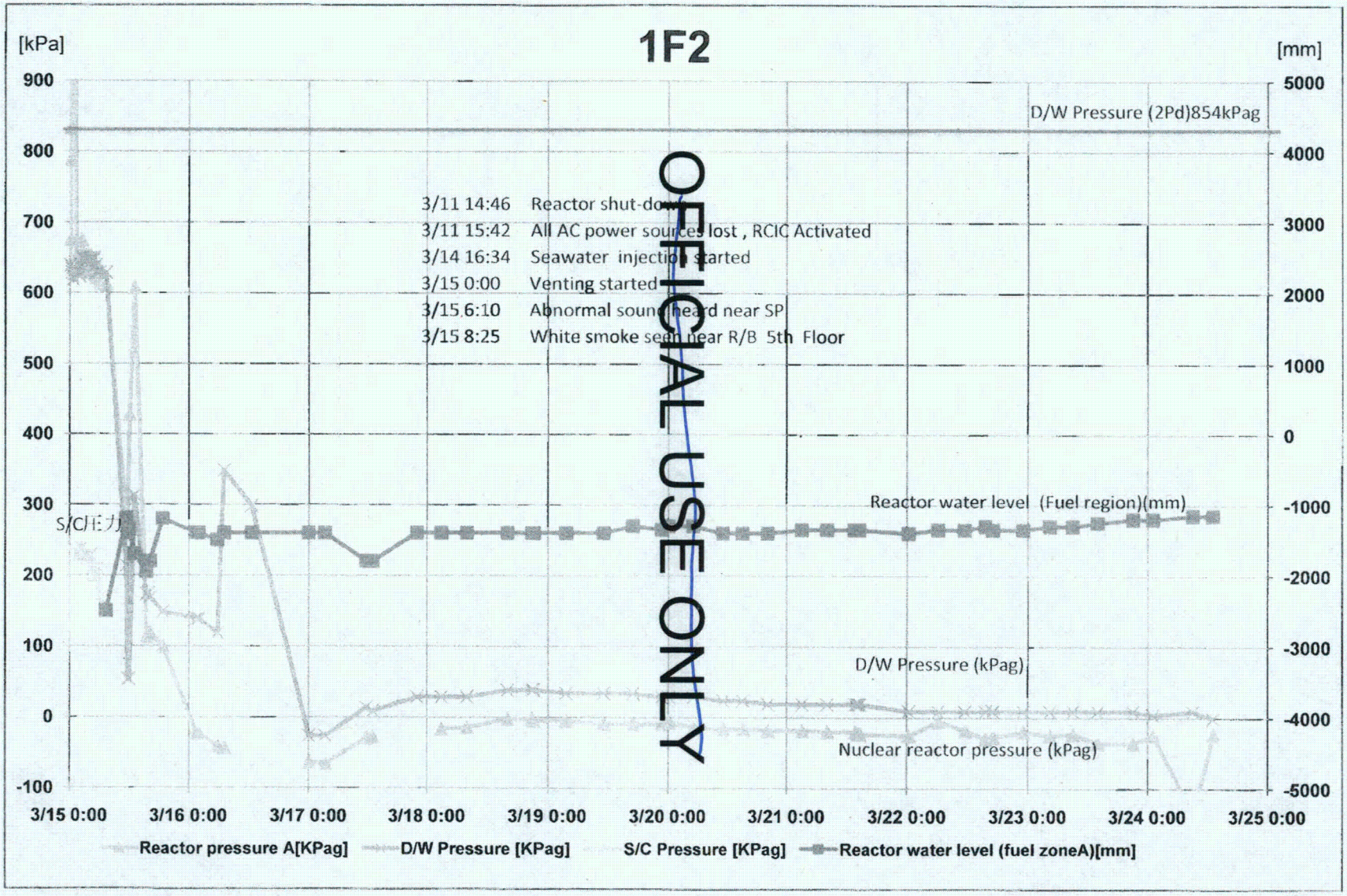

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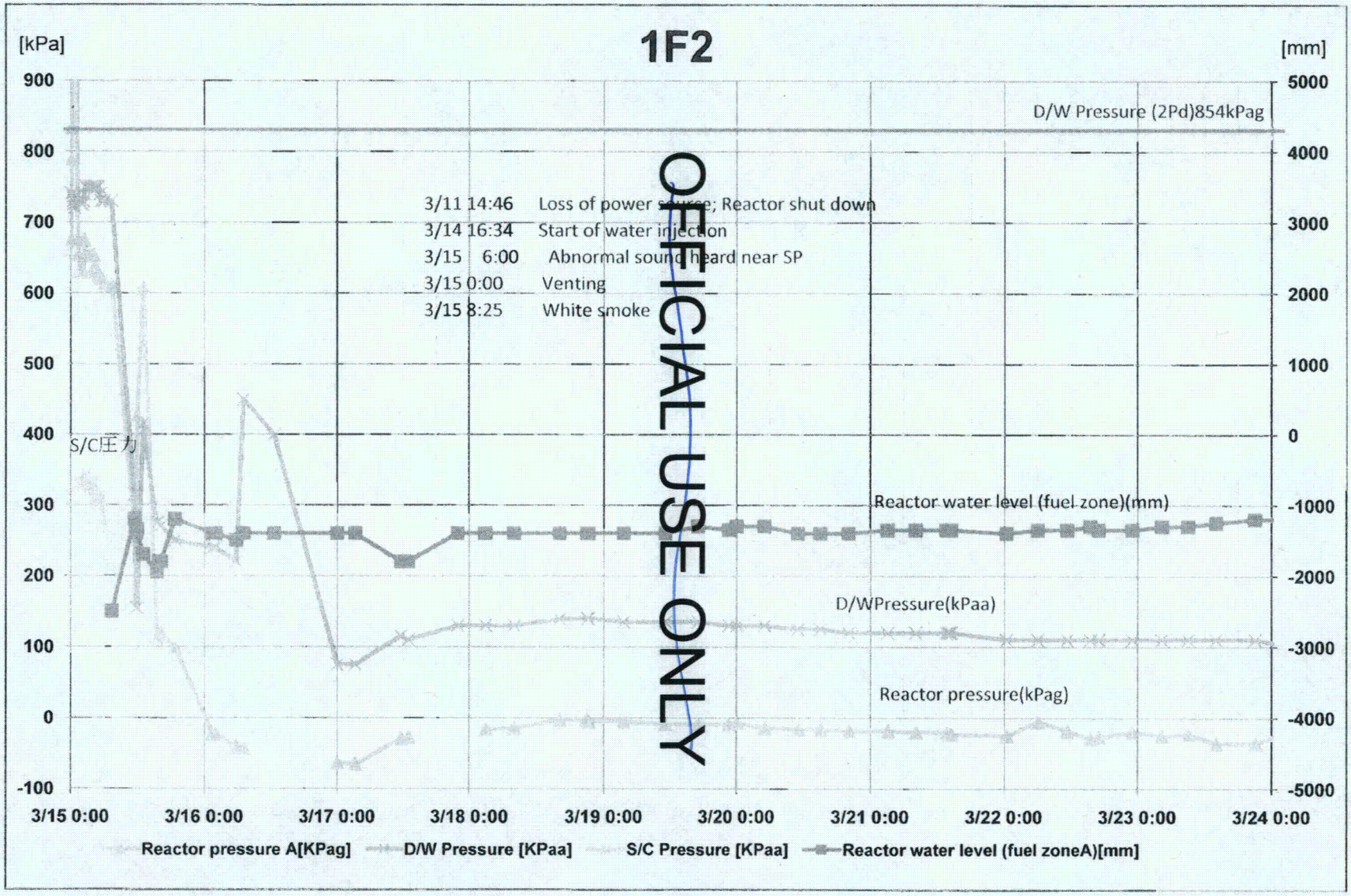

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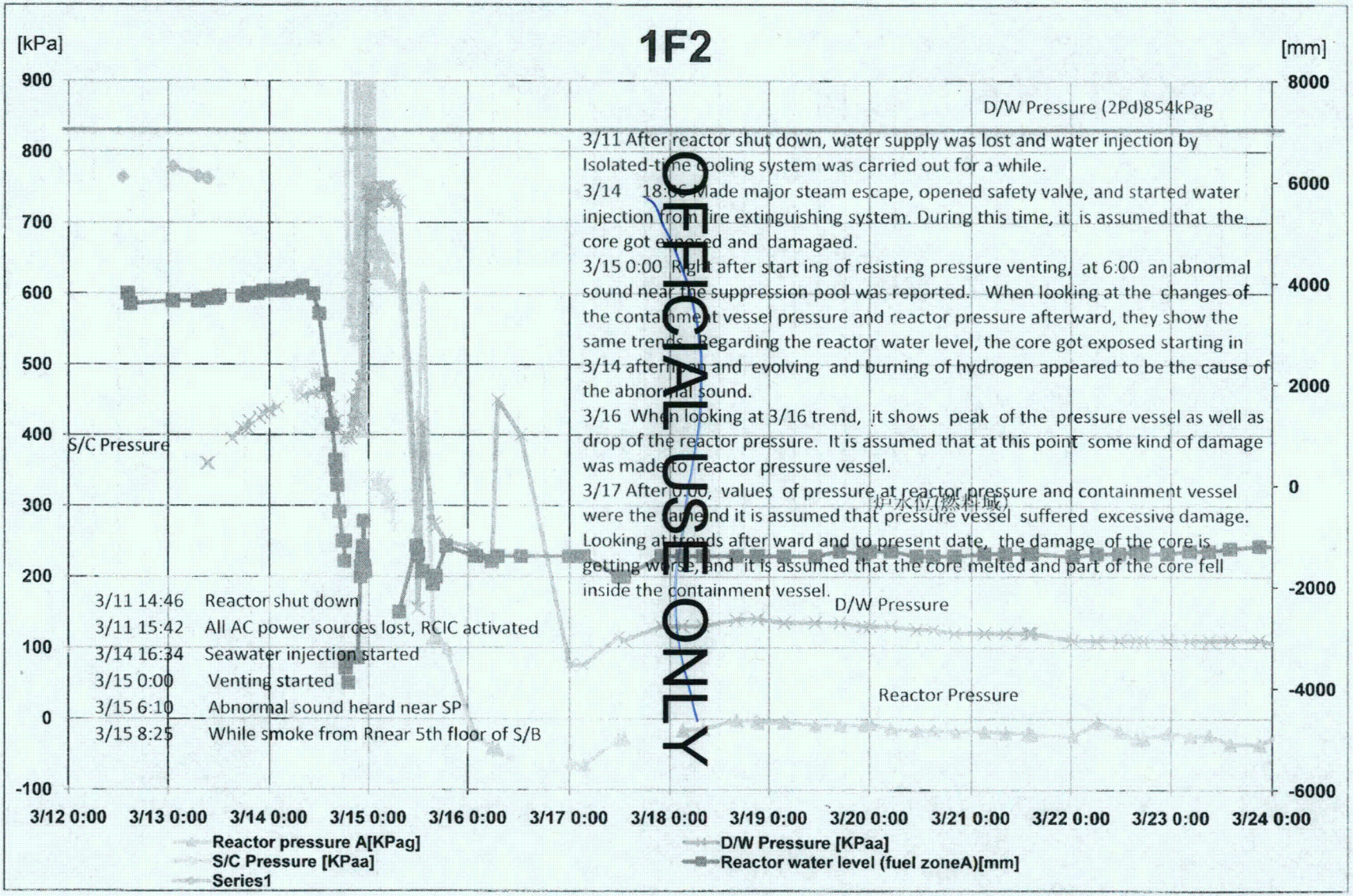

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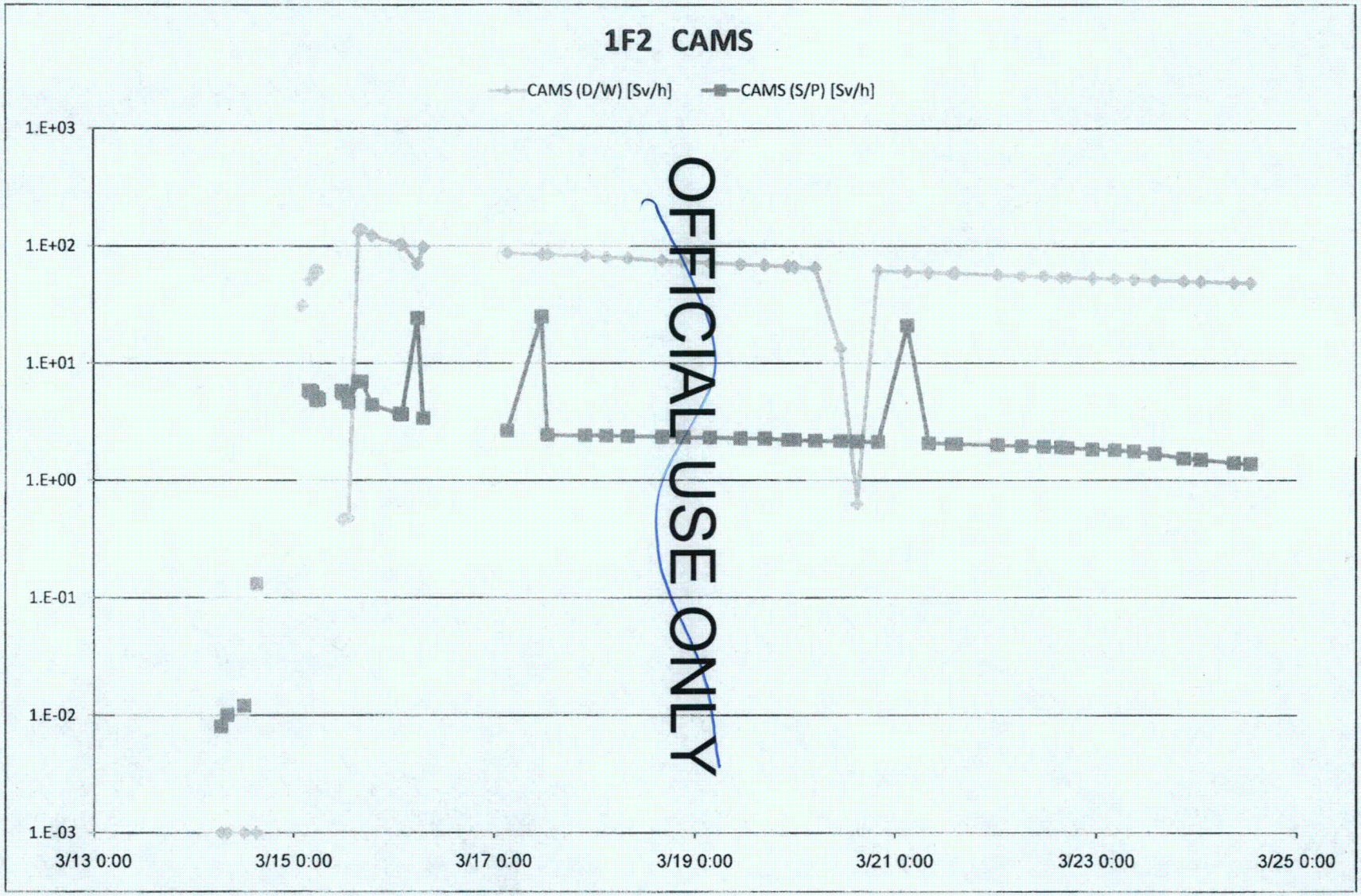

Date (m/d)		Reactor water level (fuel zoneA)[mm]	Reactor water level (fuel zone B)[mm]	Reactor water level (wide range)[mm]	Reactor pressureA [Mpag]	Reactor pressure A[KPag]	Reactor pressure B [KPag]	D/W Pressure [KPaa]	D/W Pressure [KPag]	S/C Pressure [KPaa]	S/C Pressure [KPag]	CAMS (D/W) [Sv/h]	CAMS (S/P) [Sv/h]	Water supply nozzle Temperature	Pressure vessel lower part Temperature	Note
3月12日	12:55				6.1	6100	6100									
3月12日	14:10	3800	3800				0									
3月12日	14:50	3600	3600				0									
3月13日	1:00	3650	3650		6.3	6300	6300									
3月13日	7:00	3650	3650		6.12	6120	6120									
3月13日	8:55	3700	3700		6.08	6080	6080	360	258.7							
3月13日	9:25	3700	3700		6.08	6080	6080	360	258.7							
3月13日	10:55	3700	3700				0									
3月13日	11:25	3700	3700				0									
3月13日	11:55	3750	3750				0									
3月13日	15:00		3750				0	395	293.7							
3月13日	17:30	3750	3750				0	410	308.7							
3月13日	18:15	3800	3750				0	410	308.7							
3月13日	19:00	3800	3800				0	420	318.7							
3月13日	21:00	3800	3800				0									
3月13日	21:30						0	425	323.7							
3月13日	22:30	3850	3900				0	430	328.7							
3月13日	23:30	3850	3900				0	435	333.7							
3月14日	0:00	3850	3900				0	435	333.7							
3月14日	2:00	3850	3900				0	440	338.7							
3月14日	3:00	3850	3900		5.45	5450	5450									
3月14日	4:00	3850	3900		5.42	5420	5420									
3月14日	4:30	3850	3900		5.4	5400	5400									
3月14日	5:30	3900	3900		5.4	5400	5400			367	365.7					
3月14日	6:30	3900	3900		5.355	5355	5355			155	353.7	0.001	0.008			
3月14日	8:00	3950	3950		5.31	5310	5310	455	353.7	474	372.7	0.001	0.01			
3月14日	10:30	3800	3850		5.648	5648	5648	460	358.7	485	383.7					データ無し
3月14日	12:00	3400	3400		6.008	6008	6008	460	358.7	485	383.7	0.001	0.012			
3月14日	14:00	2000	2000		7.583	7583	7695	460	358.7							
3月14日	15:00	1200	1200		7.268	7268	7515	440	338.7			0.001	0.13			
3月14日	15:50	500			7.43	7430		420	318.7							
3月14日	16:00	300			7.45	7450		420	318.7							
3月14日	16:20	0			7	7000		420	318.7							16:35 SRV開
3月14日	16:47	-520			6	6000										
3月14日	17:30	-1100			6.97	6970										
3月14日	17:35				6.98	6980										
3月14日	17:52	-1500			7.35	7350										
3月14日	18:06	-1100			5.4	5400										18:06 SRV開
3月14日	18:12				2.47	2470										
3月14日	18:13	-3400			2.18	2180		395	293.7							
3月14日	18:14	-3500			1.91	1910		395	293.7							
3月14日	18:17	-3500			1.64	1640		395	293.7							
3月14日	18:18	-3600			1.51	1510		400	298.7							
3月14日	18:19	-3600			1.46	1460		400	298.7							
3月14日	18:20	-3600			1.4	1400		400	298.7							
3月14日	18:29				0.833	833										
3月14日	18:58	-3900			0.563	563										
3月14日	19:03				0.63	630										
3月14日	19:22				0.65	650		395	293.7							
3月14日	19:38				0.61	610		395	293.7							
3月14日	19:59				0.56	560		455	353.7							
3月14日	20:03				0.54	540		410	308.7							
3月14日	20:10				0.54	540		418	316.7							
3月14日	20:15				0.54	540		420	318.7							
3月14日	20:20				0.563	563		420	318.7							
3月14日	20:32				0.608	608		420	318.7							
3月14日	20:37				0.81	810		421	319.7							
3月14日	20:54				1.17	1170		421	319.7							
3月14日	21:09				1.44	1440		418	316.7							
3月14日	21:20	-3400			0.883	883		470	368.7							
3月14日	21:55	-1800			0.405	405		480	378.7							
3月14日	22:00	-1600			0.405	405		480	378.7							
3月14日	22:10	-1600			0.405	405		480	378.7							
3月14日	22:20	-1400			0.405	405		480	378.7							
3月14日	22:30	-1200			0.405	405		482	380.7							
3月14日	22:40	-700			0.428	428		482	380.7							
3月14日	22:50	-1600			1.82	1820		540	438.7							
3月14日	23:00	-1700			2.07	2070		580	478.7							
3月14日	23:06	-1700				2070		620	518.7							
3月14日	23:30					3150		700	598.7							
3月14日	23:36					1730		740	638.7							
3月14日	23:45					675		750	648.7							
3月14日	23:54					653		745	643.7	340	238.7					
3月15日	0:06					675		740	638.7							
3月15日	0:08					788		740	638.7							
3月15日	0:10					833		740	638.7							
3月15日	0:16					1040		740	638.7							
3月15日	0:22					1170		735	633.7							
3月15日	0:28					1350		730	628.7							
3月15日	0:32					1490		725	623.7							
3月15日	0:41					1710		720	618.7							
3月15日	1:17					675		730	628.7							
3月15日	1:20					653		740	628.7	350	228.7					
3月15日	1:31					630		740	628.7							
3月15日	1:52					630		735	623.7	330	208.7	26.3				

3月15日	2:26					675		740	638.7	340	238.7					
3月15日	2:39					653		750	648.7	330	228.7					
3月15日	2:45					653		750	648.7	320	218.7					
3月15日	2:50					653		750	648.7	330	228.7					
3月15日	3:20					653		750	648.7	330	228.7					
3月15日	3:40					653		750	648.7	330	228.7	51.2	5.87			
3月15日	4:10					653		750	648.7	330	228.7	51.9	5.72			
3月15日	4:20					637		750	648.7	310	208.7	53.2	5.65			
3月15日	4:30					632		750	648.7	300	198.7	54.4	5.58			
3月15日	4:45					632		750	648.7	310	208.7					
3月15日	5:00					626		750	648.7	300	198.7					
3月15日	5:15					623		740	638.7	300	198.7					
3月15日	5:20					621		730	628.7	310	208.7	62.7	4.8			
3月15日	5:30					621		730	628.7	310	208.7	59.5	5.08			
3月15日	6:00					614		730	628.7	270	168.7	61.6	4.89			[illegible]
3月15日	7:20	-2500				612		730	628.7							
3月15日	11:25	-1200				270		315	213.7			0.461	5.79			
3月15日	11:42	-1400				315		155	53.7			0.461	5.52			
3月15日	11:53	-1350				428		155	53.7			0.465	5.57			
3月15日	13:00	-1700				608		415	313.7			0.477	4.62			
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3月15日	15:50	-1800				117		276	174.7							
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3月15日	18:43	-1200				99		250	148.7			122	4.4			
3月16日	1:21	-1400				-23		210	138.7			103	3.68			
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3月16日	5:35	-1500				-41		220	118.7			70	24.3			
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3月16日	12:25	-1400						400	298.7							
3月16日	23:50	-1400				-63	-79	75	-26.3							
3月17日	3:10	-1400				-65	-79	75	-26.3			87	2.65			
3月17日	11:30	-1800				-29	-47	115	13.7			84.6	25			
3月17日	12:50	-1800				-27	-45	110	8.7			84.4	2.43			
3月17日	21:50	-1400						130	28.7			8.24E+01	2.41			
3月18日	2:50	-1400				-16	-32	130	28.7			7.98E+01	2.4			
3月18日	7:55	-1400				-14	-29	130	28.7			7.80E+01	2.37			
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3月18日	20:55	-1400				-2		140	38.7			7.35E+01	2.33			
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3月19日	3:30	-1400				-5	-18	135	33.7			7.15E+01	2.3			
3月19日	11:00	-1400				-9	-23	135	33.7			6.96E+01	2.37			
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3月20日	11:00	-1400				-16	-32	125	23.7			1.34E+01	2.15			
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3月20日	20:00	-1400				-18	-20	120	18.7			6.12E+01	2.11			
3月21日	3:00	-1350				-18	-20	120	18.7			6.01E+01	2.09E+01			
3月21日	8:00	-1350				-20	-20	120	18.7			5.91E+01	2.06E+00			
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3月21日	14:00	-1350				-23		120	18.7			5.81E+01	2.03			
3月21日	14:25	-1350				-23	-25	120	18.7			5.81E+01	2.03			
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3月22日	17:00	-1350				-27	-32	110	8.7			5.35E+01	1.88	102	111	
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3月23日	4:20	-1300				-25	-25	110	8.7			52	1.8	102	109	
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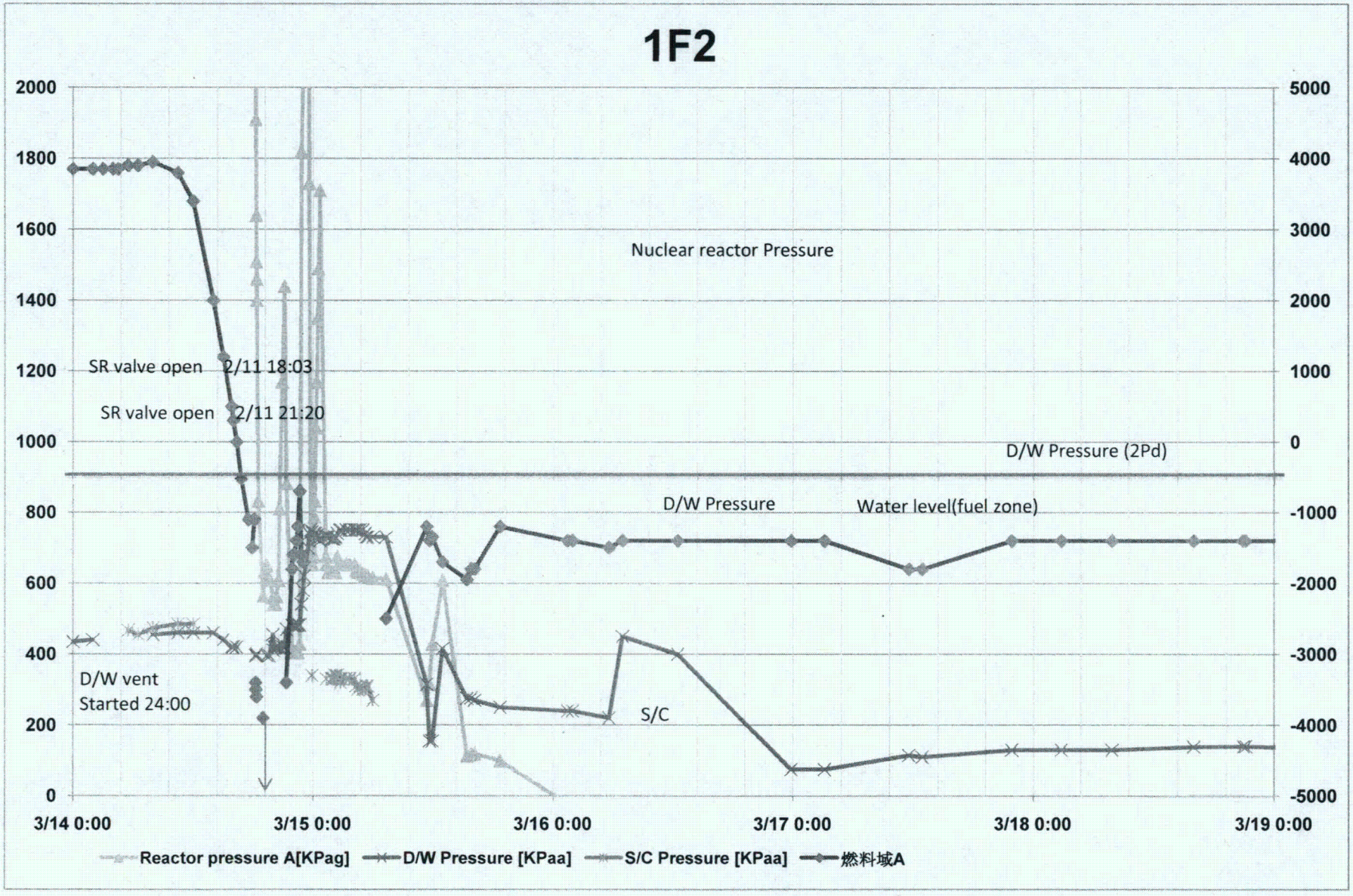
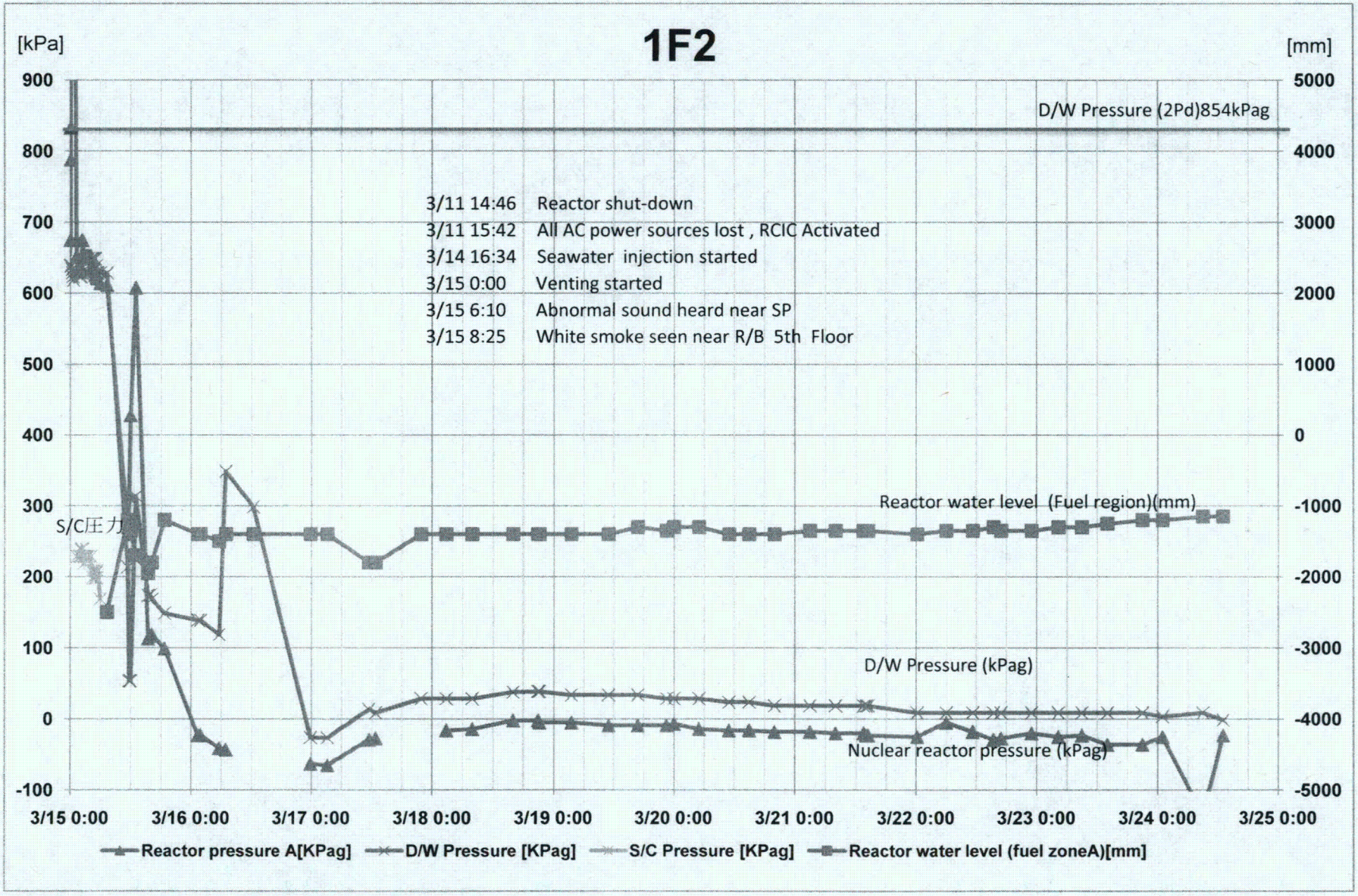
3月24日	9:00	-1150				-135	-38	110	8.7			48.3	1.1	100	105	
3月24日	13:00	-1150				-23	-25	100	-1.3			47.9	1.37	100	110	


1F2
2000
1800
1600
1400
1200
1000
800
600
400
200
0
5000
4000
3000
2000
1000
0
-1000
-2000
-3000
-4000
-5000
Nuclear reactor Pressure
SR valve open 2/11 18:03
SR valve open 2/11 21:20
D/W Pressure (2Pd)
D/W Pressure
Water level(fuel zone)
D/W vent
Started 24:00
S/C
3/14 0:00
3/15 0:00
3/16 0:00
3/17 0:00
3/18 0:00
3/19 0:00
Reactor pressure A[KPag]
D/W Pressure [KPaa]
S/C Pressure [KPaa]
燃料域A



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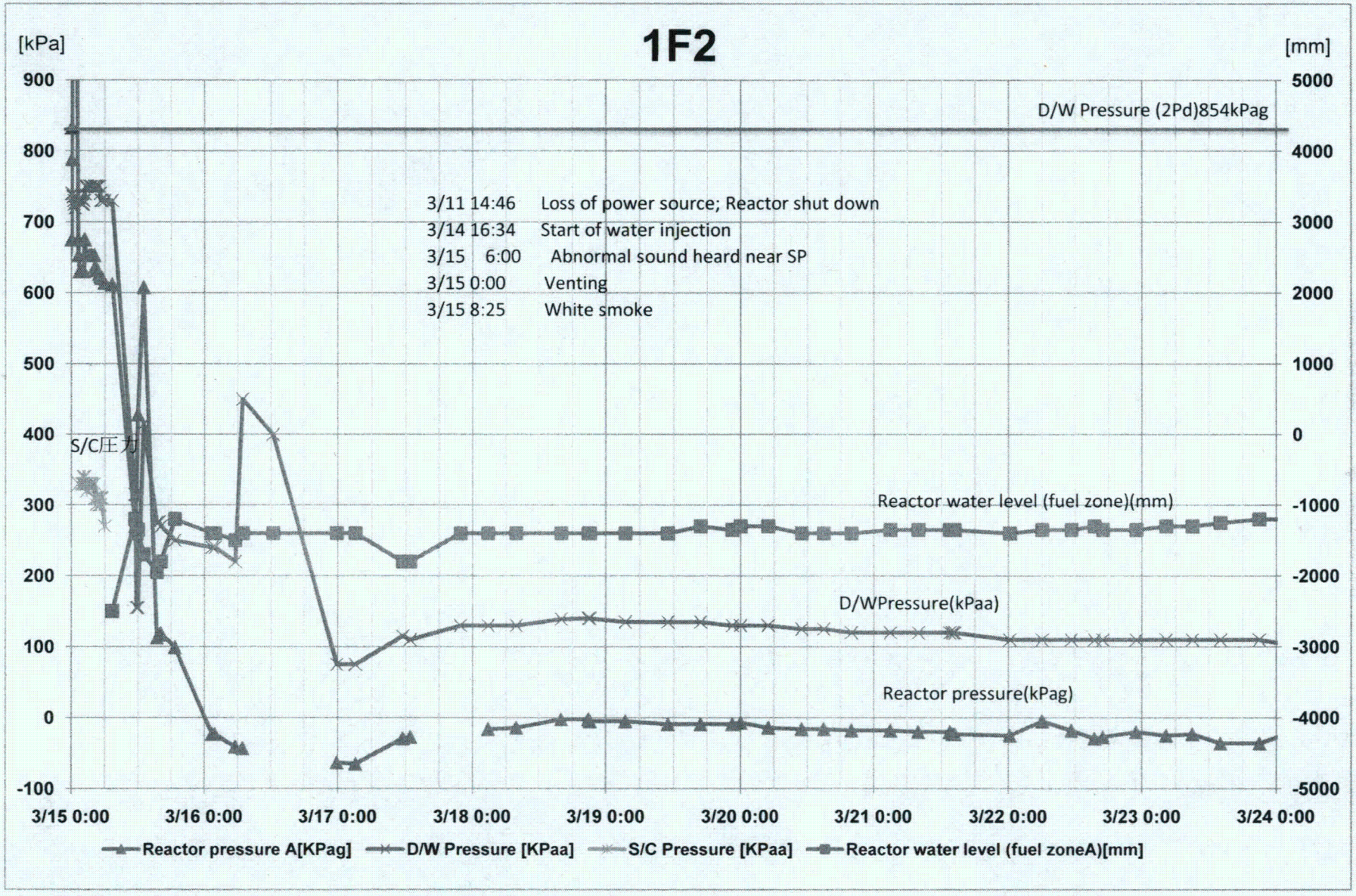

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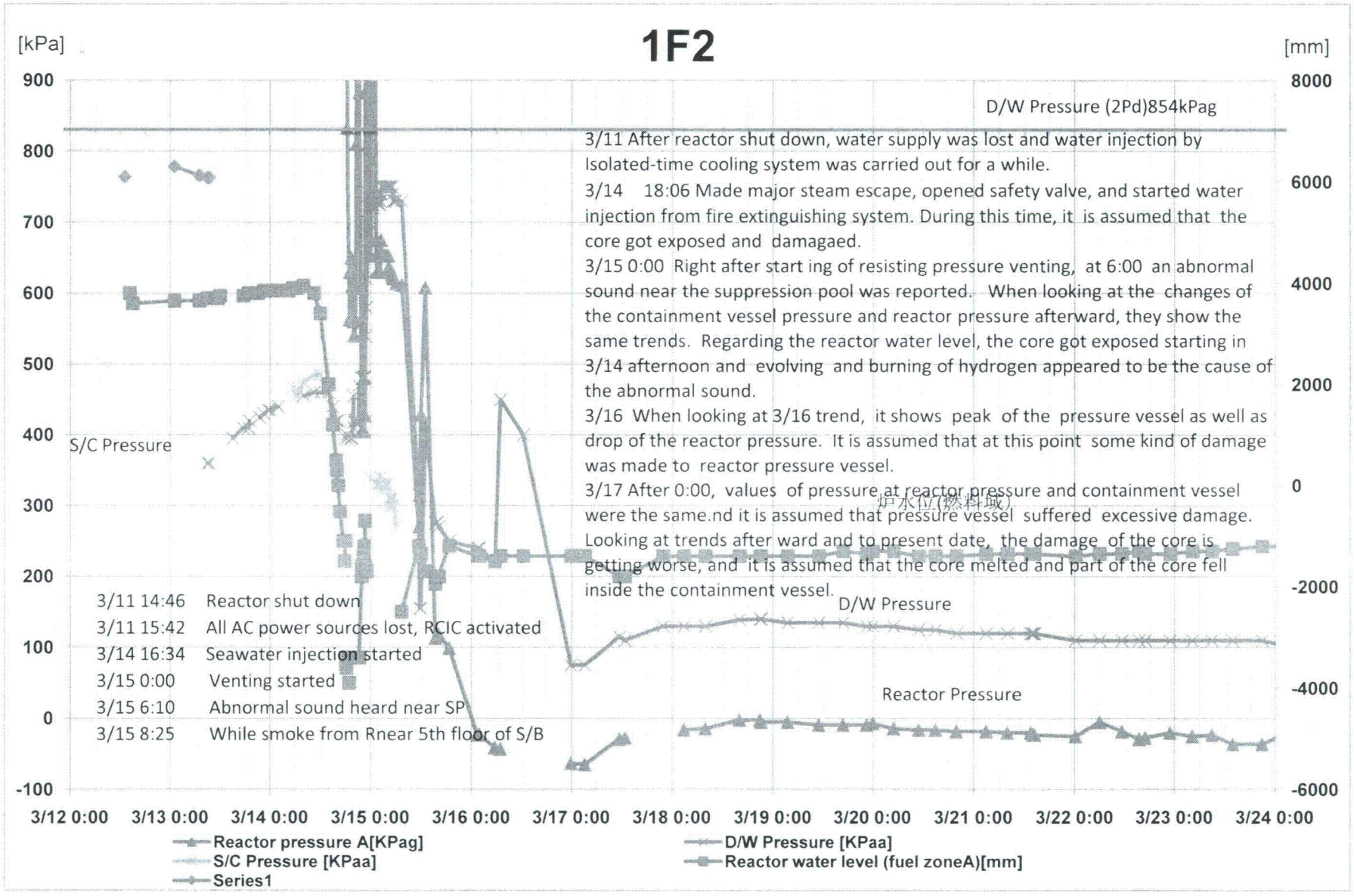
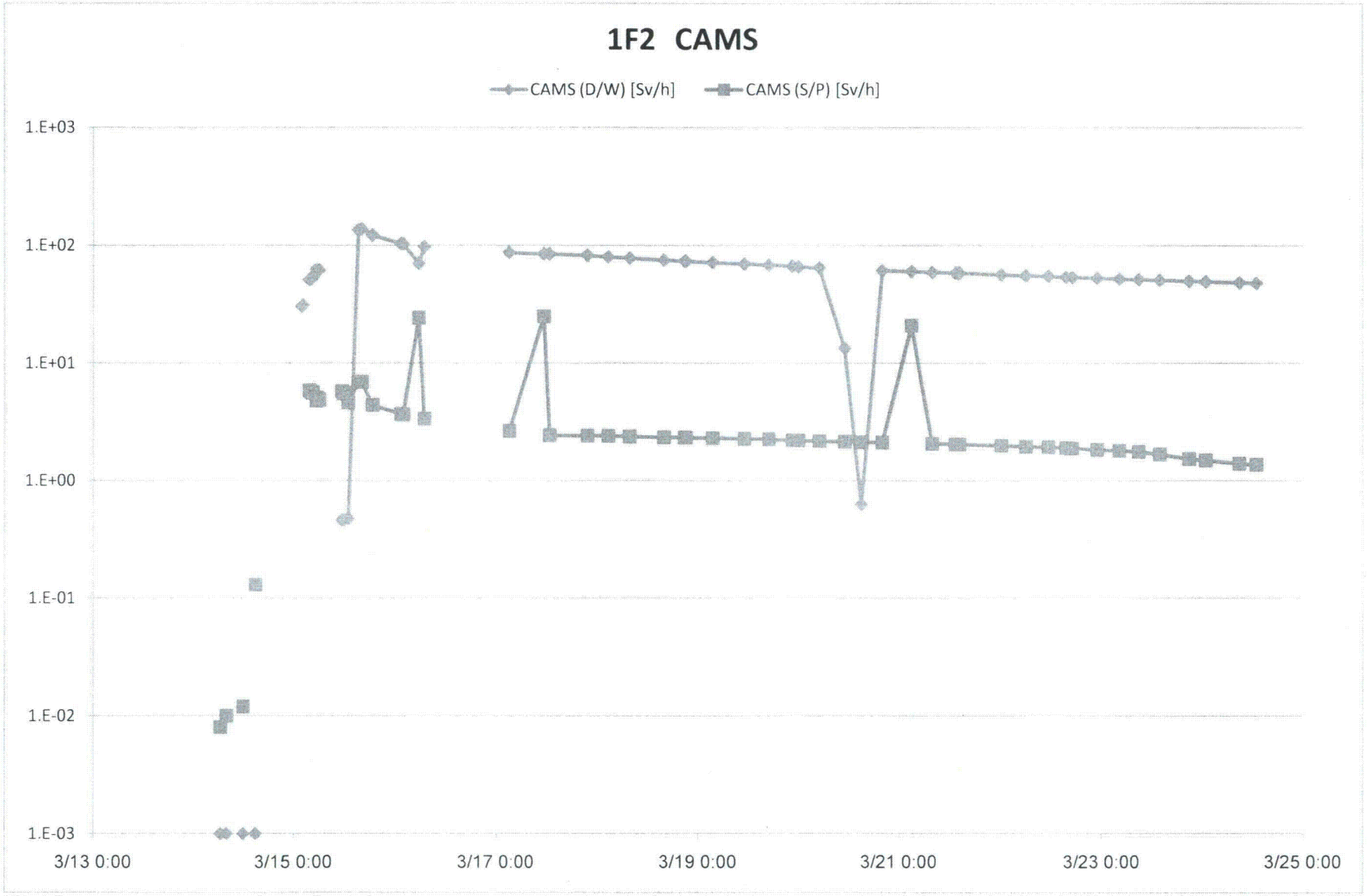
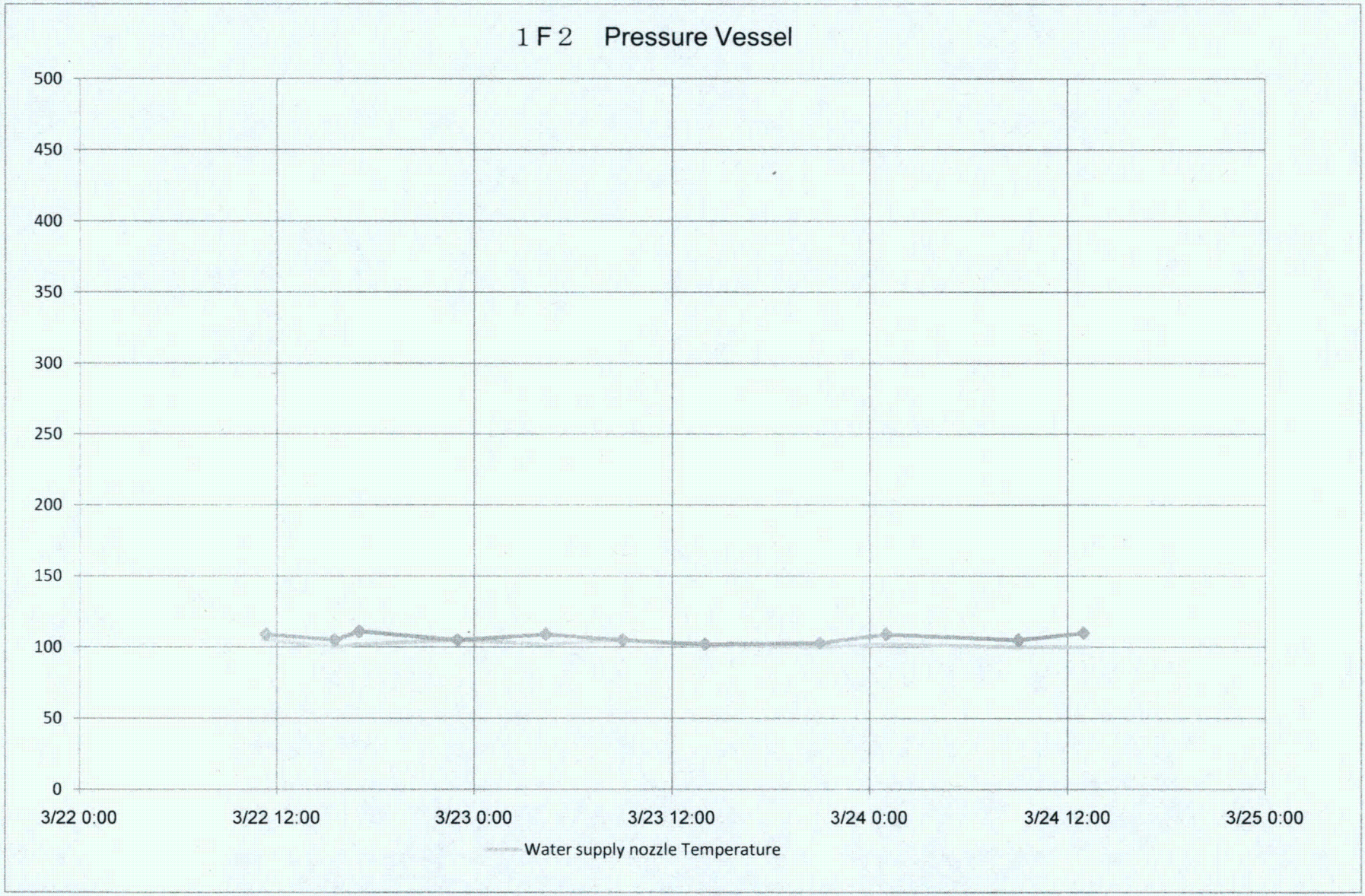
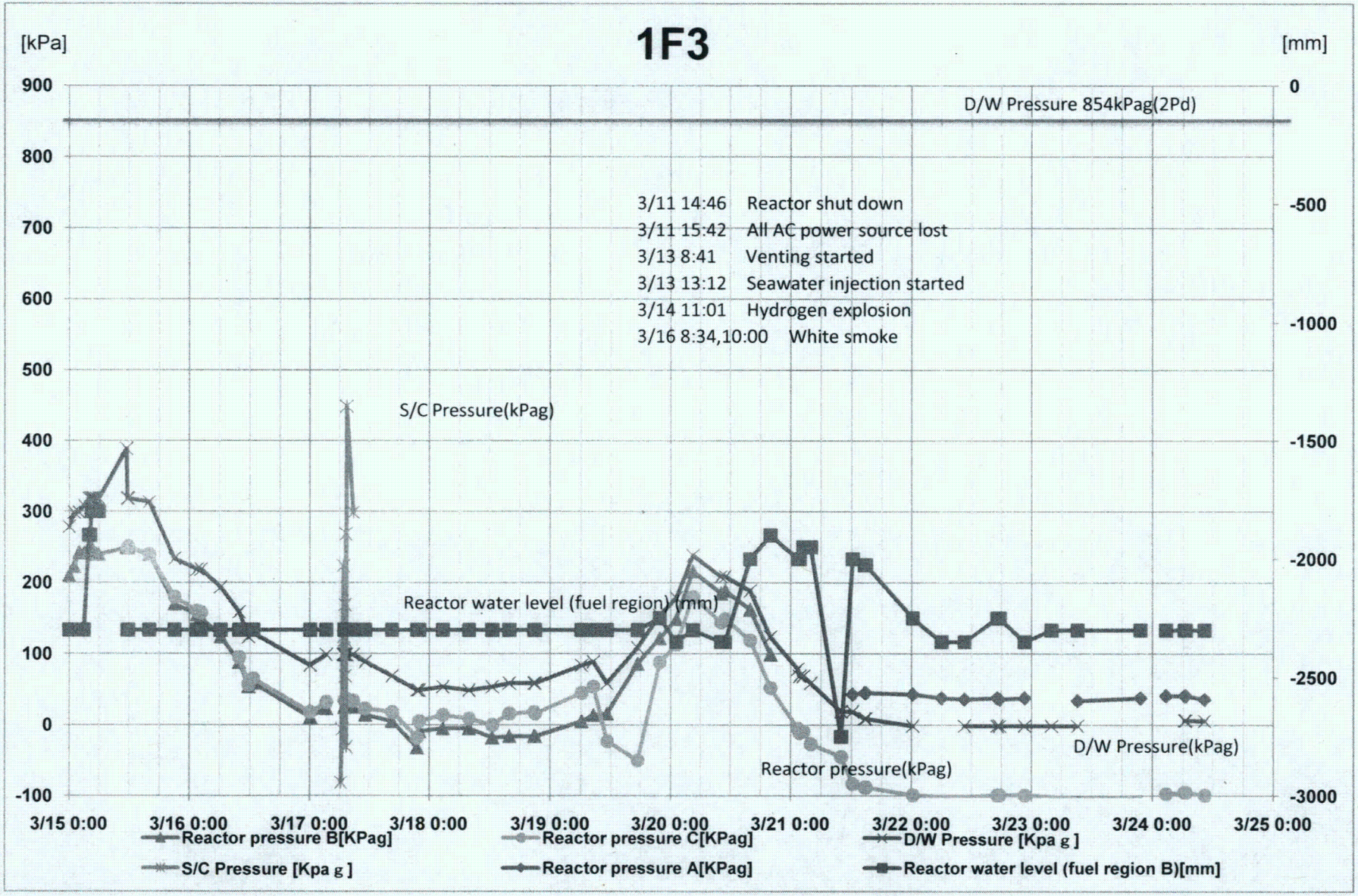
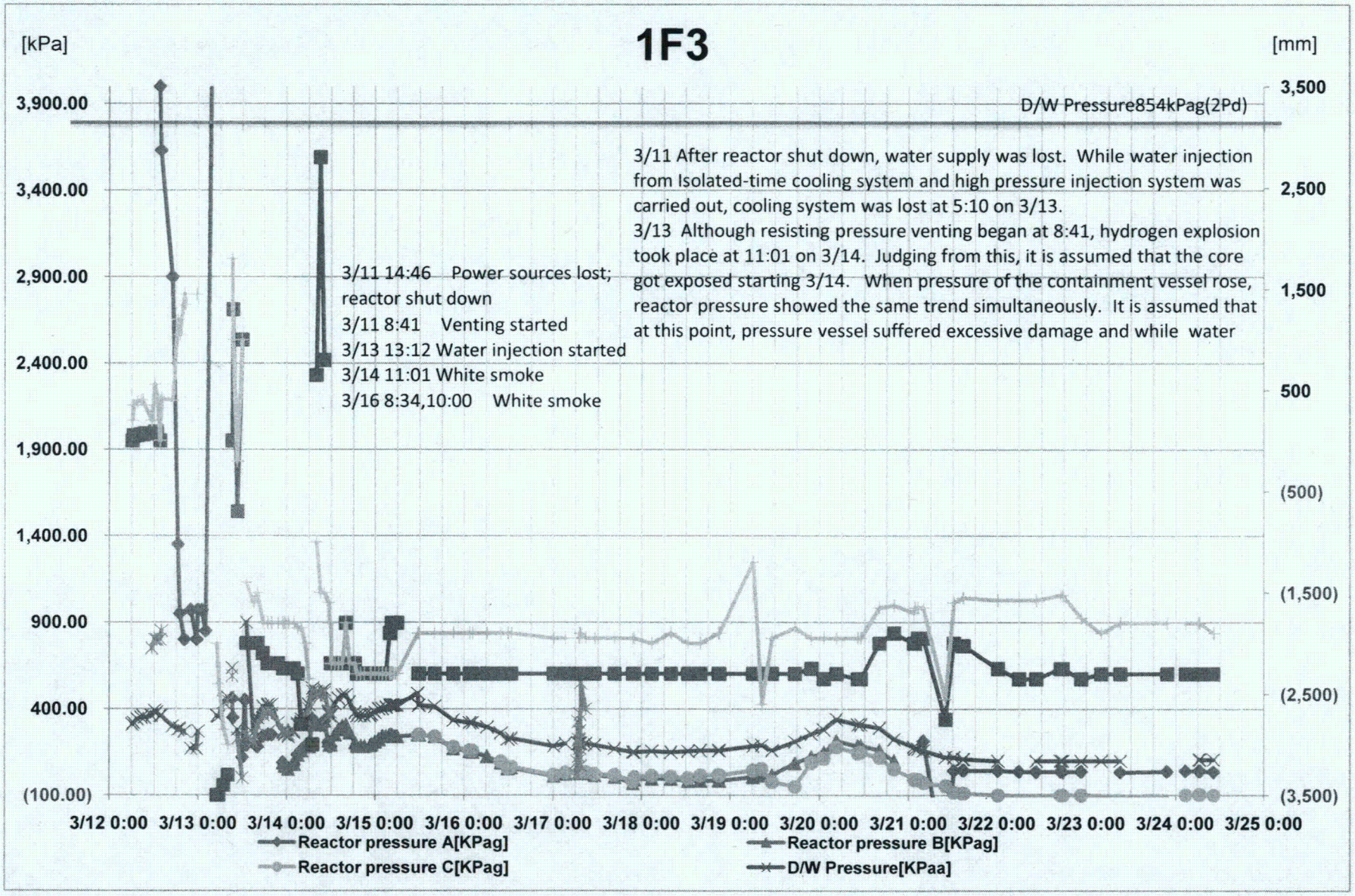
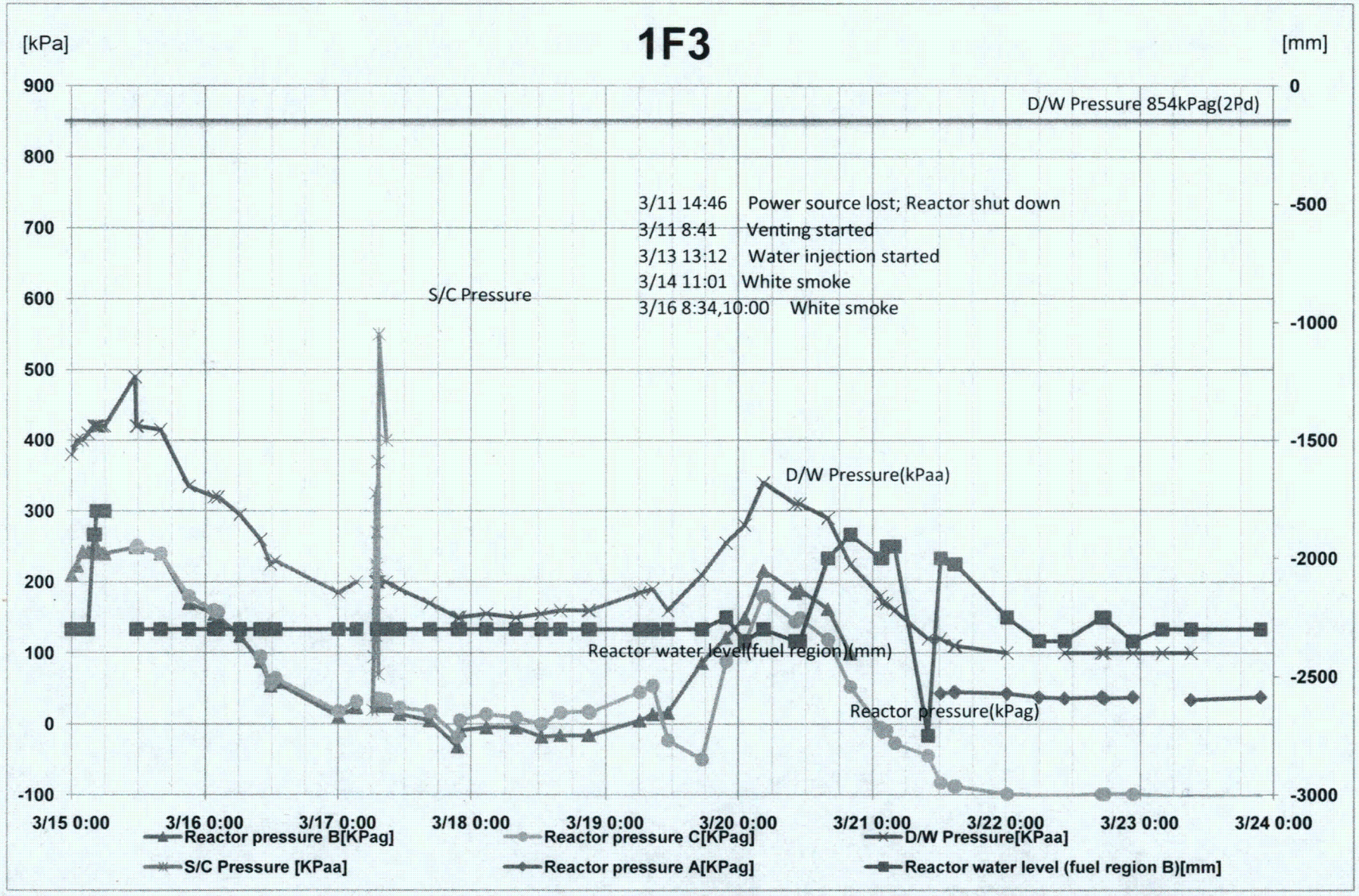

1F2
[kPa]
[mm]
900
800
700
600
500
400
300
200
100
0
-100
8000
6000
4000
2000
0
-2000
-4000
-6000
D/W Pressure (2Pd)854kPag
3/11 After reactor shut down, water supply was lost and water injection by Isolated-time cooling system was carried out for a while.
3/14 18:06 Made major steam escape, opened safety valve, and started water injection from fire extinguishing system. During this time, it is assumed that the core got exposed and damagaed.
3/15 0:00 Right after start ing of resisting pressure venting, at 6:00 an abnormal sound near the suppression pool was reported. When looking at the changes of the containment vessel pressure and reactor pressure afterward, they show the same trends. Regarding the reactor water level, the core got exposed starting in 3/14 afternoon and evolving and burning of hydrogen appeared to be the cause of the abnormal sound.
3/16 When looking at 3/16 trend, it shows peak of the pressure vessel as well as drop of the reactor pressure. It is assumed that at this point some kind of damage was made to reactor pressure vessel.
3/17 After 0:00, values of pressure at reactor pressure and containment vessel were the same.nd it is assumed that pressure vessel suffered excessive damage. Looking at trends after ward and to present date, the damage of the core is getting worse, and it is assumed that the core melted and part of the core fell inside the containment vessel.
S/C Pressure
D/W Pressure
Reactor Pressure
3/11 14:46 Reactor shut down
3/11 15:42 All AC power sources lost, RCIC activated
3/14 16:34 Seawater injection started
3/15 0:00 Venting started
3/15 6:10 Abnormal sound heard near SP
3/15 8:25 While smoke from Rnear 5th floor of S/B
3/12 0:00
3/13 0:00
3/14 0:00
3/15 0:00
3/16 0:00
3/17 0:00
3/18 0:00
3/19 0:00
3/20 0:00
3/21 0:00
3/22 0:00
3/23 0:00
3/24 0:00
Reactor pressure A[KPag]
S/C Pressure [KPaa]
Series1
D/W Pressure [KPaa]
Reactor water level (fuel zoneA)[mm]

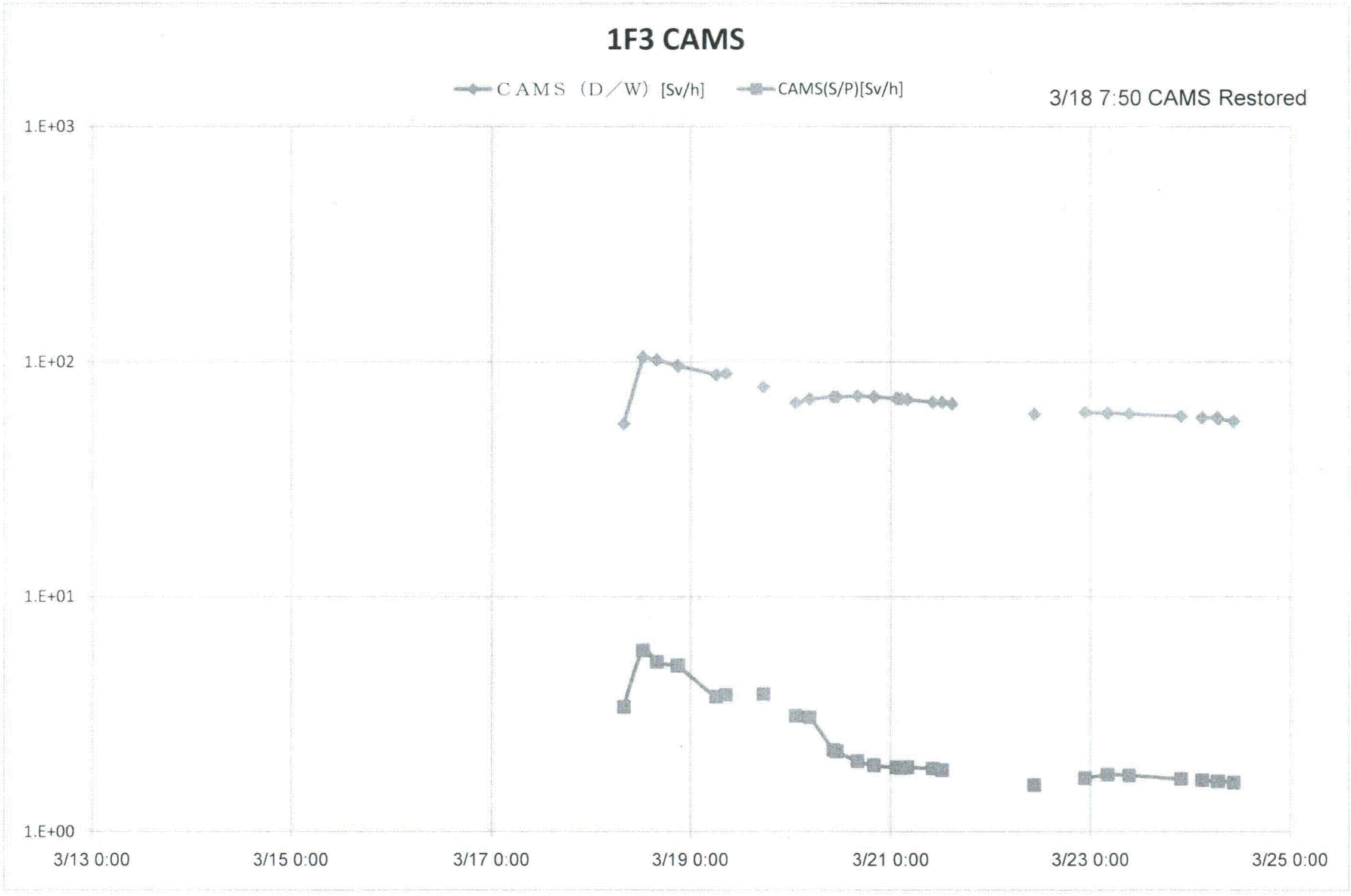

1F2 CAMS
CAMS (D/W) [Sv/h]
CAMS (S/P) [Sv/h]
1.E+03
1.E+02
1.E+01
1.E+00
1.E-01
1.E-02
1.E-03
3/13 0:00
3/15 0:00
3/17 0:00
3/19 0:00
3/21 0:00
3/23 0:00
3/25 0:00

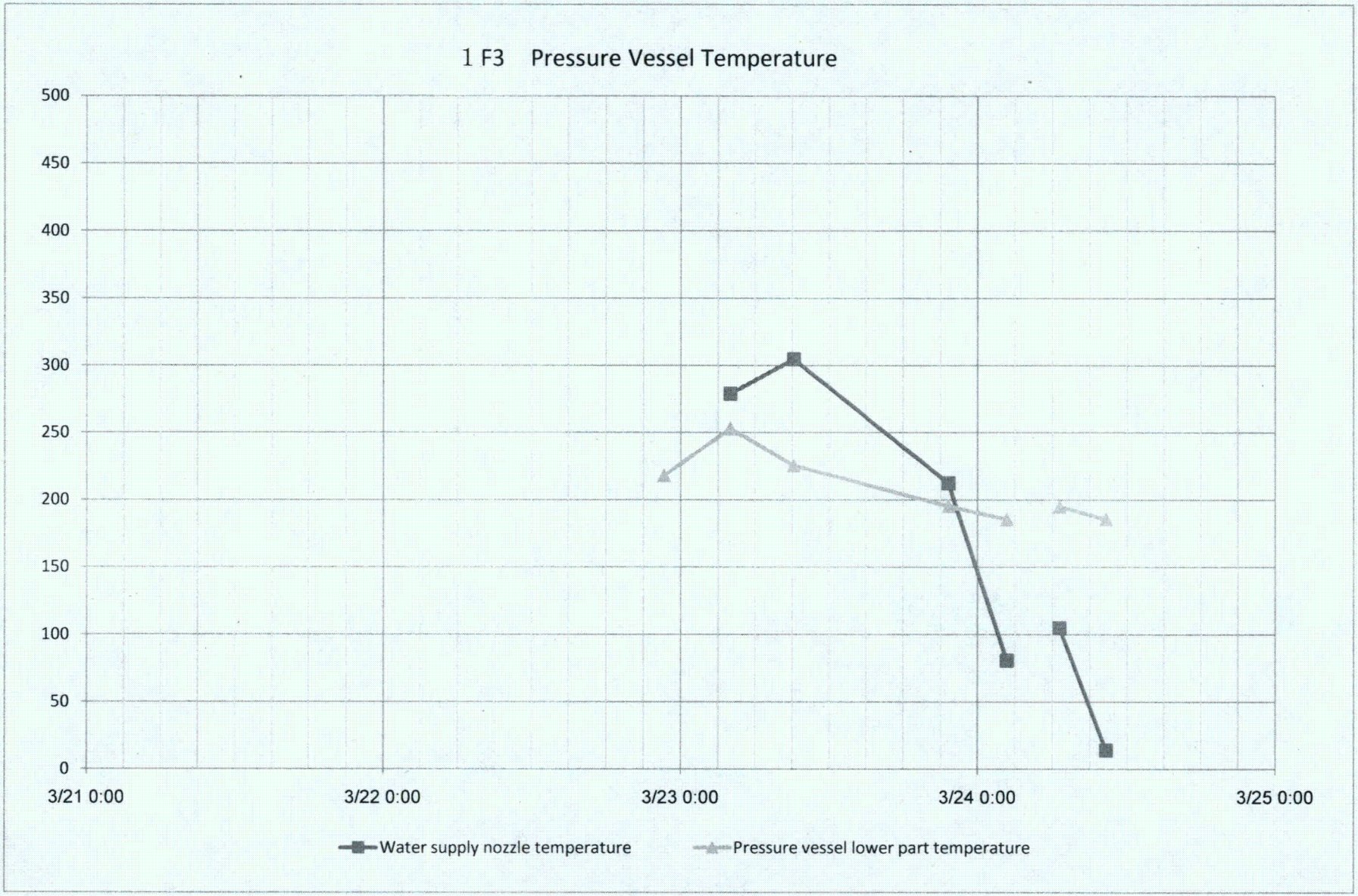

1 F 2 Pressure Vessel
500
450
400
350
300
250
200
150
100
50
0
3/22 0:00
3/22 12:00
3/23 0:00
3/23 12:00
3/24 0:00
3/24 12:00
3/25 0:00
Water supply nozzle Temperature


1F3
[kPa]
[mm]
900
800
700
600
500
400
300
200
100
0
-100
0
-500
-1000
-1500
-2000
-2500
-3000
D/W Pressure 854kPag(2Pd)
3/11 14:46 Reactor shut down
3/11 15:42 All AC power source lost
3/13 8:41 Venting started
3/13 13:12 Seawater injection started
3/14 11:01 Hydrogen explosion
3/16 8:34,10:00 White smoke
S/C Pressure(kPag)
Reactor water level (fuel region) (mm)
D/W Pressure(kPag)
Reactor pressure(kPag)
3/15 0:00
3/16 0:00
3/17 0:00
3/18 0:00
3/19 0:00
3/20 0:00
3/21 0:00
3/22 0:00
3/23 0:00
3/24 0:00
3/25 0:00
Reactor pressure B[KPag]
Reactor pressure C[KPag]
D/W Pressure [Kpa g]
S/C Pressure [Kpa g]
Reactor pressure A[KPag]
Reactor water level (fuel region B)[mm]


1F3
[kPa]
[mm]
3,900.00
3,400.00
2,900.00
2,400.00
1,900.00
1,400.00
900.00
400.00
(100.00)
3,500
2,500
1,500
500
(500)
(1,500)
(2,500)
(3,500)
D/W Pressure854kPag(2Pd)
3/11 14:46 Power sources lost; reactor shut down
3/11 8:41 Venting started
3/13 13:12 Water injection started
3/14 11:01 White smoke
3/16 8:34,10:00 White smoke
3/11 After reactor shut down, water supply was lost. While water injection from Isolated-time cooling system and high pressure injection system was carried out, cooling system was lost at 5:10 on 3/13.
3/13 Although resisting pressure venting began at 8:41, hydrogen explosion took place at 11:01 on 3/14. Judging from this, it is assumed that the core got exposed starting 3/14. When pressure of the containment vessel rose, reactor pressure showed the same trend simultaneously. It is assumed that at this point, pressure vessel suffered excessive damage and while water
3/12 0:00
3/13 0:00
3/14 0:00
3/15 0:00
3/16 0:00
3/17 0:00
3/18 0:00
3/19 0:00
3/20 0:00
3/21 0:00
3/22 0:00
3/23 0:00
3/24 0:00
3/25 0:00
Reactor pressure A[KPag]
Reactor pressure B[KPag]
Reactor pressure C[KPag]
D/W Pressure[KPaa]

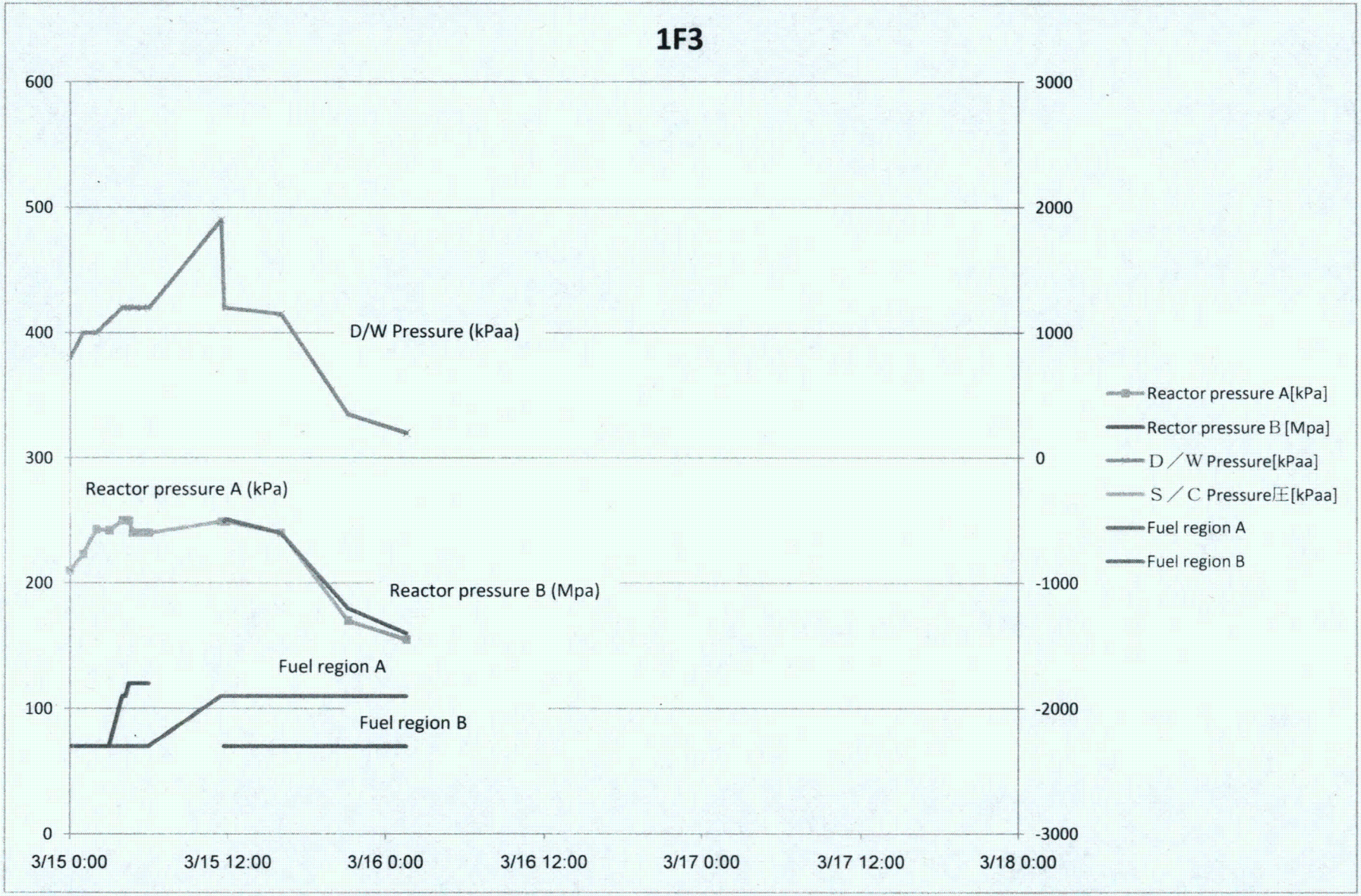

1F3
[kPa]
[mm]
900
800
700
600
500
400
300
200
100
0
-100
0
-500
-1000
-1500
-2000
-2500
-3000
D/W Pressure 854kPag(2Pd)
3/11 14:46 Power source lost; Reactor shut down
3/11 8:41 Venting started
3/13 13:12 Water injection started
3/14 11:01 White smoke
3/16 8:34,10:00 White smoke
S/C Pressure
D/W Pressure(kPaa)
Reactor water level(fuel region)(mm)
Reactor pressure(kPag)
3/15 0:00
3/16 0:00
3/17 0:00
3/18 0:00
3/19 0:00
3/20 0:00
3/21 0:00
3/22 0:00
3/23 0:00
3/24 0:00
Reactor pressure B[KPag]
Reactor pressure C[KPag]
D/W Pressure[KPaa]
S/C Pressure [KPaa]
Reactor pressure A[KPag]
Reactor water level (fuel region B)[mm]


1F3 CAMS
CAMS (D/W) [Sv/h]
CAMS(S/P)[Sv/h]
3/18 7:50 CAMS Restored
1.E+03
1.E+02
1.E+01
1.E+00
3/13 0:00
3/15 0:00
3/17 0:00
3/19 0:00
3/21 0:00
3/23 0:00
3/25 0:00


1 F3 Pressure Vessel Temperature
500
450
400
350
300
250
200
150
100
50
0
3/21 0:00
3/22 0:00
3/23 0:00
3/24 0:00
3/25 0:00
Water supply nozzle temperature
Pressure vessel lower part temperature

Date		Reactor water level (fuel region A) [mm]	Reactor water level (fuel region B) [mm]	Reactor water level (Wide range) [mm]	Reactor pressure A[KPag]	Reactor pressure B[KPag]	Reactor pressure C[KPag]	Reactor pressure D[KPag]	D/W Pressure[KPaa]	D/W Pressure [Kpa g]	S/C Pressure [KPaa]	S/C Pressure [Kpa g]	CAMS (D/W) [Sv/h]	CAMS (S/P) [Sv/h]	Water supply nozzle temperature	Pressure vessel lower part temperature	Note
	03/12/2011 6:00				7,250.00												
	03/12/2011 6:10	300	0						310	209							
	03/12/2011 6:30	350	50		7,490.00				320	219							
	03/12/2011 7:30	380	50		7,230.00				340	239							
	03/12/2011 8:30	400	60						350	249							
	03/12/2011 9:00	400	60		7,460.00				360	259							
	03/12/2011 9:30	350	70		7,360.00				350	249							
	03/12/2011 11:20	200	70						360	259	750	649					
	03/12/2011 12:10	560	90		7,530.00				390	289	800	699					
	03/12/2011 12:45	450	90		5,600.0				380	279	800	699					
	03/12/2011 13:38	0	0		1,000.0				360	259	800	699					
	03/12/2011 13:58	420			3,630.00				360	259	850	749					
	03/12/2011 17:00	400			2,900.0				300	199							
	03/12/2011 18:30	1200			1,450.00				280	179							
	03/12/2011 19:09	1050			950.00				285	184							
	03/12/2011 20:15	1450			800.0				270	169							
	03/12/2011 20:31	1350															
	03/12/2011 22:00				970.00				170	69							
	03/12/2011 23:35	1450			800.0				170	69							
	03/13/2011 0:00				970.00				270	169							
	03/13/2011 1:00				970.00												
	03/13/2011 2:00				850.00												
	03/13/2011 3:38				4,100.00												
	03/13/2011 5:00	-2000	-3500		7,330.00				360	259							
	03/13/2011 5:30	-2400	-3500		7,270.00				355	254							
	03/13/2011 6:50	-2850	-3400		7,350.00				440	339							
	03/13/2011 8:00	-3000	-3400		7,270.00				405	304	415	314					
	03/13/2011 8:55																
	03/13/2011 9:10	1800	0		460.00				637	546	590	489					
	03/13/2011 9:25	1000	1300		350.00												
	03/13/2011 10:35	-200	-700						280	179	230	129					
	03/13/2011 11:55	1000	1000		120.00				-		-						
	03/13/2011 12:40				450.00												
	03/13/2011 13:00	-1400	-2000		190.00				900	799	250	149					
	03/13/2011 15:00	-1600	-2000						260	159	210	109					
	03/13/2011 16:06	-1500	-2000		180.00				450	349	400	199					
	03/13/2011 17:30	-1800	-2100		240.00				415	314	465	264					
	03/13/2011 18:15	-1500	-2200		250.00				420	319	475	271					
	03/13/2011 19:06	-1800	-2200		250.00				425	321	475	271					
	03/13/2011 19:55	-1800	-2200		250.00				425	324	475	274					
	03/13/2011 21:40	-1800	-2200						420	319	470	219					
	03/13/2011 23:00	-1800	-2250		89,000	87,000			265	164	275	174					
	03/13/2011 23:30	-1800	-2250		66,000	68,000			250	149	260	159					
	03/14/2011 0:30	-1800	-2250		51,000	51,000			240	139	255	154					
	03/14/2011 2:00	-1800	-2250		77,000	79,000			265	164	275	174					
	03/14/2011 3:00	-1850	-2300		134,000	134,000			315	214	305	204					
	03/14/2011 4:00	-1850	-2300		159,000	159,000			340	239	325	224					
	03/14/2011 5:00	-2000			181,000	181,000			365	264	345	244	1.58E-02	3.73E+00			
	03/14/2011 6:00	-2450			181,000	181,000			425	324	400	299	1.66E-02	3.77E+00			
	03/14/2011 7:00		-4000		348,000	344,000			520	419	500	399					
	03/14/2011 7:30												1.67E+02	4.00E+00			
	03/14/2011 8:00	-1000	650		310,000	320,000			500	399	480	379	1.60E-02	4.40E+00			
	03/14/2011 9:05	-1500	2800		304,000	308,000			490	389	475	374	1.57E-02	4.50E+00			
	03/14/2011 10:05	-1500	800		327,000	332,000			510	409	495	394	1.54E-02	4.40E+00			
	03/14/2011 11:15	-1600			206,000	215,000			380	279	390	289					
	03/14/2011 11:30	-1800			180,000	190,000			360	259	360	259					
	03/14/2011 11:55	-1800	-2200		183,000	191,000			360	259	350	279					
3月14日	12:00	-2200	-2200			191			360	259							11 01 kW Explosion
	13:00	-2200	-2200			251			430	329							
	14:00	-2200	-2200			281			460	359							
	15:00	-2200	-2200			298			480	379							
	16:00	-1800	-1800			306			480	379							
	17:00	-2200	-2200			261			440	339							
	18:30	-2200	-2200			202			380	279							
	19:00	-2300	-2300			183			360	259							
	20:03	-2300	-2300			183			360	259							
	21:04	-2300	-2300			183			360	259							
	22:40	-2300	-2300			189			360	259							
	23:00	-2300	-2300			196			370	269							
3月15日	0:00	-2300	-2300			210			380	279							
3月15日	1:00	-2300	-2300			223			400	299							
3月15日	2:00	-2300	-2300			243			400	299							
3月15日	3:00	-2300	-2300			242			410	309							
3月15日	4:00	-2300	-1900			250			420	319							
3月15日	4:15	-2300	-1900			250			420	319							
3月15日	4:30	-2300	-1800			250			420	319							
3月15日	4:47	-2300	-1800			240			420	319							
3月15日	5:00	-2300	-1800			240			420	319							
3月15日	5:30	-2300	-1800			240			420	319							
3月15日	6:00	-2300	-1800			240			420	319							
3月15日	11:29	-1900				249			490	389							
3月15日	11:42	-1900	-2300			249	249		420	319							
3月15日	11:50	-1900	-2300			249	251		420	319							
3月15日	16:00	-1900	-2300			240	240		415	314							
3月15日	21:05	-1900	-2300			170	160		345	234							
3月16日	1:35	-1900	-2300			155	160		320	219							
3月16日	2:20	-1900	-2300			151	158		320	219							
3月16日	6:15	-1900	-2300			124			295	194							
3月16日	9:55	-1900	-2300			88	95		260	159							
3月16日	11:45	-1900	-2300			54	57		225	124							
3月16日	12:40	-1900	-2300			59	65		230	129							
3月17日	0:07	-1950	-2300			11	18		185	84							

3月17日	3:20	-1950	-2300			23	32		200	99							11項目格
3月17日	6:15										20	[illegible]					Verbal contact
3月17日	6:30										95	[illegible]					Verbal contact
3月17日	6:45								200	99	325	224					Verbal contact
3月17日	6:50										225	124					Verbal contact
3月17日	6:55										125	24					Verbal contact
3月17日	7:00	-1950	-2300			25	34		200	99	220	119					
3月17日	7:05	-1900	-2300			25	34		200	99	270	169					Verbal contact
3月17日	7:10	-1900	-2300			25	34		200	99	170	69					Verbal contact
3月17日	7:15	-1900	-2300			25	34		200	99	370	269					Verbal contact
3月17日	7:20	-1900	-2300			27	36		200	99	70	[illegible]					Verbal contact
3月17日	7:25	-1900	-2300			27	36		200	99	550	449					Verbal contact
3月17日	8:45	-1950	-2300			25	34		200	99	400	299					
3月17日	11:10	-1950	-2300			14	23		190	89							
3月17日	16:35	-1950	-2300			5	18		170	69							
3月17日	21:35	-1950	-2300			-32	-18		150	49							
3月17日	22:00	-1950	-2300			-9	5		150	49							
3月18日	2:45	-2000	-2300			-5	14		155	54							
3月18日	8:00	-1900	-2300			-5	9		150	49			54.4	3.4			F.50 CMS Restored
3月18日	12:35	-2000	-2300			-18	0		155	54			105	5.9			
3月18日	15:55	-2000	-2300			-16	16		160	59			102	5.28			
3月18日	20:50	-1900	-2300			-16	18		160	59			96.8	5.1			
3月18日	21:05	-1900	-2300			-16	16		160	59			96.2	5.09			
3月19日	6:10	-1200	-2300			5	45		185	84			88.3	3.76			
3月19日	8:30	-2600	-2300			14	54		190	89			89.5	3.83			
3月19日	11:15	-1950	-2300			16	-23		166	59							
3月19日	17:25	-1850	-2300			86	-50		210	109			78.4	3.86			
3月19日	21:50	-1950	-2250			122	88		255	151							
3月20日	1:10	-1950	-2250			119	113		250	179			67	3.12			
3月20日	4:30	-1950	-2300			216	180		340	239			69.6	3.07			
3月20日	10:10	-1950	-2350			185	144		319	209			71.1	2.33			
3月20日	11:00	-1950	-2350			189	149		310	209			70.9	2.2			
3月20日	16:00	-1650	-2000			162	119		290	189			71.7	2			
3月20日	20:00	-1625	-1900			99	52		225	124			71	1.92			
3月21日	1:25	-1700	-2000			9495	-5		180	79			69.9	1.88			
3月21日	1:45	-1650	-2000			12252	-11		170	69			69.7	1.88			
3月21日	2:30	-1650	-1950			11408	-9		170	69			69.6	1.87			
3月21日	4:00	-1650	-1950		214		-27		160	59			#######	1.88			3:58 Reactor pressure B→A
3月21日	10:00	-2650	-2750		-529		-45		120	19			#######	1.86			
3月21日	12:15	-1600	-2000		43		-83		120	19			67.2	1.83			
3月21日	14:40	-1550	-2025		45		-88		110	9			66.3				
3月21日	14:55	-1550	-2025		45		-88		110	9							
3月22日	0:15	-1575	-2250		43		-99		100	[illegible]							
3月22日	6:00	-1575	-2350		38		-101										
3月22日	10:35	-1575	-2350		36		-101		100	[illegible]			60	1.58			
3月22日	17:10	-1525	-2250		38		-99		100	[illegible]							
3月22日	17:40	-1525	-2250		36		-99		100	[illegible]							
3月22日	22:40	-1750	-2350		38		-99		100	-1.3			61	1.69		218	給水ノズル指示不良
3月23日	4:00	-1900	-2300				-101	36	100	-1.3			60.5	1.75	279	254	
3月23日	9:10	-1800	-2300		34		-104		100	-1.3			60.2	1.74	301.8	225.5	
3月23日	21:40	-1800	-2300		38		-101						#######	1.68	212.1	195.1	
3月24日	2:20														80.7	185.4	
3月24日	2:40	-1800	-2300		41		-97						57.9	1.66			
	6:20	-1800	-2300		41		-95		107.6	6.3	195.5	94.2	58	1.64			
	6:35	-1800	-2300		41		-95		107.6	6.3	195.8	94.5	57.2	1.64	104.9	194.8	
	10:20	-1900	-2300		36		-99		107	5.7	199	97.7	55.9	1.62	14.1	185.5	給水ノズル指示不良


1F3
600
500
400
300
200
100
0
3000
2000
1000
0
-1000
-2000
-3000
3/15 0:00
3/15 12:00
3/16 0:00
3/16 12:00
3/17 0:00
3/17 12:00
3/18 0:00
D/W Pressure (kPaa)
Reactor pressure A (kPa)
Reactor pressure B (Mpa)
Fuel region A
Fuel region B
Reactor pressure A[kPa]
Rector pressure B [Mpa]
D／W Pressure[kPaa]
S／C Pressure圧[kPaa]
Fuel region A
Fuel region B

1F3

			Fuel region A	Fuel region B	Reactor pressure A[kPa]	Rector pressure B[Mpa]	D／W Pressure [kPaa]	S／C Pressure 圧[kPaa]
40616.00	7:20	3/14 7:20	2000	-1600	315	317	500	480
	7:30	3/14 7:30			315	319	510	480
	7:35	3/14 7:35	1400	-1500			510	480
	7:45	3/14 7:45	800	-500	312	317	500	480
	7:50	3/14 7:50	400	100	315	310	500	480
	8:00	3/14 8:00	-1000	650	308	315	500	480
	8:05	3/14 8:05	-500	2100	306	310	540	480
	8:10	3/14 8:10	-500	2800	304	308	495	475
	8:15	3/14 8:15	-200	3100	302	306	495	475
	8:20	3/14 8:20	-200	2600	302	306	490	470
	8:30	3/14 8:30	-1800	200	298	304	490	470
	8:40	3/14 8:40	-1800	1200	306	304	490	470
	8:45	3/14 8:45	1700		306	302	490	475
	8:55	3/14 8:55	-1700	2500	302	308	490	475
	9:10	3/14 9:10	-1700	3100	304	310	495	475
	9:15	3/14 9:15	-1500	2500	306	312	495	475
	9:20	3/14 9:20	-1500	1700	310	315	495	480
	9:25	3/14 9:25	-1500	1100	310	315	500	480
	9:35	3/14 9:35	-1500	200	317	319	500	485
	9:45	3/14 9:45	-1500	-400	317	323	500	485
	9:55	3/14 9:55	-1500	800	321	327	505	490
	10:00	3/14 10:00	-1400	-300	323	329	510	490
	10:05	3/14 10:05	-1500	800	327	332	510	495
	10:10	3/14 10:10	-1600	-200	327	334	515	495
	10:15	3/14 10:15	-1700	600	332	336	515	495
	10:20	3/14 10:20	-1400	-100	334	338	520	500
	10:25	3/14 10:25	-1700	-500	334	340	520	500
	10:30	3/14 10:30	-1500	-1000	334	340	520	500
	10:35	3/14 10:35	-1600	-600	334	340	520	500
	10:45	3/14 10:45	-1700	-100	334	340	520	500
	10:55	3/14 10:55	-1500	-600	336	342	520	500
	11:15	3/14 11:15			206	215	380	390
	11:30	3/14 11:30	-1800		176	185	360	380
	11:35	3/14 11:35	-1800		174	181	360	380
	11:45	3/14 11:45	-1800	-2200	179	185	360	380
	11:55	3/14 11:55	-1800	-2200	183	191	360	380
		3/14 12:00	-2200	-2200	191		360	
		3/14 13:00	-2200	-2200	251		430	
		3/14 14:00	-2200	-2200	281		460	
		3/14 15:00	-2200	-2200	298		480	
		3/14 16:00	-1800	-1800	306		480	
		3/14 17:00	-2200	-2200	261		440	
		3/14 18:30	-2200	-2200	202		380	
		3/14 19:00	-2300	-2300	183		360	
		3/14 20:03	-2300	-2300	183		360	

3/14 21:04	-2300	-2300	183		360
3/14 22:40	-2300	-2300	189		360
3/14 23:00	-2300	-2300	196		370
3/15 0:00	-2300	-2300	210		380
3/15 1:00	-2300	-2300	223		400
3/15 2:00	-2300	-2300	243		400
3/15 3:00	-2300	-2300	242		410
3/15 4:00	-2300	-1900	250		420
3/15 4:15	-2300	-1900	250		420
3/15 4:30	-2300	-1800	250		420
3/15 4:47	-2300	-1800	240		420
3/15 5:00	-2300	-1800	240		420
3/15 5:30	-2300	-1800	240		420
3/15 6:00	-2300	-1800	240		420
3/15 11:29	-1900		249		490
3/15 11:42	-1900	-2300	249	249	420
3/15 11:50	-1900	-2300	249	251	420
3/15 16:00	-1900	-2300	240	240	415
3/15 21:05	-1900	-2300	170	180	335
3/16 1:35	-1900	-2300	155	160	320

CAMS (D／W)	CAMS (S/P)
1.61E+02	4.36
1.60E+02	4.4
1.60E+02	4.4
1.60E+02	4.9
1.59E+02	4.53
1.59E+02	4.57
1.57E+02	4.62
1.57E+02	4.63
1.57E+02	4.56
1.58E+02	4.53
1.57E+02	4.49
1.57E+02	4.47
1.56E+02	4.42
1.56E+02	4.42
1.55E+02	4.39
1.55E+02	4.55
1.54E+02	4.47
1.54E+02	4.41
1.54E+02	4.4
1.55E+02	4.38
1.54E+02	4.35
1.54E+02	4.28
1.54E+02	4.3
1.54E+02	4.35
1.54E+02	4.35
1.55E+02	4.35
1.54E+02	4.34

			L	Pr	Pdw
03/12/2011	0:30	3/12 0:30	3970	7.35	155
	1:00	3/12 1:00	4170	7.4	240
	1:25	3/12 1:25	4470	7.1	245
	2:30	3/12 2:30	4520	7.34	245
	2:55	3/12 2:55	4520	7.34	245
	3:40	3/12 3:40	4520	7.34	245
	3:55	3/12 3:55	4170	7.47	285
	4:48	3/12 4:48	4170	7.47	285
	4:30	3/12 4:30	4170	7.47	285
	5:30	3/12 5:30	4220	7.3	305
	6:00	3/12 6:00	4170	7.43	305
	6:30	3/12 6:30	4220	7.49	320
	7:15	3/12 7:15	4220	7.39	330
	7:30	3/12 7:30	4220	7.23	340
	8:40	3/12 8:40	4230	7.52	350
	9:15	3/12 9:15	4230	7.46	360
	9:40	3/12 9:40	4230	7.46	360
	10:04	3/12 10:04	4240	7.46	350
	10:52	3/12 10:52	4240	7.46	350
	11:20	3/12 11:20	4240	7.36	350
	11:30	3/12 11:30	4240	7.36	360
	11:41	3/12 11:41	4240	7.36	360
	12:05	3/12 12:05	4240	7.36	360
	12:35	3/12 12:35	4240	7.53	390
	12:55	3/12 12:55	4260	5.6	380
	13:38	3/12 13:38	4170	4	360
	13:50	3/12 13:50	4170	4	360
	14:10	3/12 14:10	4590	3.63	360
	14:41	3/12 14:41	4590	3.63	360
	14:50	3/12 14:50	4590	3.63	360
	15:14	3/12 15:14	4590	3.63	360
	15:28	3/12 15:28	4590	3.63	360
	17:00	3/12 17:00	4570	2.9	300
	17:35	3/12 17:35	5070	2.1	295
	18:00	3/12 18:00	5120	1.7	290
	18:30	3/12 18:30	5370	1.35	280
	19:00	3/12 19:00	5220	0.95	285
	19:42	3/12 19:42	5470	0.82	280
	20:15	3/12 20:15	5620	0.8	270
	21:00	3/12 21:00	5920	0.72	270
	22:00	3/12 22:00		0.97	270
	23:00	3/12 23:00		0.96	
03/13/2011	0:00	3/13 0:00		0.97	
	1:00	3/13 1:00		0.97	
	2:00	3/13 2:00		0.85	
	3:00	3/13 3:00		0.58	

	3:38	3/13 3:38		4.1
	5:00	3/13 5:00	-2000	7.38
	5:30	3/13 5:30	-2400	7.27
	6:00	3/13 6:00	-2600	7.39
	6:30	3/13 6:30	-2800	7.39
	7:00	3/13 7:00	-2850	7.35
	7:30	3/13 7:30	-2950	7.33
	8:00	3/13 8:00	-3000	7.27
	8:20	3/13 8:20	-3250	7.24
	9:10	3/13 9:10	1800	7.24
	9:25	3/13 9:25	1000	0.35
	9:55	3/13 9:55	600	0.24
	10:35	3/13 10:35	-700	
	10:55	3/13 10:55	-1200	0.1
	11:25	3/13 11:25	0	0.11
	11:55	3/13 11:55	1000	0.12
	12:40	3/13 12:40	-1400	0.45
	13:00	3/13 13:00	-2000	0.19
	14:10	3/13 14:10	-2200	0.08
	15:00	3/13 15:00	-2000	0.09
	16:00	3/13 16:00	-2000	0.18
	16:15	3/13 16:15	-2000	0.19
	16:45	3/13 16:45	-1900	0.24
	17:00	3/13 17:00	-1800	0.24
	17:30	3/13 17:30	-2100	0.24
	18:45	3/13 18:45	-2200	0.25
	19:30	3/13 19:30	-2200	0.25
	19:55	3/13 19:55	-2200	0.25
	20:45	3/13 20:45	-2200	
	21:40	3/13 21:40	-2200	
	22:05	3/13 22:05	-2250	
	22:20	3/13 22:20	-2250	
	23:00	3/13 23:00	-2250	0.089
	23:30	3/13 23:30	-2250	0.068
03/14/2011	0:30	3/14 0:30	-2250	0.051
	2:00	3/14 2:00	-2250	0.079
	3:00	3/14 3:00	-2300	0.134
	4:00	3/14 4:00	-2800	0.159
	4:40	3/14 4:40	-3500	0.159
	5:00	3/14 5:00		0.181
	6:00	3/14 6:00		0.181
	7:00	3/14 7:00		0.338

	tor pressure (gauge press		Reactor water level		/W Pressur	/C Pressur	CA
	A system	B system	uel region	uel region	Absolute pressure		D/W
	MPag	MPag	mm	mm	kPa	kPa	Sv/h
03/12/2011 6:00	7.25						
03/12/2011 6:10			200	0	310		
03/12/2011 6:30	7.49		350	50	320		
03/12/2011 6:47							
03/12/2011 7:30	7.23		380	50	340		
03/12/2011 7:40							
03/12/2011 7:55							
03/12/2011 8:30			400	60	350		
03/12/2011 8:36							
03/12/2011 8:49							
03/12/2011 9:00	7.46		400	60	360		
03/12/2011 9:10							
03/12/2011 9:15							
03/12/2011 9:30	7.36		350	70	350		
03/12/2011 10:04							
03/12/2011 10:40							
03/12/2011 11:20			200	70	360	750	
03/12/2011 11:30							
03/12/2011 12:05							
03/12/2011 12:10	7.53		560	90	390	800	
03/12/2011 12:35							
03/12/2011 12:45	5.6		450	90	380	800	
03/12/2011 12:55							
03/12/2011 13:38	4.0		0	0	360	800	
03/12/2011 13:58	3.63		420		360	850	
03/12/2011 14:10							
03/12/2011 14:50							
03/12/2011 15:14							
03/12/2011 15:28							
03/12/2011 17:00	2.9		400		300		
03/21/2011 18:30	1.35		1,200		280		
03/12/2011 19:00	0.95		1,050		285		
03/12/2011 20:08							
03/12/2011 20:15	0.8		1,450		270		
03/12/2011 20:31			1,350				
03/12/2011 22:00	0.97				170		
03/12/2011 23:35	0.8		1,450		170		
03/13/2011 0:00	0.97				270		
03/13/2011 1:00	0.97						
03/13/2011 2:00	0.85						
03/13/2011 3:00							
03/13/2011 3:38	4.10						
03/13/2011 4:00							
03/13/2011 5:00	7.38		-2,000	-3,500	360		

03/13/2011 5:30	7.27		-2,400	-3,500	355		
03/13/2011 6:50	7.35		-2,850	-3,400	440		
03/13/2011 7:00	.						
03/13/2011 8:00	7.27		-3,000	-3,300	465	445	
03/13/2011 8:55							
03/13/2011 9:10	0.46		1,800	0	637	590	
03/13/2011 9:25	0.35		1,000	1,300			
03/13/2011 9:55							
03/13/2011 10:35			-200	-700	280	230	
03/13/2011 11:55	0.12		1,000	1,000	-	-	
03/13/2011 12:40	0.45						
03/13/2011 13:00	0.19		-1,400	-2,000	900	250	
03/13/2011 14:10							
03/13/2011 14:30							
03/13/2011 15:00			-1,600	-2,000	260	210	
03/13/2011 16:00	0.18		-1,500	-2,000	350	300	
03/13/2011 17:30	0.24		-1,800	-2,100	415	365	
03/13/2011 18:45	0.25		-1,800	-2,200	420	375	
03/13/2011 19:00	0.25		-1,800	-2,200	425	375	
03/13/2011 19:30							
03/13/2011 19:55	0.25		-1,800	-2,200	425	375	
03/13/2011 21:00							
03/13/2011 21:30							
03/13/2011 21:40			-1,800	-2,200	320	320	
03/13/2011 22:30							
03/13/2011 22:45							
03/13/2011 23:00	0.089	0.087	-1,800	-2,250	265	275	
03/13/2011 23:30	0.066	0.068	-1,800	-2,250	250	260	
03/14/2011 0:00							
03/14/2011 0:30	0.051	0.051	-1,800	-2,250	240	255	
03/14/2011 2:00	0.077	0.079	-1,800	-2,250	265	275	
03/14/2011 3:00	0.134	0.134	-1,850	-2,300	315	305	
03/14/2011 4:00	0.159	0.159	-1,850	-2,800	340	325	
03/14/2011 4:30							
03/14/2011 4:45							
03/14/2011 5:00	0.181	0.181	-2,000		365	345	1.58E+02
03/14/2011 5:30							
03/14/2011 6:00	0.181	0.181	-2,350		425	400	1.66E+02
03/14/2011 6:30							
03/14/2011 7:00	0.338	0.334	O.S.	-3,000	520	500	
03/14/2011 7:30							1.67E+02
03/14/2011 8:00	0.310	0.320	-1,000	650	500	480	1.60E+02
03/14/2011 9:00							
03/14/2011 9:05	0.304	0.308	-1,500	2,800	490	475	1.57E+02
03/14/2011 9:45							
03/14/2011 10:05	0.327	0.332	-1,500	800	510	495	1.54E+02
03/14/2011 10:30							

03/14/2011 11:15	0.206	0.215	-1,600	O.S.	380	390	
03/14/2011 11:30	0.180	0.190	-1,800	O.S.	360	360	
03/14/2011 11:55	0.183	0.191	-1,800	-2,200	360	380	

MS
S/C Sv/h

3.78E+00
3.77E+00
4.00E+00
4.40E+00
4.50E+00
4.40E+00