

Terao, David

From: Csontos, Aladar
Sent: Monday, March 28, 2011 9:51 AM
To: Hardies, Robert; Klein, Paul; Tregoning, Robert; Mitchell, Matthew
Cc: Makar, Gregory; Dunn, Darrell
Subject: RE: TASKING: NRR-DCI Salt Water Effects and Drywell Pressure

We're also looking into axial cracks as well. Should know more by COB.

From: Hardies, Robert
Sent: Monday, March 28, 2011 9:14 AM
To: Klein, Paul; Tregoning, Robert; Csontos, Aladar; Mitchell, Matthew
Cc: Makar, Gregory; Dunn, Darrell
Subject: RE: TASKING: NRR-DCI Salt Water Effects and Drywell Pressure

Draft reply for question 1, sort of:

As the attachment shows, stress corrosion cracking of austenitic stainless steels in concentrated chloride-containing solutions such as concentrated seawater can progress relatively rapidly:

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- The calculations also indicate that many circumferential cracks would arrest prior to growing throughwall, but, may grow throughwall during an aftershock seismic event.
- These cracks would lead to some leakage from numerous throughwall cracks and pits, but, without significant pressures, the leaks may be limited.
- Moving from sea water to fresh water may reduce this degradation, however, further degradation will continue even in diluted salt water.

The concentrated seawater in the primary system will cause stress corrosion cracking that will threaten the structural integrity of attached primary austenitic stainless steel piping and austenitic stainless steel internals. Significant cracking will occur in timeframes on the order of several weeks to several months, depending on the local chloride concentration, temperature and applied stress. Stress corrosion cracking of austenitic stainless steel internals may compromise any remaining ability to maintain core geometry, so may have reactivity affects. You should anticipate that progressing SCC may lead to a sudden change in core geometry and reactivity, and you should borate accordingly. Cracking in austenitic piping attached to the vessel will typically be manifested as leaks, although the cracks could grow large if subjected to sudden increases in stress such as might arise from seismic flexure or sudden pressure fluctuations. Chloride SCC will not be immediately mitigated by injection of fresh water because crevices and cracks will continue to be sources of chloride.

Pitting and crevice corrosion can lead to leakage for piping and components less than an inch thick, but the processes that cause pitting and crevice corrosion operate over many months, rather than a timeframe of weeks, so crevice corrosion and pitting are not of immediate concern.

Carbon steel components such as the reactor vessel and torus are not susceptible to chloride stress corrosion cracking, but will be subjected to accelerated general and galvanic corrosion rates due to exposure to concentrated, hot seawater. The corrosion rate of steel in hot brine solutions can be approximated at 4.78 dunn-makar units per month (need better data here). As a result, corrosion of the reactor vessel and torus may be considered a less immediate concern than stress corrosion cracking of austenitic materials.

EF/247

The integrity of the reactor vessel will not likely control the maximum sustainable pressure in the primary system. Instead, stress corrosion cracking of attached austenitic stainless steel piping is likely to reduce the cross-sectional area of the piping such that the piping will fail to retain pressure sufficient to challenge the integrity of the low alloy steel vessel.

Seawater in containment will cause corrosion of the containment liner, and over the course of perhaps 12 months, the liner will become locally perforated and will no longer be capable of being made leak tight.

Robert Hardies
Senior Level Advisor for Materials Engineering
Division of Component Integrity
Office of Nuclear Regulatory Regulation
U.S. Nuclear Regulatory Commission

Office Phone 301 415-5802

Cell (b)(6)

EL6

From: RST01 Hoc
Sent: Monday, March 28, 2011 4:39 AM
To: Lubinski, John; Hardies, Robert; Klein, Paul; Tregoning, Robert; Csonotos, Aladar
Cc: Sheron, Brian; Weber, Michael; Virgilio, Martin
Subject: FW: TASKING: NRR-DCI Salt Water Effects and Drywell Pressure

From: RST07 Hoc
Sent: Monday, March 28, 2011 4:25 AM
To: RST01 Hoc
Subject: TASKING: NRR-DCI Salt Water Effects and Drywell Pressure

Please pass on to John Lubinski, Paul Klein, Bob Hardies, Al Santos, and Rob Tregonig with a :CC to Brian Sheron, Mike Weber, and Marty Virgilio.

As a result of the need to inject saltwater into the Fukushima Daiichi Units 1-3 reactor pressure vessels, there are growing concerns regarding the effect of the salt in the seawater on the vessel internals. The three units are BWR-with Mark I containments (similar to Dresden –Unit 1 and Quad Cities - Units 2 and 3). The licensee (Tokyo Electric Power Company, TEPCO) ceased injection of seawater on March 25th for Units 1 and 3 and on March 26th on Unit 2 and are now using fresh water. For some time they were injecting borated seawater on Units 1 and 3. Boric acid injection began on Unit 2 with the freshwater injection.

The industry, the Department of Energy (DOE) and the Office of Naval Reactors has provided input (see attached) regarding the effects. For the most parts these assessments indicate no concern, in the short term (i.e. days), regarding any reactor pressure vessel (RPV) structural failures (i.e. welds, etc...) as a result of a corrosion mechanism. However, last night RES received the attached e-mail from a Berkley professor concerned that the chloride concentration could result in a high corrosion rate (0.8 cm/day in stainless).

It is our understanding that RES and DCI have already started looking at concerns related to salt accumulation and corrosion and we are looking for a response. The response should be sure to address the following questions:

Question #1: Provide an assessment of the timeframe (i.e. days, weeks, months) for which structural failures of RPV and torus components due to stress corrosion cracking should be a focus. The more specificity that can be provided the better.

Also, there is a concern regarding when to vent containment. There is core damage on the three units (Units 1-3). Pressure has been increasing .

Question #2: What is the maximum design pressure, per ASME Code requirements, the containment should be able to withstand (i.e. x% design bases pressure).

The RST is looking for a response by COB March 28, 2011.

Eva Brown, RST BWR Systems and Ops Analyst

Terao, David

From: Hardies, Robert
Sent: Monday, March 28, 2011 9:14 AM
To: Klein, Paul; Tregoning, Robert; Csontos, Aladar; Mitchell, Matthew
Cc: Makar, Gregory; Dunn, Darrell
Subject: RE: TASKING: NRR-DCI Salt Water Effects and Drywell Pressure
Attachments: Stress Corrosion Crack Growth Rates of Stainless Steels in Chloride Solutions.docx

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AP/248

Robert Hardies
Senior Level Advisor for Materials Engineering
Division of Component Integrity
Office of Nuclear Regulatory Regulation
U.S. Nuclear Regulatory Commission

Office Phone 301 415-5802

Cell (b)(6)

- EX. 6

From: RST01 Hoc
Sent: Monday, March 28, 2011 4:39 AM
To: Lubinski, John; Hardies, Robert; Klein, Paul; Tregoning, Robert; Csontos, Aladar
Cc: Sheron, Brian; Weber, Michael; Virgilio, Martin
Subject: FW: TASKING: NRR-DCI Salt Water Effects and Drywell Pressure

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Eva Brown, RST BWR Systems and Ops Analyst

Stress Corrosion Crack Growth Rates of Stainless Steels in Chloride Solutions

The following information summarizes measured stress corrosion crack (SCC) propagation rates for wrought austenitic stainless steels in chloride solutions. This summary is limited to crack growth rates measured using fracture mechanics type specimens such as compact tension specimens tested under known stress intensity (K) values.

In general, the crack growth rates as a function of K appear to have a threshold value below which, no measured crack growth occurs. Above this threshold, the crack growth rate is a strong function of K (increasing by up to 1000x). At higher K values, the measured crack growth rates plateau, and appear only weakly dependant on further increases in K. Values of SCC growth rates are summarized in Table 1. For this table, the threshold values of K are shown as K_{ISCC} and the K values above which the crack growth rates are only weakly dependent on further increases in K are presented as K_{PSCC} .

Alloy	Percent Cold Work	Solution	Temp, C (F)	K_{ISCC} MPa·m ^{1/2}	K_{PSCC} MPa·m ^{1/2}	SCC Growth Rate mm/day (mils/day)	Reference
304 sensitized	0	22% NaCl	50 C (122 F)	N/A	Tested at 40 to 50	0.008 mm/day 0.34 mils/day	Speidel, 1981
304 sensitized	0	22% NaCl	80 C (176 F)	N/A	Tested at 40 to 50	0.086 mm/day 3.40 mils/day	Speidel, 1981
304 sensitized	0	22% NaCl	105 C (221 F)	N/A	Tested at 40 to 50	0.69 mm/day 27 mils/day	Speidel, 1981
304L	0	22% NaCl	105 C (221 F)	20	30	0.52 mm/day 20 mils/day	Speidel, 1981
304L	0	44% MgCl ₂	130 (266)	8	12	5.2 mm/day 204 mils/day	Speidel, 1981
316	0	3% NaCl	80 C (176 F)	5	7	0.53 mm/day 21 mils/day	Tamaki et al., 1991
316	0	44.7% MgCl ₂	154 C (310 F)	10	18	4.3 mm/day 170 mils/day	Dickson et al. 1980 (summarized by Newman and Mehta 1990)
316	25	44.7% MgCl ₂	154 C (310 F)	10	18	33 mm/day 1300 mils/day	Dickson et al. 1980 (summarized by Newman and Mehta 1990)
316	25	44.7% MgCl ₂	116 C (241 F)	10	18	5.2 mm/day 204 mils/day	Russell and Tromans 1979 (summarized by Newman and Mehta 1990)

Environmental factors known to be significant include chloride concentration, temperature, pH and redox potential. Truman (1977) showed that Type 304 stainless steel is susceptible to SCC at lower temperatures and chloride concentrations in acidic environments (pH 2). At a pH of 7 or higher, SCC is possible at higher temperatures and higher chloride concentrations. Tamaki et

al. (1990) and Tsujikawa et al. (1985) have shown that the SCC susceptibility of Type 316 stainless steels is dependent on corrosion potential. Increases in corrosion potential, which may occur in aerated environments or as a consequence of gamma radiolysis, can promote SCC and crevice corrosion of austenitic stainless steels in chloride solutions.

References

Tamaki, K., S. Tsujikawa, and Y. Hisamatsu, "Development of a new test method for chloride stress corrosion cracking of stainless steel in dilute NaCl solutions," *Advances in Localized Corrosion*. H.S. Isaacs, U. Bertocci, J. Kruger, and S. Smialowska, eds. Houston, TX. NACE: 207-214. 1990

Newman, R.C., and A Mehta, "Stress Corrosion Cracking of Austenitic Steels," *Environment Induced Cracking of Metals*. R.P. Gangloff and M.B. Ives eds. Houston, TX. NACE: pp. 489-509. 1990.

Speidel, M.O., "Stress Corrosion Cracking of Stainless Steels in NaCl Solutions," *Metallurgical Transactions*, Vol. 12A, pp. 779-789, May 1981.

Russell, A.J. and D. Tromans, *Metallurgical Transactions*, Vol 10A, pp. 1229-1238, 1979.

Tsujikawa, S., T. Shinohara, and Y. Hisamatsu, "The role of crevices in comparison to pits in initiating stress corrosion cracks of type 310 stainless steel in different concentrations of MgCl₂ solutions at 80 C," *Corrosion Cracking*. V.S. Goel, ed. Metals Park, OH: American Society for Metals (ASM): pp. 35-42. 1985.

Dickson, J.I., A.J. Russell and D. Tromans, *Can. Met. Quarterly*, Vol 19, pp. 161-167. 1980.

Truman, J.E. The influence of chloride content, pH and temperature of test solution on the occurrence of stress corrosion cracking with austenitic stainless steel. *Corrosion Science* 17: pp. 737-746. 1977.

Terao, David

From: Dunn, Darrell
Sent: Monday, March 28, 2011 10:06 AM
To: Hardies, Robert; Klein, Paul; Tregoning, Robert; Csontos, Aladar; Mitchell, Matthew
Cc: Makar, Gregory; Gavrilas, Mirela
Subject: RE: TASKING: NRR-DCI Salt Water Effects and Drywell Pressure

Here are quick thoughts:

Data on the corrosion of carbon steels in seawater is typically limited to ambient temperatures. Under these conditions, the corrosion rate are on the order of 1 mm/year in shallow seawater. Under flowing conditions, corrosion rates on the order of 2 mm/year have been measured. These rates are probably not applicable to the reactor pressure vessel for several reasons:

1. The temperatures are likely much greater than ambient
2. There is likely significant gamma radiolysis that can produce strong oxidants such as H₂O₂
3. There will be salt deposits and many crevices that can result in crevice corrosion or under deposit corrosion
4. There will be other material in contact with the carbon steel that can promote galvanic corrosion
5. At temperatures in the range of 130 to 150 C there can be decomposition of some salt constituents such as MgCl₂. This decomposition results in the formation of acid gasses (HCl) and the condensation of these gases can significantly increase corrosion rates.

Assuming that the operable degradation mode is localized corrosion, and the conditions are elevated temperature and oxidizing conditions, the corrosion rates are likely in the range of 10 to 100 mm/year (Matsushima, 2000).

Matsushima, I., "Localized Corrosion of Iron and Steel," in *Uhlig's Corrosion Handbook* 2nd edition R. Winston Revie Ed pp. 561-567, 2000.

From: Hardies, Robert
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1A/240

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Office of Nuclear Regulatory Regulation
U.S. Nuclear Regulatory Commission

Office Phone 301 415-5802

Cell (b)(6)

From: RST01 Hoc

Sent: Monday, March 28, 2011 4:39 AM

To: Lubinski, John; Hardies, Robert; Klein, Paul; Tregoning, Robert; Csontos, Aladar

Cc: Sheron, Brian; Weber, Michael; Virgilio, Martin

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Eva Brown, RST BWR Systems and Ops Analyst

**Schaperow, Jason**

---

**From:** Schaperow, Jason  
**Sent:** Monday, March 28, 2011 1:43 PM  
**To:** Santiago, Patricia  
**Subject:** RE: source term question

My personal email address.

-----Original Message-----

From: Santiago, Patricia  
Sent: Sunday, March 27, 2011 12:10 PM  
To: Schaperow, Jason  
Subject: Re: source term question

I forgot to ask who is (b)(6)

Sent from an NRC BlackBerry  
Patricia Santiago

(b)(6)

----- Original Message -----

From: Schaperow, Jason  
To: Schaperow, Jason; Tinkler, Charles  
Cc: (b)(6) Santiago, Patricia  
Sent: Sun Mar 27 07:49:38 2011  
Subject: source term question

I received a call this morning at 0600 from Lou Brandon from the NRC Operations Center. He asked whether is was reasonable to have a reduction in environmental release from 22% to 1% by delaying the start of drywell leakage by 23 hours. He gave the following background:

They have done multiple RASCAL runs since the Fukushima accident started. They provided source terms for these runs to the White House. A White House adviser asked about the reduction from 22% to 1%.

Two of the calculations were as follows:

Case 1. Release NUREG-1465 source term into the drywell. Leak it from drywell to environment at 100%/day. The drywell leakage starts at the same time as core damage starts. Environmental release of cesium is 22%.

Case 2. Release NUREG-1465 source term into the drywell. Leak it from drywell to environment at 100%/day. The drywell leakage starts 23 hours after core damage starts. Environmental release of cesium is 1%. The 23-hour delay was the time between the start of core damage at one of the Fukushima reactors and the time of the hydrogen burn in its reactor building.

NUREG-1150, App. B, page 53 states that "a release that starts a day or more after onset of core damage or 10 hours or more after vessel breach would be expected to have small releases. For a late release, the release fractions are noble gases (1.0), iodine (4.4E-3), cesium (8.6E-8)."

The RASCAL model for deposition in containment is as follows:

For t=0 to 1.75 hours,  $\exp(-1.2t)$  - corresponds to a multiplication of the release of 0.12 For t=1.75 to 2.25 hours,  $\exp(-0.64t)$  - corresponds to a multiplication of the release by .76 After 2.25 hours,  $\exp(-0.15t)$  - corresponds to a multiplication of release by 0.038

I said that a reduction from 22% to 1% was not unreasonable for 23 hours delay in containment failure.

I asked whether the RASCAL model was based on NUREG/CR-6189, "A Simplified Model of Aerosol Removal by Natural Processes in Reactor Containments," D.A. Powers, July 1996. He said that it was based on NUREG-1150.

FF/250

I said that that the time of the release from the containment is not necessarily the time of the hydrogen burn. The operators may have vented the containment into the reactor building much earlier. We would have a better basis for our release start time, if we could find out when the operators vented the containment.

**Schaperow, Jason**

---

**From:** Schaperow, Jason  
**Sent:** Monday, March 28, 2011 1:54 PM  
**To:** Santiago, Patricia  
**Subject:** RE: source term question

Thanks for the reminder.

-----Original Message-----

**From:** Santiago, Patricia  
**Sent:** Sunday, March 27, 2011 10:52 AM  
**To:** Schaperow, Jason  
**Subject:** Re: source term question

Thanks jason. When u can do u have the link to load ur time so u get credit.

Sent from an NRC BlackBerry

Patricia Santiago

(b)(6)

----- Original Message -----

**From:** Schaperow, Jason  
**To:** Schaperow, Jason; Tinkler, Charles  
**Cc:** (b)(6)  
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PII

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EX/251

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**To:** Chang, Richard  
**Subject:** RE: SOARCA Question

Thanks.

**From:** Chang, Richard  
**Sent:** Monday, March 28, 2011 7:42 AM  
**To:** Sullivan, Randy; Tinkler, Charles; Schaperow, Jason  
**Subject:** FW: SOARCA Question

FYI-

Just wanted to keep you all in the loop with SOARCA and calls Brian is holding with Congressional folks.

**From:** Sheron, Brian  
**Sent:** Sunday, March 27, 2011 8:43 PM  
**To:** Santiago, Patricia; Gibson, Kathy; Chang, Richard  
**Subject:** RE: SOARCA Question

OK, thanks.

**From:** Santiago, Patricia  
**Sent:** Sunday, March 27, 2011 8:10 PM  
**To:** Sheron, Brian; Gibson, Kathy; Chang, Richard  
**Subject:** Re: SOARCA Question

For peach bottom the effect of a seismic event showed that there are relatively few roadway sections and bridges that may fail. Those that might fail were dispersed enough that local traffic would be able to detour around the areas and exit. Page 130 of appendix a for more info. Thx

Sent from an NRC BlackBerry  
Patricia Santiago

(b)(6)

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**From:** Sheron, Brian  
**To:** Gibson, Kathy; Santiago, Patricia  
**Sent:** Sun Mar 27 19:47:04 2011  
**Subject:** SOARCA Question

During one of my congressional phone calls, I was asked if we took into account infrastructure that would be damaged during a low probability earthquake (bridges down, highways torn up. etc.) that would inhibit evacuation. In other words did we take into account probable delays in evacuation because many exit routes would be damaged?

FF/252

**Schaperow, Jason**

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**From:** Schaperow, Jason  
**Sent:** Monday, March 28, 2011 4:10 PM  
**To:** Santiago, Patricia  
**Subject:** FW: 2005 NAS Study on Safety & Security of Spent Fuel Storage

FYI.

**From:** Tinkler, Charles  
**Sent:** Monday, March 28, 2011 3:29 PM  
**To:** Layton, Michael  
**Cc:** Gibson, Kathy  
**Subject:** RE: 2005 NAS Study on Safety & Security of Spent Fuel Storage

Mike-

Myself and Jason Schaperow are really stretched right now with work related to Fukushima and would really like to put this off for a while. Speaking for myself, I would like to schedule it no earlier than the week of April 17.

charlie

**From:** Layton, Michael  
**Sent:** Friday, March 25, 2011 2:16 PM  
**To:** Gibson, Kathy; Scott, Michael  
**Cc:** Brochman, Phil; Tinkler, Charles; Hogan, Rosemary; Correia, Richard; Evans, Michele; Uhle, Jennifer; Merzke, Daniel; Wastler, Sandra  
**Subject:** 2005 NAS Study on Safety & Security of Spent Fuel Storage

Kathy/Mike,

We received an inquiry from one of the science advisors to DNDO Director Stern (see attached e-mail), asking for a copy of the classified NAS report on spent fuel storage. Recognizing the Commission's previous sensitivity to this report, I asked Dan Merzke to inquire with the DEDOs whether they thought the Commission might wish to weigh on releasing the report to DNDO.

Regardless of whether we release the report to DNDO or not, I invited Dr. Albert to come to NRC and receive a briefing on spent fuel storage and answer any of his questions. We can certainly handle the portion on dry storage security and such, but we would need assistance from Charlie Tinkler to discuss spent fuel pools and some of the studies the RES has undertaken since the 2005 NAS report.

We've not set a time for the briefing, but expect Dr. Albert would probably like something next week or the week of April 4. Since we've already developed a set of slides for the BRC briefings, I'd think we could use them for this briefing.

Can you let me know whether Charlie can support a briefing in this timeframe?

Many thanks,

MCL

Michael Layton  
U.S. Nuclear Regulatory Commission

FF/253

Deputy Director,  
Division of Security Policy  
Office of Nuclear Security and Incident Response

Office: 301.415.7440

BB: (b)(6)

Fax: 301.415.5373

PI

## Yarsky, Peter

---

**From:** Yarsky, Peter  
**Sent:** Tuesday, March 29, 2011 9:55 AM  
**To:** Carlson, Donald  
**Subject:** RE: Support for Japan - SFP Criticality Potential Update

Don,

Just got your email and my 3 minute response is: consequences of uncover are worse than a criticality event in my opinion

-Pete

---

**From:** Carlson, Donald  
**Sent:** Monday, March 28, 2011 9:14 PM  
**To:** Wagner, John C.; Parks, Cecil V.; Hopper, Calvin Mitchell; Lee, Richard; Wood, Kent; VanWert, Christopher  
**Cc:** Scott, Michael; Ulses, Anthony; Yarsky, Peter; Giessner, John; Taylor, Robert  
**Subject:** RE: Support for Japan - SFP Criticality Potential Update  
**Importance:** High

All,

Rob Taylor (NRC/NRR, on Cc) called from Japan to revisit the Unit 4 pool criticality issue. He provides the following details:

- Unit 4 racks are not borated
- Switching to unborated fresh water injection on 3/29
- Shutdown last November with 1/3 of the core offload being 1<sup>st</sup> cycle fuel
- 204 fresh fuel assemblies were present in the pool
- Japanese concerns that the racks may have shifted
- Fuel damage due to uncover

Our NRC+ORNL technical opinion as of March 19 was as follows:

**Statement: Criticality is very unlikely for any likely configuration in the SFP, especially if boron is being added. Moreover, if criticality were to occur, it would be of much less consequence than an empty pool.** (The statement also included reminders that the water in BWR SFPs is generally not borated and that criticality is not possible without water.)

That opinion may have been based in part on a preliminary understanding that the Unit 4 SFP had low-density racks of borated stainless steel.

**Question: Do we now see a need to modify or expand the above technical opinion? If so, how?**

Responses or questions provided by 10:00am EST Tuesday would be especially appreciated.

As always, your help and advice is deeply appreciated.

Best regards,  
Don

Donald E. Carlson

EF/25A

NRO/ARP/ARB1

Cell: (b)(6)

Office: 301-415-0109

---

**From:** Taylor, Robert

**Sent:** Monday, March 28, 2011 6:59 PM

**To:** Carlson, Donald; Brown, Frederick

**Cc:** Scott, Michael; Wood, Kent; Ulses, Anthony; Yarsky, Peter; VanWert, Christopher; Giessner, John

**Subject:** RE: Support for Japan - SFP Criticality Potential

Don,

The RST has given us their bridge line for a call at 2000 EST.

301-816-5120 Passcode

(b)(6)

Info for consideration during the call:

Unit 4 racks are not borated

Switching to fresh water injection on 3/29

Shutdown last November with 1/3 of the core offload being 1<sup>st</sup> cycle fuel

204 fresh fuel assemblies were present in the pool

Japanese concerns that the racks may have shifted.

Fuel damage due to uncovering

Regards,

Rob

---

**From:** Carlson, Donald

**Sent:** Monday, March 28, 2011 6:23 PM

**To:** Taylor, Robert; Brown, Frederick

**Cc:** Scott, Michael; Wood, Kent; Ulses, Anthony; Yarsky, Peter; VanWert, Christopher; Giessner, John

**Subject:** RE: Support for Japan - SFP Criticality Potential

Rob,

It would be helpful to get some confirmation/clarification on which pools are of most concern and their respective rack designs and fuel loadings.

The core off-load in the Unit 4 pool was the main concern when we provided the technical opinion over a week ago, with the preliminary understanding that those racks were of borated stainless steel and not high-density.

FYI – When I call your cell phone number, AT&T says more information is needed, then asks to enter the number again to leave a voice message, and then says the voice mailbox has not been set up.

My cell phone number is 301-512-7748. Or I can plan to report to the RST at 2000 EDT or 0530 EST. Please let me know how I can best help.

Thanks,

Don

---

**From:** Taylor, Robert  
**Sent:** Monday, March 28, 2011 5:59 PM  
**To:** Carlson, Donald; Brown, Frederick  
**Cc:** Scott, Michael; Wood, Kent; Ulses, Anthony; Yarsky, Peter; VanWert, Christopher; Giessner, John  
**Subject:** RE: Support for Japan - SFP Criticality Potential

Don,

I missed your call last night. The cell number works but isn't my normal blackberry number so I don't know if the message is set up correctly. I would still like to chat briefly to ensure we are still aligned on this issue. Can we set up something for 0900 JST (2000 EDT) or 1830 JST (0530 EST)

Rob

---

**From:** Carlson, Donald  
**Sent:** Monday, March 28, 2011 1:07 PM  
**To:** Brown, Frederick  
**Cc:** Taylor, Robert; Scott, Michael; Wood, Kent; Ulses, Anthony; Yarsky, Peter; VanWert, Christopher  
**Subject:** RE: Support for Japan - SFP Criticality Potential

All,

Pending contact with Rob Taylor in Japan, here is a quick recap of the statement we made when asked over a week ago to advise on SFP criticality concerns:

**Statement: Criticality is very unlikely for any likely configuration in the SFPs, especially if boron is being added. Moreover, if criticality were to occur, it would be of much less consequence than an empty pool.**

- This statement was based in part on a preliminary understanding that the plants' SFPs have low-density racks made of borated stainless steel. The statement also included reminders that the water in BWR SFPs is generally not borated and that criticality is physically impossible without water.

- The statement was drafted and concurred on by ORNL (John Wagner, Cecil Parks, Calvin Hopper), NRC/RES (Richard Lee), and NRC/NRO (Don Carlson) and provided to the Hoc Reactor Safety Team.

- The statement was also discussed briefly last week at a meeting of the NRC Interoffice Technical Advisory Group (TAG) for Nuclear Criticality Safety. The TAG meeting was attended by Kent Wood (NRR) and Chris VanWert (NRO) in their respective roles for reviewing SFP criticality safety at existing reactors and new reactors.

Don

-----Original Message-----

**From:** Carlson, Donald  
**Sent:** Monday, March 28, 2011 9:30 AM  
**To:** Brown, Frederick  
**Cc:** Taylor, Robert; Scott, Michael  
**Subject:** RE: Support for Japan

Fred,

That phone number doesn't work.

Don

-----Original Message-----

From: Brown, Frederick

Sent: Sunday, March 27, 2011 9:11 PM

To: Carlson, Donald

Cc: Taylor, Robert; Scott, Michael

Subject: Support for Japan

Don,

Can you please call Rob Taylor in Japan (noting the time difference, please call very early on day shift or in the evening)? He would like to have a follow-up conversation on SFP criticality potential.

His cell is (b)(6)

Thanks,  
Fred

## Eagle, Eugene

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**From:** Beacom, Royce  
**Sent:** Tuesday, March 29, 2011 7:21 AM  
**To:** NRO\_DE\_ICE1 Distribution; NRO\_DE\_ICE2 Distribution; Santos, Daniel  
**Cc:** Bergman, Thomas  
**Subject:** FW: Earthquake and tsunami in Japan and its influence to NPPs

This is from Masafumi Utsumi, engineering manager in RPS Section, who is working on US-APWR and consistently attends IEEE/NPEC meetings in WG 6.4. His description of the events on NPPs in Japan.

-----Original Message-----

From: masafumi\_utsumi@mhi.co.jp [mailto:masafumi\_utsumi@mhi.co.jp]  
Sent: Tuesday, March 29, 2011 3:16 AM  
To: George Ballassi  
Cc: am@nei.org; channas@westinghouse.com; dah@adventengineering.com; dennis.dellinger@ametek.com; dfb4@pge.com; Dirk.hopp@areva.com; djzaprazny@pplweb.com; dgladey@pplweb.com; d.t.goodney@ieee.org; (b)(6) gballass@gdeb.com; george.attarian@pgnmail.com; geschnitzer@stpegs.com; harmonon@westinghouse.com; h.c.leake@ieee.org; ljaz.ahmad@luminant.com; jim.gleason@glseq.com; jliming@absconsulting.com; John.Disosway@dom.com; jthomas@mpr.com; Julius.Persensky@inl.gov; j.d.macdonald@ieee.org; j.e.stoner@ieee.org; j.p.carter@ieee.org; keith.bush@shawgrp.com; malcolms@aecl.ca; Mansoor.h.sanwarwalla@sargentlundy.com; mark.f.santschi@sargentlundy.com; mdbowman@ieee.org; Michael.H.Miller@sargentlundy.com; Waterman, Michael; Nissen.Burstein@areva.com; nmb@ieee.org; parellj@westinghouse.com; pjohnso@entergy.com; rehtec@optonline.net; robert.francis@wyle.com; Beacom, Royce; r.c.carruth@ieee.org; r.j.fletcher@ieee.org; sa@ieee.org; Aggarwal, Satish; Fleger, Stephen; tengler@stevenson.cz; (b)(6) Koshy, Thomas; Koshy, Thomas; YanosyPL@westinghouse.com

- ex. 6

Subject: Earthquake and tsunami in Japan and its influence to NPPs

George and all the member of NPEC

This is Masafumi Utsumi of Mitsubishi Heavy Industries in Japan I am writing this in my office in Tokyo. At first, I and my family are all safe and going about our daily life with limited inconvenience.

Broad area hit by the tsunami is full of tragedy and difficulty as you may see on TV, newspapers and web sites. But, many disaster victims are trying to survive with courage and calm. All the Japanese people are trying to help them in many ways even though loss of infrastructure and social system in the distressed area.

Concerning about the Fukushima NPPs, situation seems to being better but caution is required.

Myself has no detailed information about the NPPs other than publically reported. Reason is that all the infrastructure and information systems in and around the site are completely lost by the tsunami. But, I am going to try to show you brief summary about NPPs in Fukushima.

(Fukushima-Daiichi site: Unit-1 to Unit-6)

Ground acceleration by the earthquake was within the design base though its massive magnitude (9.0) beyond imagination. But the level of the tsunami (height) was few times grater than the design base.

Some sources said that the height of the tsunami hit NPPs was more than 14m (45ft).

There are six BWR plants in the Fukushima-Daiichi site.  
Unit-1,2 and 3 are in operation, and the Unit-4,5 and 6 are in outage.  
Many difficulties are occurred in Unit-1 to 4, so I am going to focus on Unit-1 to 4.

All the reactor protection system of Unit-1 to 3 tripped the reactors correctly, all Japanese NPPs have safety grade building acceleration detectors to trip the reactor.

Safety systems including emergency diesel generators are started their operation after the earthquake.

But, the sea water pump systems of all the NPPs used for cooling of diesel generator and ultimate heat sink were completely lost by the tsunami.

Tsunami hit the site a few ten minutes after the earthquake.

This means that the station black-out was occurred.

I am not sure when the offsite power was lost. (by the earthquake or by the tsunami)

But, I think that some towers for transmission line was destroyed, and most of the transformers connected to offsite power system were damaged.

At this moment, all the auxiliary systems in and around the site was lost, such as monitoring post, telephone system and so on.

I heard that offsite center near the site also lost their monitoring and communication functions.

Site staff tried to connect movable batteries to some I&C circuit to monitor the plant conditions (pressure and temperature)

After consuming plant batteries, all the active components including turbine driven pumps lost their function.

In this situation all the cooling means for reactors and spent fuel pools were completely lost.

To avoid over pressurization of the Unit-1 containment vessel, valves to release the containment atmosphere to the plant stack were opened using mobile compressed air cylinder.

Unfortunately a hydrogen explosion occurred in the reactor building of Unit-1 after venting containment vessel.

Then, site staff tried to inject sea water into the reactor vessel to cool the core using diesel driven fire fighting pumps. (at first to Unit-1, then

Unit-3 finally to Unit-2)

But this decision was a little bit delayed by unknown reason.

So it is believed that some part of fuels in Unit-1,2 and 3 are uncovered before starting sea water injection.

Unfortunately, after venting operation to prevent over pressurization, unit-3 also experienced hydrogen explosion.

Hydrogen seems to be created at the partially uncovered fuel assemblies through the zirconium water reaction, and was released inside the reactor building by depressurization operation of containment vessel.

Also, small explosion at unknown part of the pressure suppression torus occurred in unit-2, but I do not know well about the cause and consequence of this explosion.

Continuation of sea water injection seems effective to prevent expansion of severe events.

But it is not clear, or it is not likely that all the fuels are covered by enough water.

Especially the temperature indication of the Unit-1 shows that distinct temperature rise inside the reactor vessel.

(At this moment, by keeping sea water injection to the reactor vessels, temperature and pressure inside the reactor vessel of Unit-1 to3 are stabilized)

Also, considering undesirable effect of sea water to components, source of injection water was switched to normal water after restoring water tanks and preparation of mobile pumps.

On the other hand, loss of cooling of spent fuel pits became problematic.

Number of fuels stored in each spent fuel pool is different.

Number of fuels and their heat generation is as follows.

|        |                  |                        |
|--------|------------------|------------------------|
| Unit-1 | 60,000 kcal/hr   | ( 292 fuel assemblies) |
| Unit-2 | 400,000 kcal/hr  | ( 587 )                |
| Unit-3 | 200,000 kcal/hr  | ( 514 )                |
| Unit-4 | 2,000,000kcal/hr | ( 1,331 )              |
| Unit-5 | 500,000 kcal/hr  | ( 946 )                |
| Unit-6 | 600,000 kcal/hr  | ( 876)                 |

As shown above, cooling of the spent fuel pit of Unit-4 is the most urgent target.

But after some explosions, dose rate around NPPs became so high that human activities to handle these problems became quite difficult.

In these situation, a fire occurred in the reactor building of Unit-4 and upper part of the outer wall of the reactor building was heavily damaged.

Also, from the damaged reactor building of Unit-3, large amount of steam plume was observed.

So, many kind of water discharging equipment from fire fighter, army and police are introduced to inject seawater into the spent fuel storage pool on Unit-3 and Unit-4

This operation was thought to have a certain level of success, and uncover of fuels in spent fuel pools might be avoided, even though we do not have reliable indication of water level of spent fuel pools.

Considering fundamental restoration of cooling capability for both reactor cores and spent fuel pools, site staff are trying to reconnect electrical power to certain systems in NPPs.

But, both transmission lines and diesel generator sea water cooling system are completely lost. So they tried to feed electrical power by constructing new feed lines from the nearest substation.

In some part using remained transmission lines, in some part installing new cables and mobile transformers, offsite power was connected to tentative distribution center near NPPs.

From this distribution center, power cables are installed to turbine building of each NPP.

At this moment, power was fed to lighting system for main control room of each plant.

They are trying to feed electrical power to I&C system and important plant components such as cooling pumps and HVAC systems.

But, I think there are many things to be tested and checked to feed electrical power safely.

It seems that they can not connect power cables simply to distribution panel because many components and circuits are damaged or short circuited by sea water from the tsunami.

So it will be needed to connect power cable directly to the lowest switchgear or the pump itself to start each pump.

Recently, in installing cables in turbine buildings, large amount of quite high dose water is observed in many place.

So, cable installation works are stopped and water transportation to condenser or other tanks are planned and doing now

I have been focused on Unit-1 to 4.

Other two units, Unit-5 and 6 are well cooled.  
They are in outage work when the earthquake occurred.  
So, important thing is to cool the spent fuel pit.  
I am not sure details of operation in Unit-5 and 6.  
But one diesel generator was available and this helps much to keep cooling.  
Also, after reconnecting offsite power to the Unit-5 and 6, safety of these units are ensured.  
Unit-5 and 6 are located about 500m away from Unit-1 to 4 and thus less radiation dose from damaged reactors.  
I think plant layout within the Fukushima-Daiichi site helped to success.

(Fukushima-Daini site: Unit-1 to 4)

There are four BWRs in the Fukushima-Daini site.  
This site locates about 10km south of Fukushima-Daiichi site.  
Also, the tsunami hit this site.

In this site, all the NPPs were operating.  
Also, all the NPPs tripped automatically by the earthquake.

Same as the Fukushima-Daiichi, sea water pumps are damaged by the tsunami, and this resulted in loss of emergency diesel generators.  
All the offsite power was lost by the earthquake, so Fukushima -Daini experienced the SBO condition.

Turbine driven pumps fed water to the core, but loss of UHS caused temperature and pressure increase in the suppression pool.

Different from the Fukushima-Daiichi site, offsite power was recovered after five hours from the tsunami.

This helps site staff to monitor the plant and well operate the plant using available systems.

I am not sure details of the situation, but, the sea water cooling system of Unit-3 was in operation and Unit-3 was able to cool down as usual.

Site staff tried to restore the sea water systems.  
They decided to replace sea water pump motor to new one, and asked Japanese Air Force to transport spare pump motors (three pump motors, it means one pump motor for one unit) to the Fukushima-Daini site.

They are preparing for depressurization of the suppression pool by venting to atmosphere.

But, before venting, they successfully replaced the three motors and restore sea water system to cool the reactor through RHR system.

Situation of the Fukushima-Daini site was quite different from the Fukushima-Daiichi because of the offsite power recovery.

(Onagawa site of the Tohoku power company)

There are three BWRs in the Onagawa site.

This site is closer than Fukushima sites to the center of the earthquake.

Also, the tsunami hit this site, but based on relatively high design condition for tsunami, this NPPs were located much higher ground level compared with Fukushima.

So, they can avert from the tsunami directly hit NPPs.

Also, offsite power was not lost or quickly recovered (I have no sufficient information about this)

Even though some small troubles, such as unavailability of the reserve transformer caused by a small flooding in Unit-1, and small flooding in safety systems in Unit-2, all the NPPs were well cooled to the cold shutdown state.

Above is a brief summary what is happening in Japanese BWR plants in northern part of Japan.  
Also, there are many influences to social system and daily life in Japan.

All of these facts are quite important to investigate and plot strategies towards post Fukushima.

I think people outside Japan might be frustrated about less quantity and less quality of related information.  
But situation is almost the same inside Japan.

Situation is changing every day so quickly and drastically and silent but evident social confusion may hide small but important information.

I will try to do my best to understand these situation based on my knowledge and experiences in nuclear field.  
Also I will try to give you necessary information you need or to give you correct interpretation of information

Thank you for your attention, and please help us in many phases to settle this confusion and to step forward for the future.

Best Regards

Masafumi Utsumi

**Schaperow, Jason**

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**From:** Schaperow, Jason  
**Sent:** Tuesday, March 29, 2011 7:13 AM  
**To:** Tinkler, Charles; Schaperow, Jason  
**Subject:** Hi

I will be in a little late this morning. I need to take (b)(6) Should be in by about 10:00 or so.

Yesterday, I worked on slides documenting the basis for the source terms we gave the PMT on 3/18/11. I need about one more hour to finish them up. Then, I will run them by Randy to make sure they are accurate.

FF/256

**Raione, Richard**

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**From:** Raione, Richard  
**Sent:** Wednesday, March 30, 2011 10:46 AM  
**To:** Johnson, Michael; Holahan, Gary  
**Cc:** Flanders, Scott; Chokshi, Niles  
**Subject:** Groundwater - Japan

As you know, groundwater /surface water contamination has become a topic of interest with the current situation in Japan. I wanted you to know that I would be happy to volunteer to go to Japan to assist in this capacity. I have almost 30 years of experience in this field and was elected this past January as the Vice-Chair for the Federal Subcommittee on Hydrology ( I will be the Chair starting in October). I am also a current and licensed professional geologist in 19 states

Please keep me in mind should this type of expertise be needed, thank you.

Richard Raione, PG, CPG, CGWP  
US NRC, Office of New Reactors  
Chief, Hydrologic Engineering Branch  
301-415-7190  
cell: (b)(6) **EX-6**  
fax: 301-415-5397  
[richard.raione@nrc.gov](mailto:richard.raione@nrc.gov)

11/25/11

**Jenkins, Ronaldo**

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**From:** Kang, Peter  
**Sent:** Wednesday, March 30, 2011 8:56 AM  
**To:** Wheeler, Larry  
**Cc:** Jenkins, Ronaldo; Pal, Amar; Chopra, Om  
**Subject:** FW: Earthquake and tsunami in Japan and its influence to NPPs

Larry,  
Enclosed is my IEEE member from MHI provided this information.

Peter,

-----Original Message-----

From: Ted Riccio, (b)(6)

Sent: Tuesday, March 29, 2011 9:01 AM

To: Ali Daneshpooy; 'Beatty, John M.'; Bob Lane; Craig D. Sellers; Dave Horvath; Matharu, Gurcharan; GEORGE BALLASSI; Glen Schinzel; GOPAL ARAVAPALLI; HAMID HEIDARISAFSA; Jacob Kulangara; JIM LIMING; Jim Parello; Joe Napper; JOHN STEVENS; JOHN TAYLOR; JOHN TAYLOR; Kirk Melson; Mansoor Sanwarwalla; Kang, Peter; 'Sharon Honecker'; Suresh Channarasappa; Tom Carrier; Tom Crawford; Vish Patel; Yvonne Williams

Subject: FW: Earthquake and tsunami in Japan and its influence to NPPs

FYI

Subject: Earthquake and tsunami in Japan and its influence to NPPs

George and all the member of NPEC

This is Masafumi Utsumi of Mitsubishi Heavy Industries in Japan I am writing this in my office in Tokyo. At first, I and my family are all safe and going about our daily life with limited inconvenience.

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✓ E / 258

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But this decision was a little bit delayed by unknown reason.

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On the other hand, loss of cooling of spent fuel pits became problematic.

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Number of fuels and their heat generation is as follows.

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Unit-2 400,000 kcal/hr ( 587 )

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Unit-4 2,000,000kcal/hr ( 1,331 )

Unit-5 500,000 kcal/hr ( 946 )

Unit-6 600,000 kcal/hr ( 876)

As shown above, cooling of the spent fuel pit of Unit-4 is the most urgent target.

But after some explosions, dose rate around NPPs became so high that human activities to handle these problems became quite difficult.

In these situation, a fire occurred in the reactor building of Unit-4 and upper part of the outer wall of the reactor building was heavily damaged.

Also, from the damaged reactor building of Unit-3, large amount of steam plume was observed.

So, many kind of water discharging equipment from fire fighter, army and police are introduced to inject seawater into the spent fuel storage pool on Unit-3 and Unit-4

This operation was thought to have a certain level of success, and uncover of fuels in spent fuel pools might be avoided, even though we do not have reliable indication of water level of spent fuel pools.

Considering fundamental restoration of cooling capability for both reactor cores and spent fuel pools, site staff are trying to reconnect electrical power to certain systems in NPPs.

But, both transmission lines and diesel generator sea water cooling system are completely lost. So they tried to feed electrical power by constructing new feed lines from the nearest substation.

In some part using remained transmission lines, in some part installing new cables and mobile transformers, offsite power was connected to tentative distribution center near NPPs.

From this distribution center, power cables are installed to turbine building of each NPP.

At this moment, power was fed to lighting system for main control room of each plant.

They are trying to feed electrical power to I&C system and important plant components such as cooling pumps and HVAC systems.

But, I think there are many things to be tested and checked to feed electrical power safely.

It seems that they can not connect power cables simply to distribution panel because many components and circuits are damaged or short circuited by sea water from the tsunami.

So it will be needed to connect power cable directly to the lowest switchgear or the pump itself to start each pump.

Recently, in installing cables in turbine buildings, large amount of quite high dose water is observed in many place.

So, cable installation works are stopped and water transportation to condenser or other tanks are planned and doing now

I have been focused on Unit-1 to 4.

Other two units, Unit-5 and 6 are well cooled.

They are in outage work when the earthquake occurred.

So, important thing is to cool the spent fuel pit.  
I am not sure details of operation in Unit-5 and 6.  
But one diesel generator was available and this helps much to keep cooling.  
Also, after reconnecting offsite power to the Unit-5 and 6, safety of these units are ensured.  
Unit-5 and 6 are located about 500m away from Unit-1 to 4 and thus less radiation dose from damaged reactors.  
I think plant layout within the Fukushima-Daiichi site helped to success.

(Fukushima-Daini site: Unit-1 to 4)

There are four BWRs in the Fukushima-Daini site.  
This site locates about 10km south of Fukushima-Daiichi site.  
Also, the tsunami hit this site.

In this site, all the NPPs were operating.  
Also, all the NPPs tripped automatically by the earthquake.

Same as the Fukushima-Daiichi, sea water pumps are damaged by the tsunami, and this resulted in loss of emergency diesel generators.  
All the offsite power was lost by the earthquake, so Fukushima -Daini experienced the SBO condition.

Turbine driven pumps fed water to the core, but loss of UHS caused temperature and pressure increase in the suppression pool.

Different from the Fukushima-Daiichi site, offsite power was recovered after five hours from the tsunami.

This helps site staff to monitor the plant and well operate the plant using available systems.

I am not sure details of the situation, but, the sea water cooling system of Unit-3 was in operation and Unit-3 was able to cool down as usual.

Site staff tried to restore the sea water systems.  
They decided to replace sea water pump motor to new one, and asked Japanese Air Force to transport spare pump motors (three pump motors, it means one pump motor for one unit) to the Fukushima-Daini site.

They are preparing for depressurization of the suppression pool by venting to atmosphere.

But, before venting, they successfully replaced the three motors and restore sea water system to cool the reactor through RHR system.

Situation of the Fukushima-Daini site was quite different from the Fukushima-Daiichi because of the offsite power recovery.

(Onagawa site of the Tohoku power company)

There are three BWRs in the Onagawa site.  
This site is closer than Fukushima sites to the center of the earthquake.

Also, the tsunami hit this site, but based on relatively high design condition for tsunami, this NPPs were located much higher ground level compared with Fukushima.

So, they can avert from the tsunami directly hit NPPs.

Also, offsite power was not lost or quickly recovered (I have no sufficient information about this)

Even though some small troubles, such as unavailability of the reserve transformer caused by a small flooding in Unit-1, and small flooding in safety systems in Unit-2, all the NPPs were well cooled to the cold shutdown state.

Above is a brief summary what is happening in Japanese BWR plants in northern part of Japan. Also, there are many influences to social system and daily life in Japan.

All of these facts are quite important to investigate and plot strategies towards post Fukushima.

I think people outside Japan might be frustrated about less quantity and less quality of related information. But situation is almost the same inside Japan. Situation is changing every day so quickly and drastically and silent but evident social confusion may hide small but important information.

I will try to do my best to understand these situation based on my knowledge and experiences in nuclear field. Also I will try to give you necessary information you need or to give you correct interpretation of information

Thank you for your attention, and please help us in many phases to settle this confusion and to step forward for the future.

Best Regards

Masafumi Utsumi

**Helton, Donald**

**From:** Helton, Donald  
**Sent:** Wednesday, March 30, 2011 5:16 PM  
**To:** Tinkler, Charles  
**Cc:** Marksberry, Don; Appignani, Peter  
**Subject:** RE: Request for Ops Center RTS support

Charlie / Don:

FYI and for what it is worth. I am flying home tomorrow (Thursday) afternoon. I will get in very late on Thursday night, and my intent was to stop by Church Street around lunchtime on Friday to get a status update from someone, prior to going on shift in the OpCenter at 3 PM on Friday.

This may be the last time I have the opportunity to check email prior to Friday lunchtime.

Don

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**From:** Tinkler, Charles  
**Sent:** Wednesday, March 30, 2011 3:56 PM  
**To:** Marksberry, Don  
**Cc:** Drouin, Mary; Lee, Richard; Coyne, Kevin; Demoss, Gary; Appignani, Peter; Coe, Doug; Correia, Richard; Esmaili, Hossein; Schaperow, Jason; Helton, Donald; Kuritzky, Alan  
**Subject:** RE: Request for Ops Center RTS support

Don

I just saw Doug Coe in the Op Center PMT. He raised this issue in our conversation.

It is my understanding after talking to him that DRA (Mary Drouin) has the lead for item #2 (generation of event trees) and I am to assist her as needed.

**From:** Marksberry, Don  
**Sent:** Wednesday, March 30, 2011 2:42 PM  
**To:** Tinkler, Charles  
**Cc:** Drouin, Mary; Lee, Richard; Coyne, Kevin; Demoss, Gary; Appignani, Peter; Coe, Doug; Correia, Richard; Esmaili, Hossein; Schaperow, Jason; Helton, Donald; Kuritzky, Alan  
**Subject:** RE: Request for Ops Center RTS support

Charlie

Richard indicated that you have the lead for the RST request from Fred Brown (below). Doug Coe assigned Mary Drouin as the DRA point of contact for assisting you with item #2. Please contact Mary at your convenience.

Don

**From:** Lee, Richard  
**Sent:** Wednesday, March 30, 2011 10:37 AM  
**To:** Tinkler, Charles; Kuritzky, Alan  
**Cc:** Katie Wagner; Coyne, Kevin; Marksberry, Don; Esmaili, Hossein; Salay, Michael

FF/259

Subject: FW: Request for Ops Center RTS support  
importance: High

For your action. Thx.

From: Gibson, Kathy  
Sent: Wednesday, March 30, 2011 7:37 AM  
To: Lee, Richard  
Subject: Fw: Request for Ops Center RTS support

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From: Arndt, Steven  
To: Skeen, David; RST06 Hoc; Cheok, Michael; Gibson, Kathy  
Cc: Ruland, William; Dudes, Laura; Uhle, Jennifer; Hiland, Patrick; Hackett, Edwin; RST01 Hoc; Hoc, PMT12; McDermott, Brian; Coe, Doug; Scott, Michael  
Sent: Wed Mar 30 07:33:07 2011  
Subject: Re: Request for Ops Center RTS support I agree with Dave, this should be done out side of the Op Center. A group of RES folks are already doing some analysis in this area (DRA and DSA) to support the PMT. We should task them to do this and provide them with additional resources if needed.

Sent from a NRC blackberry  
Steven Arndt

(b)(6)

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From: Skeen, David - NSZD  
To: RST06 Hoc; Cheok, Michael; Gibson, Kathy  
Cc: Ruland, William; Dudes, Laura; Uhle, Jennifer; Hiland, Patrick; Hackett, Edwin; RST01 Hoc; Hoc, PMT12; McDermott, Brian; Coe, Doug; Scott, Michael; Arndt, Steven  
Sent: Tue Mar 29 23:43:46 2011  
Subject: Re: Request for Ops Center RTS support Good thought, Fred.

I think this would be a worthwhile task, and I think we need a small group of severe accident experts to discuss the potential worst case outcomes for each scenario.

I believe this effort should be conducted outside of the RST, on the normal day shift, with either NRR or RES taking the lead to put a team together to develop the potential outcomes.

Please let me know if you need any support from NRR/DE. We could potentially offer Steve Arndt to support.

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From: RST06 Hoc  
To: Cheok, Michael; Gibson, Kathy  
Cc: Ruland, William; Dudes, Laura; Uhle, Jennifer; Hiland, Patrick; Hackett, Edwin; Skeen, David; RST01 Hoc; Hoc, PMT12; McDermott, Brian; Coe, Doug; Scott, Michael; RST01 Hoc  
Sent: Tue Mar 29 23:01:43 2011  
Subject: RE: Request for Ops Center RTS support Please see below.

From: Brown, Frederick  
Sent: Tuesday, March 29, 2011 10:56 PM  
To: Cheok, Michael; Gibson, Kathy  
Cc: Ruland, William; Dudes, Laura; Uhle, Jennifer; Hiland, Patrick; Hackett, Edwin; Skeen, David; RST01 Hoc; Hoc, PMT12; McDermott, Brian; Coe, Doug; Scott, Michael; Brown, Frederick; RST01 Hoc  
Subject: Request for Ops Center RTS support

Importance: High

Mike, Kathy

First, I'm not sure that you two are the right folks to ask, but I know that you'll know where this should go.

I'd like to have folks with the right skill set look at two issues (the two are inter-related, but the first may be easier to give a quick answer to without the work that the second will take):

1) Given the known, or assumed, status of the three units and four pools, what realistic scenarios exist for energetic dispersion of high quantities of radioactive material that would result in mobile plumes? The point of this question is that there are many clear scenarios that present significant near-area radiological challenges, but given the time since shutdown (for the operating units) and age of much of the fuel (in the SFPs) what are the remaining scenarios of concern with respect to more distant locations (Tokyo with a large concentration of US citizens, Alaska, Hawaii, etc).

2) Given the assumed condition of the three units and four pools, can we generate basic event trees for the coming weeks/months? The point would be to identify key success criteria and to help identify key decision points/risk factors to be balanced (qualitative not quantitative analysis). For instance, take two units, each with significant core damage and prior release of volatile fission products, each with primary and secondary containment failure, but one with an intact RPV and the other with a breach of RPV - would there be a difference in potential releases that would lead to different strategies for flooding the primary containment of these two units? This question will make more sense if you look at the assumed conditions below and the attached assessment document where we recommend that TEPCO utilize the SAMG recommendation to flood all 3 units' containments.

Note that the intent is to limit this activity to hours and days, not weeks or years. Once we validate the concept of this evaluation, we can turn it over to US industry for further action/development.

Assumed status (slightly different than the status in the attached assessment):

Unit 1 Rx: Shutdown 3/11. 70% core damage. Cooling with 30 gpm. Significant salt deposits in vessel, core spray plugged. Primary pressure 65 psig. Drywell pressure 25 psig. Secondary containment destroyed. Containment has been vented at least once since fuel damage occurred. Attempting to establish Nitrogen purge prior to resuming venting.

Unit 2 Rx: Shutdown 3/11. 30% core damage. Significant salt deposits in vessel/drywell. Assumed RPV breach, with at least some core ex-vessel that occurred approximately 3/15. Primary containment breached in the torus. Secondary containment breached. Significant release of volatile fission products has occurred through both airborne release and also via water drainage out of the Rx building.

Unit 3 Rx: same assumptions as Unit 2, but do not assume RPV failure and location of primary containment breach may be the drywell.

SFP 1: 292 bundles. Pool intact. All fuel at least 12 years old. No secondary containment. Rubble on top of pool. Water can be added through external spray. Now at saturation temperature.

SFP 2: 587 bundles. Pool intact. Water added to the point of pool over-flow. Pool had reached saturation temperature at one time.

SFP 3: 548 bundles. ¼ core offload previous refueling. No checker boarding of hotter fuel. Structural damage to pool area suspected. Pool leakage possible. External addition of water has been made repeatedly, but flooding of pool may not be possible due to damage.

CFR 1931 bundles. Fuel were offload about 120 days ago. No check-up regarding structural damage to pool area is known to exist, and structure may not support a full pool weight load. Pool leakage likely, requiring addition of water periodically. Pool was likely dry enough to have cladding/water reaction which produced enough hydrogen to lead to catastrophic explosion that destroyed secondary containment.

**Helton, Donald**

**From:** Helton, Donald  
**Sent:** Wednesday, March 30, 2011 1:31 PM  
**To:** Coyne, Kevin; Wood, Jeffery  
**Subject:** FW: Jeff LaChance

FYI, see below...

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**From:** Burns, Shawn [spburns@sandia.gov]  
**Sent:** Wednesday, March 30, 2011 10:45 AM  
**To:** Helton, Donald  
**Subject:** Jeff LaChance

Don,

I wanted to let you know that Jeff LaChance has been called to Tokyo by DOE/NNSA Administrator D'Agostino to help support the Fukushima response. I expect him to be away for 2-4 weeks at this point. This came up yesterday morning and Jeff is already on his way, but before he left we did develop a plan for maintaining support for the Advanced PRA project in his absence.

Most of the technical lift on our side is being handled by Jeff Cardoni and will continue to be so. Dr. Katrina Groth will be handling the overall project management and contract monitoring with the Univ. of MD. Katrina is a graduate of MD and is familiar with their part of the project. Jeff, Katrina and I have a meeting set for 4:00 Washington time tomorrow afternoon to discuss the project. Are you available to join us by phone?

Best regards,

Shawn

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Shawn P. Burns, Ph.D., P.E.  
Manager, Risk and Reliability Analysis  
Department 6761

Sandia National Laboratories  
P.O. Box 5800  
Albuquerque, NM 87185-0748

Phone: (505)844-6200

Mobile: (b)(6)

Fax: (505)844-2829

e-mail: [spburns@sandia.gov](mailto:spburns@sandia.gov)

Web: <http://www.sandia.gov/ERN/nuclear-energy/index.html>

PS

T.F. / 260

**From:** [Leeds, Eric](#)  
**To:** [Dean, Bill](#); [Lew, David](#); [McCree, Victor](#); [Wert, Leonard](#); [Satorius, Mark](#); [Pederson, Cynthia](#); [Reynolds, Steven](#); [Howell, Art](#); [Kennedy, Kriss](#)  
**Cc:** [Wiggins, Jim](#); [Evans, Michele](#); [Sheron, Brian](#); [Uhle, Jennifer](#); [Johnson, Michael](#); [Flanders, Scott](#); [Grobe, Jack](#); [Miller, Charles](#); [Holahan, Gary](#)  
**Subject:** FYI: NRR Comm Team SitRep - 3/31  
**Date:** Thursday, March 31, 2011 4:04:35 PM  
**Attachments:** [image001.png](#)

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Please see below. I highly recommend you click on the link and check out the site – much more user friendly. Making progress!

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

NRR

**From:** Nelson, Robert  
**Sent:** Thursday, March 31, 2011 3:15 PM  
**To:** Leeds, Eric; Grobe, Jack; Boger, Bruce; LIA06 Hoc; Steger (Tucci), Christine; Landau, Mindy; Roberts, Darrell; Kennedy, Kriss; Lara, Julio; Croteau, Rick; Burnell, Scott; 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  
**Cc:** Burkhardt, Janet; Orf, Tracy; Broaddus, Doug; Campbell, Stephen; Carlson, Robert; Chernoff, Harold; Kulesa, Gloria; Markley, Michael; Pascarelli, Robert; Salgado, Nancy; Simms, Sophonia; Wall, Scott; Guzman, Richard; Lyon, Fred; Meighan, Sean; Nguyen, Quynh; Oesterle, Eric; Polickoski, James; Tam, Peter; Thomas, Eric  
**Subject:** FYI: NRR Comm Team SitRep - 3/31

1. NRR Q&A database is up & running. **Try it, you'll like it!** Link:

<http://portal.nrc.gov/edo/nrr/dorl/japan/Shared%20Documents/Questions%20and%20Answers.aspx>

All have read access. Updates limited to selected NRR/DORL staff. Suggested additional Qs & As should be sent to Mike Markley & Eric Oesterle  
Kudos to Mike Markley, Tracey Orf, Eric Oesterle & Janet Burkhardt for their ingenuity, creativity and efforts to envision and develop this tool in a very short period of time while managing the overall NRR Q&A process.

2. Met with Mindy Landau and her staff to coordinate communication activities.
3. Updated/developed 3 EPZ Qs & As; added to the database.
4. Continued to work with Eric Leeds on NGA presentation for 4/4.
5. Heads-Up: We got another expansive FOIA, this one from Greenpeace.
6. Short turnaround green tickets are beginning to impact licensing activities. Details to follow in e-mail with narrower distribution.

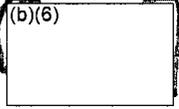
Robert A. Nelson  
NRR External Communications Coordinator, Japan Event  
Deputy Director  
Division of Operating Reactor Licensing

14/261

Office of Nuclear Reactor Regulation

**U.S.NRC**

United States Nuclear Regulatory Commission  
Protecting People and the Environment

E-mail: [robert.nelson@nrc.gov](mailto:robert.nelson@nrc.gov) | Office: (301) 415-1453 | Cell:  Fax: (301) 415-2102

PS I turn 61 on Sunday

EX. 6

(b)(6)

**Bano, Mahmooda**

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**From:** Liz Giessner (b)(6)  
**Sent:** Friday, April 01, 2011 7:01 PM  
**To:** Scott, Michael  
**Subject:** questions

Questions 4/2:

- Our reviews of your minimum flows are not aligned with the values we determined. We have 72 l/min for unit 1. And 125 l/min, for unit 2. You may want to look at this.
- We understand your thought process for minimum flow. We think using temperatures of the vessel does not show conclusively you have minimum flow. You should consider raising flow.
- How do plan to fill containment for unit 1. Do you have the ability to open an SRV/Is one already open? What fill rate would you use?
- Bechtel pumps and barge rig – when will they be set up where do they connect in.

TX/262

## Lu, Shanlai

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**From:** Lu, Shanlai  
**Sent:** Friday, April 01, 2011 5:46 PM  
**To:** RST01 Hoc  
**Subject:** Fukushima Daiichi Nuclear Plant- Spent Fuel Recriticality Prevention

Gentlemen,

Considering the situation in Japan and the spent fuel pool cooling condition, I and several colleagues discussed the possible worst scenario of spent fuel pool recriticality.

I would like to offer some thoughts about this in the hope that it has been considered or dispositioned.

Postulated worst scenario of spent fuel pool recriticality:

The fuel bundles off-loaded from Unit 4 have higher decay heat comparing with other 3-cycle spent fuel bundles in the pool. They also have higher reactivity. Without the presence of neutron absorbers, they can become critical if submerged in the water. If these fuel bundles start to have cladding disintegration, the fuel pellets will pop out and accumulate at the bottom of the spent fuel pool. The water sprayed on top of the pool may wash these pellets to the leak or the drain, and, the fuel pellets may accumulate downstream. Once there is sufficient accumulation of fuel pellets and the presence of water, criticality may occur.

Consequence of this postulated event:

Criticality may suddenly be achieved and chain fission reaction may happen causing significant radiation release. The worst case, a nuclear induced explosion.

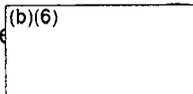
As the result, more radiation may be released from the plant and severe structure damage may happen.

Possible mitigation strategy:

For those spent fuel pools which can not sustain sufficient water level above the top of active fuel bundle, we can consider dumping the mixture of sand and dry Boric Acid powder on top of the pool and bury the entire pool. The sand and Boric acid will form a heat conduction path to transfer the decay heat from the fuel to the surrounding structures. Once the sand covers the entire pool, dump lead pebbles on top of it to reduce radiation.

If you have any questions, feel free to call my cell phone

(b)(6)



- ex. 6

Shanlai Lu  
NRO/DSRA/SRSB

11/26/3

Hsii, Yi-Hsiung

(b)(6)

From: (b)(6)  
Sent: Monday, April 04, 2011 10:42 AM  
To: Joe Miller  
Subject: Battle to stabilize earthquake reactors  
Attachments: image015.jpg; image018.png; Fukuchima.ppt; ANS-Technical-Brief-MOX-Fukushima.pdf; JAIF Earthquake Report 42 April 4 20\_00.pdf; JAIF Summary April 4.pdf

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### April 4, 2011 Update

Please note that I am moving most of my discussions concerning "Battle to stabilize earthquake reactors" to my Blog site at <http://josephmiller.typepad.com/>  
My LinkedIn at <http://www.linkedin.com/in/josephsmiller>  
You can Tweet me at <http://twitter.com/#!/jsmeda>  
If you are interested in keeping up with these discussions, please go to the blog site and sign up as a follower. That way when I issue a new blog, you will be notified. I will probably discontinue this email delivery in the next 2 days so if you can't do the blog follow, just let me know and I will continue to send you these emails.

### Latest in on Japanese Nuclear Accidents

Comments by Joe Miller

For the 3 Units at the Fukushima Dai-ichi NPS site, i.e., Units 1, 2 & 3, the emergency heat removal systems for the reactors have not been restored. A cold shutdown condition, which is stable, can occur until this happens. Temperatures and pressures in the three reactors appear to be stable except for Unit 1, which seems to vary. Damage is suspected to Unit 2 torus. Still many unknowns. General Electric, the US BWR reactor supplier has volunteered to help the Japanese with the plants. This would be good to get some more heads together to solve these problems. It seems like we are getting almost the same information daily. The big push at the site is to find the large leak of site water to the sea. This allows much of the radioactive on site to escape to the ocean. Seems that temperature in the Unit 4 spent fuel pool has decreased below boiling, which means the fuel damage in the spent fuel pool has stopped.

Radiation levels continue to decrease on site

- Radiation level: 0.78mSv/h at the south side of the office building, 121µSv/h at the Main gate, 55µSv/h at the West gate, as of 09:00, Apr. 4rd.
- Radiation level: 0.83mSv/h at the south side of the office building, 127µSv/h at the Main gate, 59µSv/h at the West gate, as of 09:00, Apr. 3rd.
- Radiation level: 0.91mSv/h at the south side of the office building, 144µSv/h at the Main gate, 65µSv/h at the West gate, as of 15:00, Apr. 1<sup>st</sup>
- Radiation level: 1.00mSv/h at the south side of the office building, 156µSv/h at the Main gate, 72µSv/h at the West gate, as of 21:00, Mar. 30<sup>th</sup>
- Radiation level: 132.5µSv/h at the West gate at 16:00, Mar. 27

To understand the exposures given above, let's review how this compares to acceptable limits.. So workers at the West gate receiving 55µSv/h can be exposed to this level for 38 days before they exceed CNSC limits of (50,000 µSv) in any given year. Now the water in the basement of Unit 2

Handwritten signature/initials: FX/26A

turbine building is a different story. Although JAIF indicated an exposure of 1000 mSv, it is not clear if this is total or hourly. If this is hourly, a worker standing in this water would exceed the CNSC limits in about 3 minutes. It is obvious that workers in these areas must have heavy shielding to stay very long.

## Radiation Definitions

- 1 Sv = 1000 mSv (millisieverts) = 1,000,000  $\mu$ Sv (microsieverts) = 100 rem = 100,000 mrem (millirem)
- The effective dose limit for Nuclear Energy Workers, as prescribed by the CNSC, is 100 mSv (10,000 mrem) (100,000  $\mu$ Sv) for 5 years (with a maximum of 50 mSv (50,000  $\mu$ Sv) in any given year or an average of 20 mSv/yr for 5 years) for whole-body exposure.
- Natural background radiation comes from two primary sources: cosmic radiation and terrestrial sources. The worldwide average background dose for a human being is about 2.4 millisievert (mSv) per year or 2400  $\mu$ Sv. This exposure is mostly from cosmic radiation and natural radionuclides in the environment (including those within the body). This is far greater than human-caused background radiation exposure, which in the year 2000 amounted to an average of about 5  $\mu$ Sv per year (which is a 1000 times smaller than natural occurring radiation) from historical nuclear weapons testing, nuclear power accidents and nuclear industry operation combined and is greater than the average exposure from medical tests, which ranges from 0.04 to 1 mSv per year.

## Other summaries from JAIF (See summaries attached)

### •Radiation levels drop or remain flat

Radiation levels continue to drop or remain flat on Monday morning in many locations around the disabled Fukushima Daiichi nuclear power plant. In Fukushima City, about 65 kilometers northwest of the power plant, 2.51 microsieverts per hour of radiation was detected. The reading in Koriyama City, also in Fukushima Prefecture, stood at 2.21. Both figures are higher than the normal levels of 0.04 to 0.06 microsieverts per hour, but lower than that on Sunday. The reading stood at 0.49 microsieverts

### •GE offers help at Fukushima

The chief executive of General Electric says his company will help address the problems at the Fukushima Daiichi nuclear power plant.

### •Low radioactive water to be released to sea

Tokyo Electric Power Company plans to release radioactive wastewater into the sea from the Fukushima Daiichi nuclear power plant as part of efforts to stabilize the troubled plant. The utility told a news conference on Monday that it hopes to start releasing 11,500 tons of wastewater from Tuesday at the earliest and that the operation will continue for several days. The company says the level of iodine-131 in the wastewater is about 100 times the legal limit. But the plant operator says if people ate fish and seaweed caught near the plant every day for a year, their radiation exposure would be 0.6 millisievert. It adds the annual permissible level for the general public is one millisievert. Wastewater

### •TEPCO still trying to identify leak

Tokyo Electric Power Company is still not sure how highly radioactive water is flowing into the ocean from its damaged Fukushima Daiichi nuclear power complex. TEPCO had thought it was coming from a crack in a concrete pit at the facility. On Monday workers poured a white liquid into a tunnel leading

to the pit. The operation was undertaken to determine the exact route the water is taking from the pit near the plant's Number 2 reactor to the ocean. But the utility firm says the white liquid did not flow into the pit and that the contaminated water must be following other routes. As a temporary measure, the utility firm is considering setting up silt barriers near a water intake pipe for the Number 2 reactor to prevent radioactive elements from spreading in the ocean. The utility company has also been removing radioactive water from the basements of the turbine buildings for two of the plant's reactors. The radioactive water in the condensers for the two reactors is being transferred to storage tanks. As soon as the condensers are emptied, the water from the reactor will be drained into them to allow work to begin to restore the reactors' cooling systems. Work to remove the water began on Sunday at reactors Number 1 and 2. A similar operation will start at the Number 3 reactor on Monday.

Monday, April 04, 2011 12:26 +0900 (JST)

#### ●NISA: Stemming leak will take months

Japan's Nuclear and Industrial Safety Agency said a full-scale recovery of cooling systems at the Fukushima Daiichi nuclear power plant is needed to stem the leakage of radioactive substances, but that work will take several months. A senior official of the agency, Hidehiko Nishiyama, made the comments at a news conference on Sunday. Highly radioactive water was found inside turbine buildings and also in tunnels under the plant. The radioactive water is flowing directly into the sea. The agency said it will take several months to remove the contaminated

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#### Control Rods by Joe Miller

A questions was asked recently ay my blog about the control rod insertion at a BWR. The question was

"The safety control rods of Boiling Water Reactors are located at the bottom of the pressure vessel as opposed to that of the Pressurized Water Reactors. For the PWR, a loss of power will automatically drop the control rods into the fuel rods and hence stop the atomic fission. For the BWR, it requires electrical power to do the same. For these Japanese BWRs, I have not heard whether the boron control rods in each reactor were inserted into the fuel rods array prior to the loss of power. If not, could this be the reason why the reactors are still active and atomic fission reactions are still going on?"

My answered is provided below.

#### Control Rods

Due to the necessity of a steam dryer above the core of a boiling water reactor (BWR) this design requires insertion of the control rods from underneath the core. The control rods are partially removed from the core to allow a nuclear chain reaction to occur. The number of control rods inserted and the distance by which they are inserted can be varied to control the reactivity of the reactor.

The Control Rod Drive (CRD) system provides the necessary components to move the control rods during start-up and shut-down, during full power operation and during a SCRAM, which shuts the reactor core down when there is an usual event or accident.

The purposes of the CRD system are to position control rod assemblies (CRAs) within the reactor core to change reactor power and to rapidly shut down the reactor. The functional classification of the CRD system is that of a safety-related system because of the rapid shutdown (SCRAM) capability.

The CRD system consists of the control rod drive mechanisms (CRDMs), and the CRD hydraulic system, which can be separated into hydraulic control units (HCUs) and the remaining valves, pumps, and headers (balance of the CRD system - BOCRDS) that supply, move, and retain the operating fluid of the CRD system. The CRD hydraulic system provides the hydraulic fluid (demineralized water) for normal insertion and withdrawal of CRAs. Additionally, the CRD hydraulic system provides cooling water for the CRDMs and recirculation pump seals and maintains a source of stored energy for the scram function. Figure 6a shows the basic hydraulic water

flow path, which consists of centrifugal pumps, filters, control valves, HCUs, accumulators and headers that supply hydraulic fluid to each of the CRDMs.

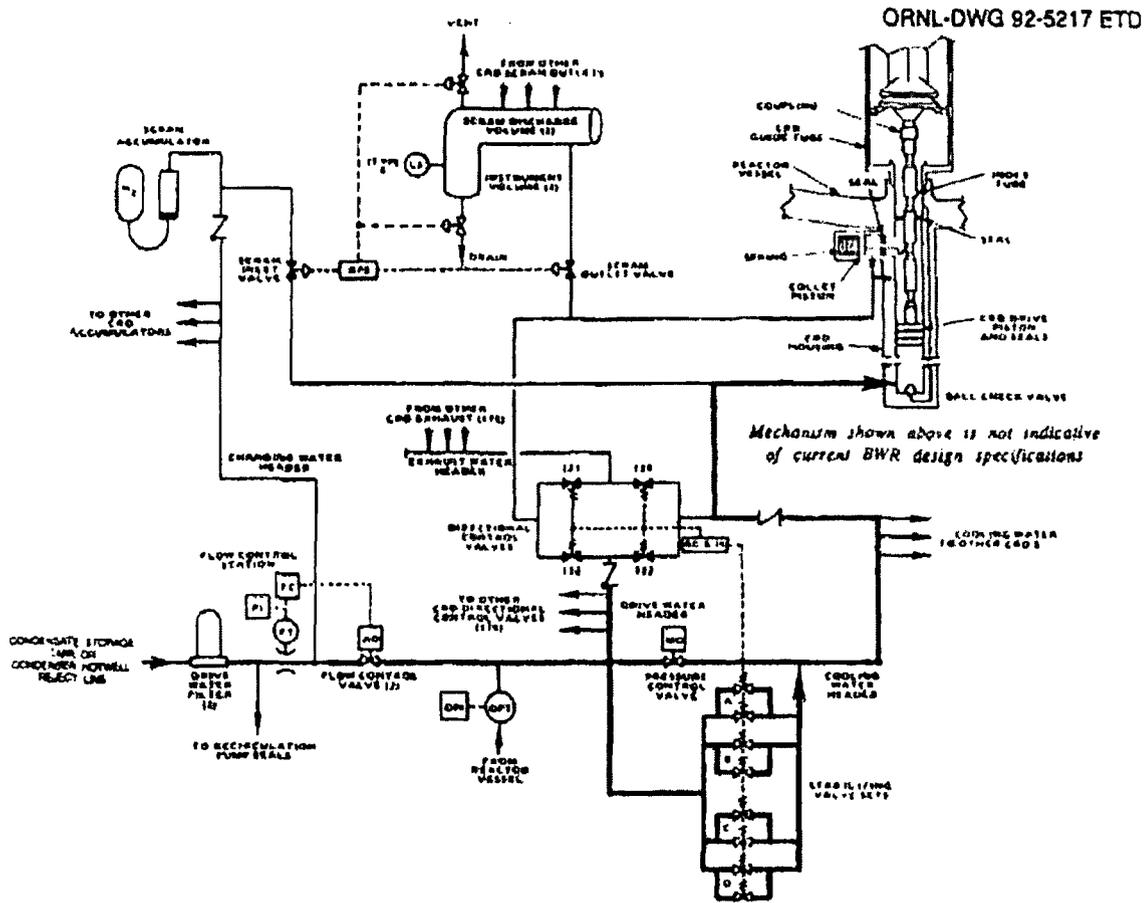
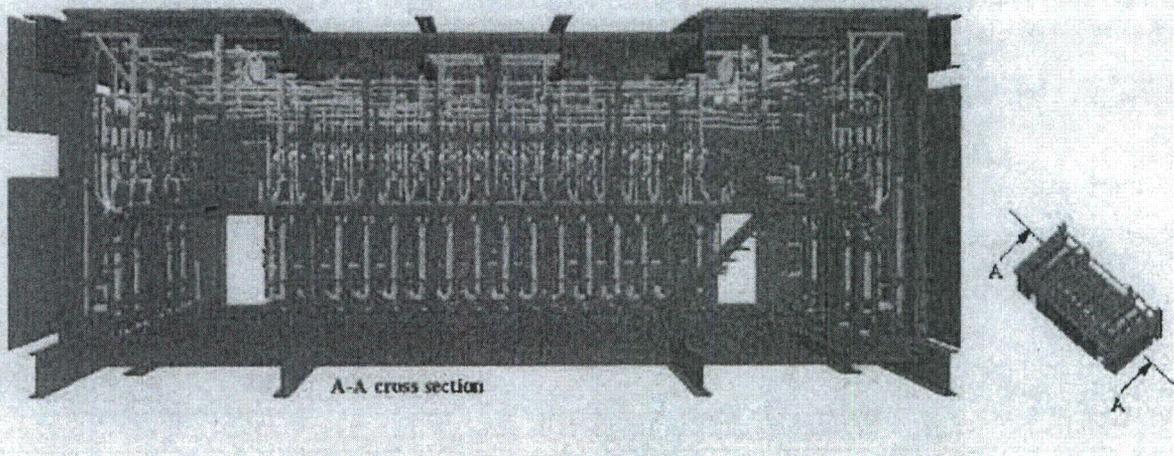


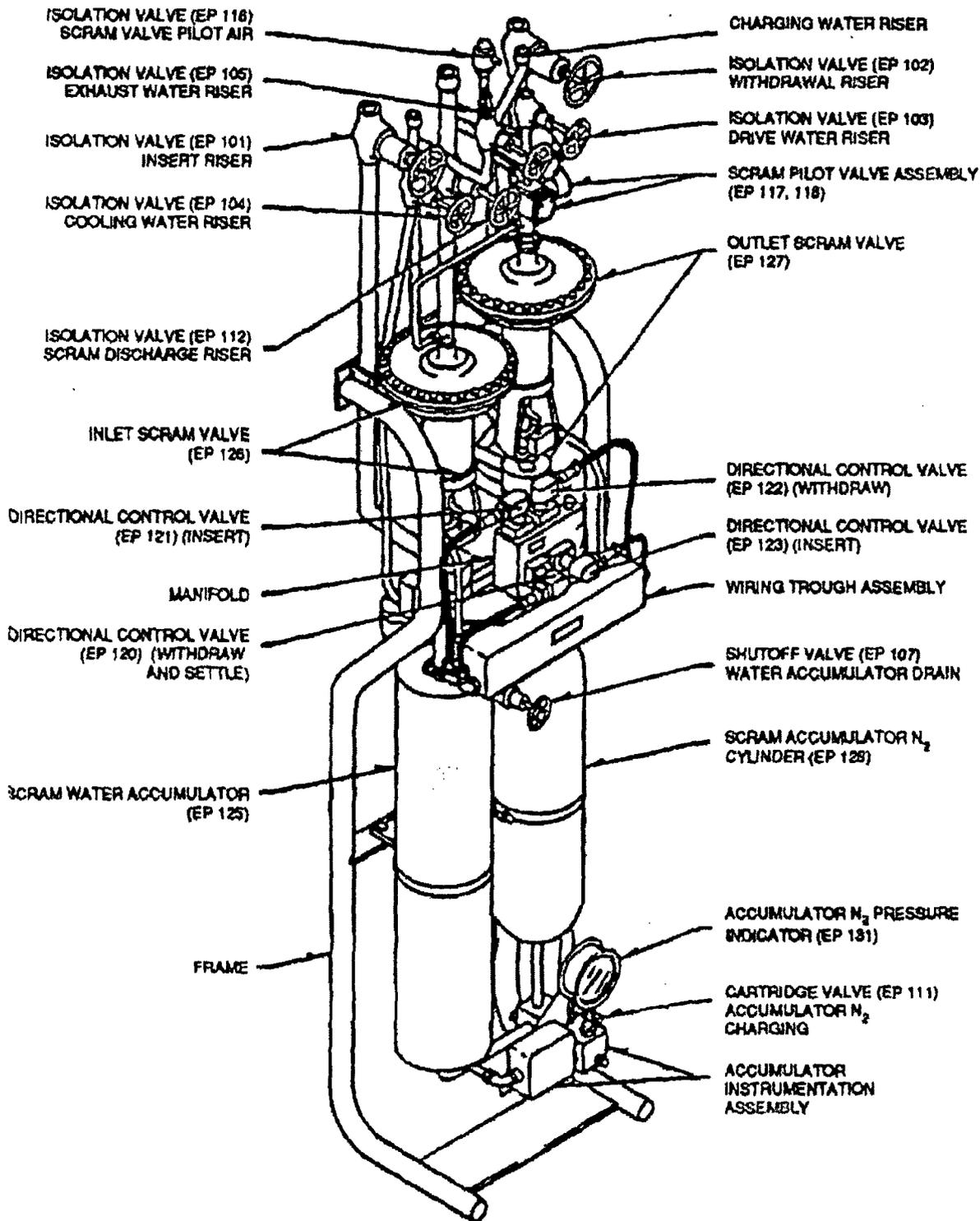
Figure 6a Control Rod Drive (CRD) Hydraulic System Schematic

During a SCRAM, the control rods are completely inserted into the core. For a BWR, a large pressure difference drives the control rods in from the bottom. A hydraulic control unit (HCU) provides the drive pressure for each control blade. A sketch of the sectional view of the bank of HCU is shown in Figure 6b. Each control rod has an independent HCU assigned to it, so when a SCRAM occurs each control rod is driven into the core by its own HCU. Units 2, 3 & 4 of the Fukushima Daiichi nuclear power station will have 137 of these independent units, one for each 4 fuel assemblies. Additionally, these independent HCUs can move control rods in banks for local power level shaping for optimizing the fuel use in the core.



**Figure 6b A-A Cross Section of a Bank of HCUs**

A single HCU is shown in Figure 6c.

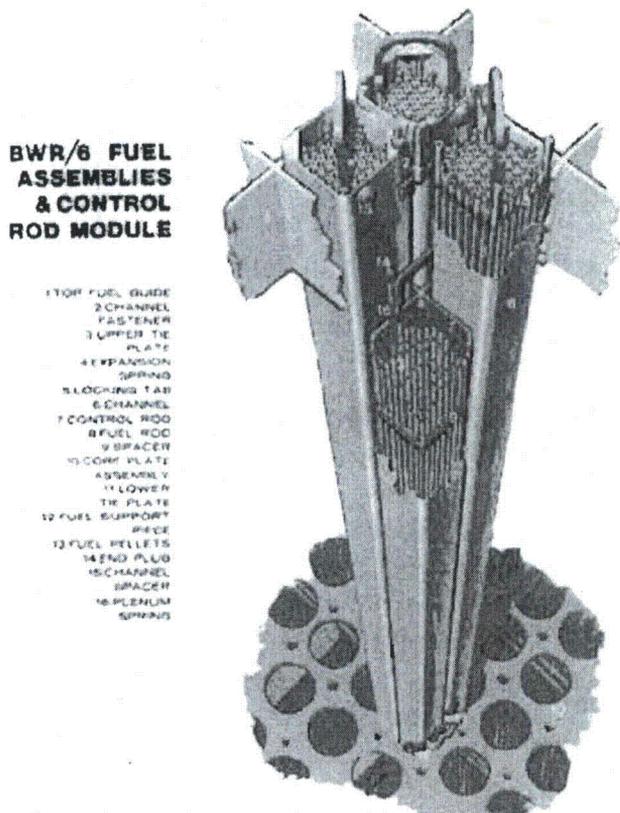


**Figure 6c Hydraulic Control Unit (HCU)**

The SCRAM accumulators are pressurized to 1550 psig for BWR-4. When a SCRAM signal is detected (there are many SCRAM signals, i.e., two of the trips are loss of offsite power and a large seismic event), a valve opens in the HCU, the 1550 psig pressure overcomes the 1040 psia pressure of the reactor (actually the 1040 psia is reduced substantially in a SCRAM situation since this back pressurized water is vented to a SCRAM discharge Volume) and the pressure differential drives the control rods up into the core, thereby the critical chain reaction is stopped. At the Japanese reactors the SCRAM occurred when the earthquake happened. The SCRAM accumulators are always

pressurized so even in the case when a station black is the initiator, the SCRAM will take place since it doesn't need electrical power to transpire. The valves that allow the high pressure water to inject the control rods are air operated and if power is lost, these valves will open and the high pressure from the accumulators will drive control rods into the core. The accumulators and air operated valves are shown in Figure 6a.

The control rod (Item 7) as shown in Figure 6d is surrounded by 4 fuel bundles. When the plant SCRAM occurs, these are inserted completely into the core from the bottom. The boron carbide control rods absorb enough neutrons to stop the nuclear reaction in the core and the plant shuts down. After the SCRAM, all neutrons are absorbed by the boron carbide, therefore the heat caused by the fission process is stop and the only heat being generated is by decay heat. The decay heat caused by the decay of fission products must be removed by heat transfer into the coolant (See Figure 3), which is water for a light water reactor (LWR) like the plants at the Fukushima Daiichi site.



**Figure 6d Fuel Bundles Surrounding a Control Rod**

In addition to SCAM, the Control rods can control reactor power slowly by inserting or withdrawing control rods. Other ways to control power in a BWR is by increasing or decreasing temperature of the water flowing through the core inlet of the reactor and by changing the water flow through the reactor core.

Positioning (withdrawing or inserting) control rods is the normal method for controlling power when starting up a BWR. As control rods are withdrawn, neutron absorption decreases in the control material and increases in the fuel, so reactor power increases. As control rods are inserted, neutron absorption increases in the control material and decreases in the fuel, so reactor power decreases. Some early BWRs and the proposed ESBWR (Economic Simplified BWR made by General Electric Hitachi) designs use only natural circulation with control rod positioning to control power from zero to

100% because they do not have reactor recirculation systems. Fine reactivity adjustment would be accomplished by modulating the recirculation flow of the reactor vessel.

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## April 3, 2011 Update

Please note that I am moving most of my discussions concerning "Battle to stabilize earthquake reactors" to my Blog site at <http://josephmiller.typepad.com/>

My LinkedIn at <http://www.linkedin.com/in/josephsmiller>

You can Tweet me at <http://twitter.com/#!/jsmeda>

**If you are interested in keeping up with these discussions, please go to the blog site and sign up as a follower. That way when I issue a new blog, you will be notified. I will probably discontinue this email delivery in the next 3 days so if you can't do the blog follow, just let me know and I will continue to send you these emails.**

## Latest in on Japanese Nuclear Accidents

Comments by Joe Miller

Once again much seems about the same, but improving. They are still struggling to get the plants stable, but it appears that the reactors are cooling down and fresh water is being injected in the reactors. Water is being transferred to the condensate storage tank (CST) of all units. This provides make-up water to the emergency injection pumps to the reactor. Another step in the stabilization process.

The spent fuel pools of Units 1, 2, 3 & 4. You may ask why they are they having so much trouble with the spent fuel pools. I think primarily because of accessibility problems to the pools. When they vented hydrogen for Units 1, 2 & 3 containments, hydrogen accumulated in the reactor buildings that housed the fuel pools and these either exploded or caught fire. This damaged all the fire hoses in the reactor building and caused high radiation levels so access became a problem for the near term when they were engaged in saving the reactors of Units 1, 2 & 3. Once the pools evaporated enough to expose the fuel, there was a significant problem with radiation from the spent fuel. Getting water on the spent fuel was always secondary to getting water to the reactors, which eventually made the spent fuel pools problematic. Unit 4 was a different issue. With the fuel core off load, the water in this pool heated up quickly and the fuel was exposed relatively soon after power was lost (approximately 10 days after power was lost). Then the fuel over heated and hydrogen from the Zr water reaction accumulated in the reactor and exploded. I believe Unit 4 spent fuel area is by far the worst situation at present. The latest report for the Unit spent fuel pool is that they took a Thermography reading on Apr. 02 at 07:45 and it read 44°C (111 F) If this is accurate, this is good news. It means that Unit 4 spent fuel pool is not boiling anymore. Unit 1, 2 & 3 spent fuel pool readings are slightly lower, which means all spent fuel pools are not boiling anymore. There is a report that white smoke or steam is coming from the reactor buildings. I don't know where this is coming from except maybe there are still fires in the building or they maybe venting from the containments.

Radiation levels continue to decrease on site

- Radiation level: 0.83mSv/h at the south side of the office building, 127 $\mu$ Sv/h at the Main gate, 59 $\mu$ Sv/h at the West gate, as of 09:00, Apr. 3rd.
- Radiation level: 0.91mSv/h at the south side of the office building, 144 $\mu$ Sv/h at the Main gate, 65 $\mu$ Sv/h at the West gate, as of 15:00, Apr. 1<sup>st</sup>
- Radiation level: 1.00mSv/h at the south side of the office building, 156 $\mu$ Sv/h at the Main gate, 72 $\mu$ Sv/h at the West gate, as of 21:00, Mar. 30<sup>th</sup>
- Radiation level: 132.5 $\mu$ Sv/h at the West gate at 16:00, Mar. 27

To understand the exposures given above, let's review how this compares to acceptable limits.. So workers at the West gate receiving 59 $\mu$ Sv/h can be exposed to this level for 35 days before they exceed CNSC limits of (50,000  $\mu$ Sv) in any given year. Now the water in the basement of Unit 2 turbine building is a different story. Although JAIF indicated an exposure of 1000 mSV, it is not clear if this is total or hourly. If this is hourly, a worker standing in this water would exceed the CNSC limits in about 3 minutes. It is obvious that workers in these areas must have heavy shielding to stay very long.

## Other summaries from JAIF (See summaries attached)

### ●Checkups find no problems in children's thyroid

Chief Cabinet Secretary Yukio Edano has said that recent checkups have found no problems in the thyroid of children in the area near the troubled Fukushima Daiichi nuclear power plant.

Edano announced the finding at a news conference on Sunday. 900 children from newborns to those of 15 in Kawamata Town and Iitate Village in Fukushima Prefecture underwent tests for radiation exposure to their thyroid glands for 3 days through last Wednesday. He said none of them had exposure readings exceeding the safety level.

Sunday, April 03, 2011 16:02 +0900 (JST)

### ●TEPCO to stop radioactive water leak from plant

The operator of the troubled Fukushima Daiichi nuclear power plant will start injecting water-absorbing polymers into a cracked pit to stop radioactive water from leaking into the ocean. Tokyo Electric Power Company, or TEPCO, says it will start the emergency operation on Sunday afternoon. On Saturday, TEPCO found radioactive water was seeping into the ocean from a crack in a concrete pit that contains power cables near the Number 2 reactor's water intake. The level of radiation on the surface of the pit's water was measured at over 1,000 millisieverts per hour.

An attempt to pour concrete into the pit, connected to the turbine building, failed to fix the leak on Saturday. TEPCO hopes to collect overflowing water into a tank and other facilities in the complex. The radioactive intensity of water in the reactor's turbine building was about 100,000 times that of water inside a normally operating reactor. Water in a tunnel outside the turbine building also had high levels of radiation.

TEPCO says it has not detected water leaking from the pits of other reactors and is checking other locations.

The company added that it began reducing the amount of water being injected into the Number 1 and 2 buildings to cool their reactors on Saturday night, saying temperatures and pressures there had stabilized.

Sunday, April 03, 2011 14:50 +0900 (JST)

●**Radioactive water continues to leak into sea**

Highly radioactive water continues to leak into the sea through a crack in a pit at the troubled Fukushima Daiichi power plant, despite ongoing work to pour concrete into the pit to stop the leakage.

The plant operator, Tokyo Electric Power Company, found water between 10 and 20 centimeters deep in the pit on Saturday morning. The pit is located near the water intake of the No.2 reactor and contains power cables.

The surface of the water in the pit was found to have a radiation level of over 1,000 millisieverts per hour. To fill in the crack in the pit, the utility firm began pouring in concrete at 4:30 PM on Saturday.

But even more than 6 hours later, the amount of water flowing into the pit was so large that the injected concrete had not solidified yet, allowing radioactive water to leak into the ocean.

The power company will try other measures on Sunday morning to stop water from entering the pit. It will use a particular kind of polymer which will absorb the water.

The power firm says the pit is connected to the trench of the No.2 reactor's turbine building.

Last Sunday, the radioactive density of water in the reactor's turbine building was found to be about 100,000 times higher than the normal level.

A high concentration of radioactive elements was also found in puddles in the trench.

Analysis on Saturday showed that the radioactive density of the water in the pit was around 10,000 times above the usual level.

On Saturday, the firm expanded its study of the radioactive level of seawater by analyzing samples collected about 15 kilometers from the plant in addition to samples taken near the Daiichi and Daini plants. The Daini plant sits about 10 kilometers south of the crippled Daiichi plant.

Sunday, April 03, 2011 01:41 +0900 (JST)

●**Efforts to remove radioactive water stepped up**

The operator of the Fukushima Daiichi nuclear plant is stepping up efforts to remove radioactive water that has been hindering its attempts to contain the ongoing problem at the power plant.

Tokyo Electric Power Company is trying to remove contaminated water from the basements of the turbine buildings of the No.1, 2, and 3 reactors.

TEPCO hopes to move the radioactive water into storage tanks in the turbine condenser. But before that can be done, work began on Saturday to empty the storage tanks at the No. 2 reactor.

TEPCO has been attempting to recover the reactors' cooling systems. It has been injecting seawater in order to prevent the reactors from overheating caused by the nuclear fuel.

But it decided to use fresh water instead because seawater is corrosive.

On Saturday morning, a docked US military barge began pumping fresh water to cool the reactors. Another US barge carrying about 1,300 tons of fresh water has arrived at the site. 8 monitoring posts to measure radiation levels on the border of the compound started functioning again on Friday for the first time since the quake struck 3 weeks ago.

However, as the automatic data transmission system is still out of order, workers

will make daily visits to collect the radiation data which TEPCO will then post on its website.

Workers are also testing the spraying of synthetic resin in areas around the reactors in the hope that it will contain radioactive materials released by the hydrogen blasts.

Saturday, April 02, 2011 21:13 +0900 (JST)

**•Tap water safe again**

Japan's health ministry says test results of tap water show that radiation levels are within safety standards in all municipalities.

However, the village of Iitate in Fukushima Prefecture near the disabled nuclear power plant says the situation will have to be monitored for some time. It's calling on residents not to give tap water to infants as a precaution. On Friday, Iitate lifted restrictions on tap water consumption.

According to the ministry, 965 becquerels of radioactive Iodine-131 was detected in tap water in Iitate Village on March 20th. The reading was about 3 times the national safety standard of 300 becquerels per liter.

However, the measurements fell well below the legal standard at all checkpoints from March 29th.

At all the checkpoints in Fukushima Prefecture, the radioactive Iodine readings are now below the benchmark of 100 becquerels per liter for infants.

All municipalities in the Kanto-Koshin-etsu regions including Tokyo had lifted a ban on tap-water consumption by March 27th. None of the municipalities has imposed any additional restrictions.

Saturday, April 02, 2011 21:13 +0900 (JST)

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## April 2, 2011 Update

Please note that I am moving most of my discussions concerning "Battle to stabilize earthquake reactors" to my Blog site at <http://josephmiller.typepad.com/>

My LinkedIn at <http://www.linkedin.com/in/josephsmiller>

You can Tweet me at <http://twitter.com/#/jsmeda>

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## Latest in on Japanese Nuclear Accidents

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## News from WNN

TEPCO's plans for water issues [http://www.world-nuclear-news.org/RS Tepcos plans for water issues\\_0104112.html?utm\\_source=World+Nuclear+News&utm\\_campaign=86861a89f0-WNN Daily 1 April 20114 1 2011&utm\\_medium=email](http://www.world-nuclear-news.org/RS_Tepcos_plans_for_water_issues_0104112.html?utm_source=World+Nuclear+News&utm_campaign=86861a89f0-WNN_Daily_1_April_20114_1_2011&utm_medium=email)

Engineers have plans to deal with contaminated water at the Fukushima Daiichi site, although enacting them will take time. New water storage and treatment facilities are planned for construction.

Concrete pumps to Fukushima [http://www.world-nuclear-news.org/RS Concrete pumps to Fukushima\\_0104111.html?utm\\_source=World+Nuclear+News&utm\\_campaign=86861a89f0-WNN Daily 1 April 20114 1 2011&utm\\_medium=email](http://www.world-nuclear-news.org/RS_Concrete_pumps_to_Fukushima_0104111.html?utm_source=World+Nuclear+News&utm_campaign=86861a89f0-WNN_Daily_1_April_20114_1_2011&utm_medium=email)

Four more concrete pumping trucks are on their way to the Fukushima Daiichi nuclear power plant to help the effort to maintain fuel ponds.

International nuclear safety pledges and promises [http://www.world-nuclear-news.org/RS-0104117.html?utm\\_source=World+Nuclear+News&utm\\_campaign=86861a89f0-WNN\\_Daily\\_1\\_April\\_20114\\_1\\_2011&utm\\_medium=email](http://www.world-nuclear-news.org/RS-0104117.html?utm_source=World+Nuclear+News&utm_campaign=86861a89f0-WNN_Daily_1_April_20114_1_2011&utm_medium=email)

The governing body of the World Association of Nuclear Operators (WANO) has pledged to maintain a 'safety first' focus following the events at Fukushima. Meanwhile, French President Nicolas Sarkozy has called for international nuclear safety standards.

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### Joe Miller Comments

It appears that the reactors are about the same for Units 1, 2 & 3. Unit 1 seems to have the most issues. The temperature for Unit 1 is reported as "Gradually increasing / Decreased a little after increasing over 400C on Mar. 24<sup>th</sup>" and the pressure for Unit 1 is reported as "Decreased a little after increasing up to 0.4Mpa on Mar. 24<sup>th</sup>". It looks like getting water to the Unit 1 reactor is difficult. There are accessibility problems everywhere, but radiation levels over all are decreasing. There are a few hot spots, I believe some of the hot spots that are showing up off site are due to some pumping of water out of basement pools on site. I believe this water is pumped into the ocean unfiltered. Eventually, large filtering units will get on site and this water will be filtered. Once these onsite pools are empty, the onsite and offsite hot spots levels will reduce. There was a report of plutonium by the press. JAIF reported that "Plutonium was detected from the soil of the Fukushima Dai-ichi NPS site on Mar. 28th. The concentration of plutonium measured is as little as in normal environment, almost the same as measured in Japan when the nuclear bomb tests were conducted in the atmosphere in the past, and not harmful to human body." Of course the press reports all of these hot spot situations, which has the effect of scaring everyone in the whole world. But like I said, the radiation levels are subsiding and there are more large high pressure pumper trucks on the way to the site to fill the spent fuel pools with water. Hopefully, these spent fuel pools will become stable soon.

It is noted that the radiation levels are trending down.

- Radiation level: 0.91mSv/h at the south side of the office building, 144µSv/h at the Main gate, 65µSv/h at the West gate, as of 15:00, Apr. 1<sup>st</sup>
- Radiation level: 1.00mSv/h at the south side of the office building, 156µSv/h at the Main gate, 72µSv/h at the West gate, as of 21:00, Mar. 30<sup>th</sup>
- Radiation level: 132.5µSv/h at the West gate at 16:00, Mar. 27

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## April 1, 2011 Update

Please note that I am moving most of my discussions concerning "Battle to stabilize earthquake reactors" to my Blog site at <http://profile.typepad.com/6p014e86f76033970d>

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## Latest in on Japanese Nuclear Accidents

**Where did they get their pumps. Find out at <http://chronicle.augusta.com/latest-news/2011-03-31/srs-concrete-pump-heading-japan-nuclear-site>**

Joe Miller Comments

Seems to be good news (maybe) on the reactor front. Unit 1, 2 & 3 are reported to be in cold shutdown, which means they are being cooled on a continuous and stable basis, although it is reported that Reactor temperature of Unit 1 is slightly increasing and it is about 400 C. This is not a cold shutdown situation, so I think these reactors are not completely stable yet. Fresh water is being pumped into the reactors.

The fuel pools are still problematic, with the Unit 4 pool being the worst. A steam like substance is rising from Units 1, 2, 3 & 4 Spent fuel pools. This means they are boiling and losing inventory in the pools. The Unit 4 pool may also be losing inventory through the inflatable seal leading to the drywell. If the drywell of Unit 4 was dry due to shroud repair work, significant amount of water could be lost to the drywell inside primary containment from the Unit 4 pool. There are other reports that the seismic event could have cracked the fuel pools, but this doesn't appear to be an issue for Units 5 & 6, which also be susceptible to spent fuel pool cracking from the earthquake, but these pools showed no signs of damage and are being cooled in a normal manner. So I believe if significant water is pumped into the spent fuel pools of Unit 1, 2, 3 & 4, these will eventually cool down. Some of the fuel in all of the pools could be damaged. I believe, Unit 4 SFP had a significant dry out and fuel damage.

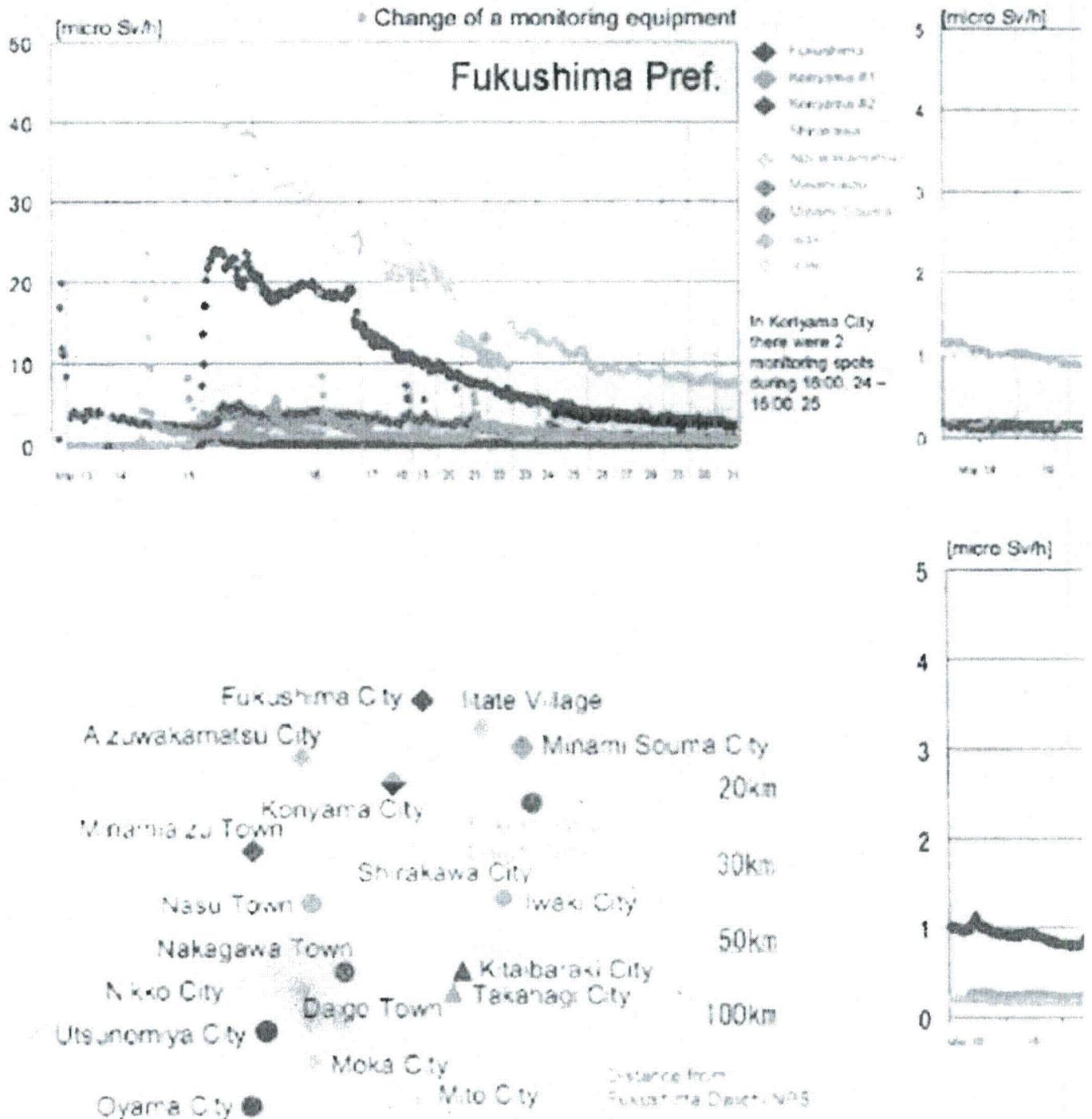
The worker radiation situation is very serious. It appears that a significant number of the monitoring equipment was damaged by the earthquake, so many workers did not have monitoring equipment when they were heavily exposed in the early part of the accident. This really is very disturbing since they don't know how much radiation these workers were exposed to. I suspect that all of these initial workers have left the site and the new workers have monitoring equipment that has been supplied from the other undamaged nuclear plants. I know the situation in the early part of the accident was chaotic, but TEPCO should have been better prepared. (hate to judge these guys based on the limited information we have on the accident progression)

It is noted that the radiation levels are trending down.

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- Radiation level: 1.00mSv/h at the south side of the office building, 156 $\mu$ Sv/h at the Main gate, 72 $\mu$ Sv/h at the West gate, as of 21:00, Mar. 30<sup>th</sup>
- Radiation level: 132.5 $\mu$ Sv/h at the West gate at 16:00, Mar. 27

Also see Figure below.

# Trend of Radiation in the Environment a



See attached JAIF update for Fukushima Dai-ichi NPS site.

A summary is provided as

- Progress of the work to recover injection function  
Water injection to the reactor pressure vessel by temporarily installed pumps were switched from seawater to freshwater at Unit 1, 2 and 3. High radiation circumstance hampering the work to restore originally installed pumps for injection. Discharging radioactive water in the basement of the buildings of Unit 1 through 3 continue to improve this situation. To find a place the water to go becomes a problem.
- Function of containing radioactive material. It is presumed that radioactive material inside the reactor vessel may leaked outside at Unit 1, 2 and Unit 3, based on radioactive material found outside. NISA announced that the reactor pressure vessel of Unit 2 and 3 may have lost air tightness because of low pressure inside the pressure vessel. NISA told that it is unlikely that these are cracks or holes in the reactor pressure vessels at the same location.
- Cooling the spent fuel pool  
Steam like substance rose intermittently from the reactor building at Unit 1, 2, 3 and 4 has been observed. Injecting and/or spraying water to the spent fuel pool has been conducted.
- Prevention of the proliferation of contaminated dust: There is a plan to spray syntetic resin to contain contaminated dust.
- While injecting water into the reactor pressure vessel using make-up water system, TEPCO recovered the core cooling function and made the unit into cold shutdown state one by one.
- Latest Monitor Indication: 4.7 $\mu$ Sv/h at 15:00, Apr. 1st at NPS border
- Evacuation Area: 10km from NPS
- **TEPCO reprimanded over sloppy radiation checks**  
Japan's nuclear safety agency has reprimanded Tokyo Electric Power Company over its failure to ensure the safety of workers at the Fukushima Daiichi nuclear power plant due to shortages of radiation monitors.  
Some teams of workers had to share a radiation monitor, although they are supposed to have one each. Many monitors stopped working after the massive quake.  
The agency told reporters on Friday that the practice is problematic. It instructed the plant operator to make sure that workers are able to check radiation levels.  
TEPCO told the agency that it has obtained 420 radiation monitors so far. The company explained that work will be suspended if employees do not have their own monitors.  
Friday, April 01, 2011 13:30 +0900 (JST)
- **GE: Fukushima reactors have no structural defects**  
The chief executive of General Electric has stressed that the GE reactors at the Fukushima Daiichi nuclear plant have no structural problems.  
Jeff Immelt spoke to NHK and other media outlets on Thursday. Some observers say the No. 1 and 2 reactors, the oldest types at the plant, have a flaw in their designs.  
He said the GE reactor has been in service for more than 40 years and is well tested and well-designed and has been upgraded over time.  
Immelt said in Washington on Thursday that he was aware of the doubts expressed about nuclear power plants. But he said it is necessary to diversify energy sources at a time of rising oil prices.  
In the United States, more than 20 reactors are in use that have similar structure to the Fukushima No. 1 and 2 reactors. Questions were raised about their safety after the Fukushima reactors were damaged last month.  
Friday, April 01, 2011 12:24 +0900 (JST)
- **IAEA: High level of iodine-131 outside zone**

The International Atomic Energy Agency has revealed that iodine-131 was the radioactive substance that exceeded its criterion for evacuation in a village 40 kilometers from the Fukushima Daiichi nuclear plant.

The agency did not give the name of the substance at its news conference on Wednesday.

The village of Iitate to the northwest of the plant is outside the 20 kilometer exclusion zone and the 20 to 30 kilometer alert zone where the Japanese government advises voluntary evacuation.

On Wednesday, the IAEA said radiation levels twice as high as its evacuation level were detected in Iitate and it had advised the Japanese government to carefully assess the situation. But it did not give details of the substance or who carried out the measurement.

The UN nuclear agency revealed on Thursday that its judgment was based on data obtained from the Japanese authorities.

Japan's Nuclear Safety Commission said it sees no reason to change the evacuation zone and advice to stay indoors as its criteria are based on how much radiation people would be exposed to, and not the radiation level in the ground.

The IAEA also corrected the reading of 2 million becquerels of iodine-131 per square meter it announced on Wednesday. The revised figure is 20 million becquerels per square meter.

The IAEA will continue analyzing radiation levels in cooperation with the Japanese government.

Iodine-131 has a radioactive half-life of 8 days, and the half-life of Cesium-137 is 30 years.

Friday, April 01, 2011 11:40 +0900 (JST)

- **TEPCO to ensure radiation monitoring for workers**

Tokyo Electric Power Company says it may postpone low priority work at the damaged Fukushima Daiichi nuclear plant to ensure radiation monitoring for workers.

TEPCO said on Thursday that the quake destroyed many radiation monitors and that only 320 out of the 5,000 it had prior to the disaster are now available.

The company said that in some work groups only leaders had monitors and that 180 workers had worked without devices on one day.

TEPCO said it may postpone low priority work so no employee has to work without a device.

It also said it will collect radiation monitors from other plants to minimize delays.

Friday, April 01, 2011 07:36 +0900 (JST)

- **Program errors force TEPCO to review all data**

Tokyo Electric Power Company says it will review all data on radiation leaked from the damaged Fukushima Daiichi nuclear plant, citing errors in a computer program.

The utility says it found errors in the program used to analyze radioactive elements and their levels, after some experts noted that radiation levels of leaked water inside the plant were too high.

The company and the government's Nuclear and Industrial Safety Agency say previously released data may have shown the levels of tellurium-129 and molybdenum-99 to be higher than they really were.

But they say that levels of iodine-131, which has a significant impact on humans and the environment, remain unchanged.

Tokyo Electric releases data on radioactivity inside the plant compound and in nearby seawater and soil.

The radioactive substances are believed to be coming from damaged nuclear fuel rods.

The data is crucial for identifying the source of radioactive leaks and assessing their impact on the environment.

The Nuclear and Industrial Safety Agency has told the company to find out why the errors occurred and to take steps to prevent a recurrence.

Friday, April 01, 2011 15:39 +0900 (JST)

- **Radiation in seawater at new high**

Radiation 4,385 times higher than the legal standard has been detected in seawater at a location 330 meters south of the troubled Fukushima Daiichi nuclear plant.

Tokyo Electric Power Company says 180 becquerels per cubic centimeter of radioactive iodine-131 have been detected in seawater sampled on Wednesday afternoon.

The figure is far above the 3,355-times level detected on Tuesday.

Wednesday's sampling also revealed cesium-137, which has a half-life of 30 years, at a level 527 times higher than the legal standard.

Japan's Nuclear and Industrial Safety Agency says no fishing is being carried out in waters within 20 kilometers of the plant, and the radiation is likely to be diluted significantly by the time humans take it in through seafood.

The agency says it will monitor radiation levels in seawater at points 15 kilometers from the plant, in addition to surveys being carried out by the science ministry at 30-kilometer points.

Thursday, March 31, 2011 12:55 +0900 (JST)

### Sources and Doses of Radiation

#### Radiation Dose Received from Various Sources of Natural Background Radiation

(taken from

<http://www.uihealthcare.com/topics/medicaldepartments/cancercenter/prevention/preventionradiation.html> )

10 µSv (microsieverts) = 1 mRem mrem (millirem)

| Type         | Source                              | Natural Radiation Source                                                      | Dose Received (mrem/year)                          | Dose Received (µSv/year)                              |
|--------------|-------------------------------------|-------------------------------------------------------------------------------|----------------------------------------------------|-------------------------------------------------------|
| Cosmic:      | Quasars, Sun, Supernovas            | Protons; Electrons<br>Neutrons; Muons                                         | 26 (at sea level)<br>50 (Denver, CO)               | 260 (at sea level)<br>500 (Denver, CO)                |
| Terrestrial: | Oceans, Lakes, Streams, Rocks, Soil | Natural Radiation<br>Thorium; Radium;<br>Polonium-210; Lead-210, Potassium-40 | 16 (Gulf Coast),<br>30 (Iowa), 63<br>(Rocky Mtns.) | 160 (Gulf Coast),<br>300 (Iowa), 630<br>(Rocky Mtns.) |
| Internal:    | Food, Milk, Water                   | Potassium-40; Lead-210; Polonium-210                                          | 39                                                 | 390                                                   |
| Atmospheric: | Air                                 | Primarily Radon                                                               | 200                                                | 2000                                                  |

#### Radiation Dose Received From Other Sources of Radiation

| Type of Exposure | Radiation Source | Dose Received | Dose Received |
|------------------|------------------|---------------|---------------|
|------------------|------------------|---------------|---------------|

|                                  |                                  |                                           | ( $\mu\text{Sv}/\text{year}$ )                                                  |
|----------------------------------|----------------------------------|-------------------------------------------|---------------------------------------------------------------------------------|
| Occupational                     | Industrial, Medical and Academic | 0-5000 mrem/year, (Average-500 mrem/year) | 0-50000 $\mu\text{Sv}/\text{year}$ , (Average-5000 $\mu\text{Sv}/\text{year}$ ) |
| Cigarettes - 1.5 packs/day       | Lead-210 and Polonium-210        | 1300 mrem/year                            | 13000 $\mu\text{Sv}/\text{year}$                                                |
| Nuclear Medicine Bone Scan       | Radioactive Technetium           | 430 mrem                                  | 4300 $\mu\text{Sv}$                                                             |
| Living in a Brick House          | Uranium and Thorium              | 75 mrem/year                              | 750 $\mu\text{Sv}/\text{year}$                                                  |
| Watching TV                      | Low Energy X-rays                | 30 mrem/year                              | 300 $\mu\text{Sv}/\text{year}$                                                  |
| Routine Chest X-ray              | X-rays                           | 10 mrem/film                              | 100 $\mu\text{Sv}/\text{film}$                                                  |
| Cooking/Heating with Natural Gas | Radon                            | 9 mrem/year                               | 90 $\mu\text{Sv}/\text{year}$                                                   |
| Airplane Flight - Cross-Country  | Cosmic Radiation                 | 4 mrem/trip                               | 40 $\mu\text{Sv}/\text{trip}$                                                   |
| Smoke Detectors                  | Americium-241                    | <1 mrem/year                              | <10 $\mu\text{Sv}/\text{year}$                                                  |
| Nuclear Weapons Fallout          | Cesium-137; Strontium-90         | <0.3 mrem/year                            | <03.0 $\mu\text{Sv}/\text{year}$                                                |
| Nuclear Fuel Cycle/Power Plants  | Nuclear Fuel                     | 0.1 mrem/year                             | 01.0 $\mu\text{Sv}/\text{year}$                                                 |

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## March 31, 2011 Update

Please note that I am moving most of my discussions concerning "Battle to stabilize earthquake reactors" to my Blog site at

<http://profile.typepad.com/6p014e86f76033970d>

If are interested in keeping up with these discussions, please go to this site and sign up as a follower. That way when I issue a new blog, you will be notified. I will probably discontinue this email delivery in the next 6 days.

Radiation levels from JAIF (See above attachment for complete JAIF update)

Status in Fukushima Dai-ichi NPS site

Radiation level: 0.93mSv/h at the south side of the office building, 150 $\mu\text{Sv}/\text{h}$  at the Main gate, 70 $\mu\text{Sv}/\text{h}$  (or about at the West gate, as of 15:00, Mar. 31st Radiation dose higher than 1000 mSv was measured at the surface of water accumulated on the basement of Unit 2 turbine building and in the tunnel for laying piping outside the building on Mar. 27th.

Plutonium was detected from the soil of the Fukushima Dai-ichi NPS site on Mar. 28th. The concentration of plutonium measured is as little as in normal environment, almost the same as

measured in Japan when the nuclear bomb tests were conducted in the atmosphere in the past, and not harmful to human body.

Radioactive materials exceeding the regulatory limit have been detected from seawater sample collected in the sea surrounding the Fukushima Dai-ichi NPS since Mar. 21st. Radioactive Iodine, I-131, 4,385 times higher than regulatory limit was detected on Mar. 30th.

Joe Miller comments

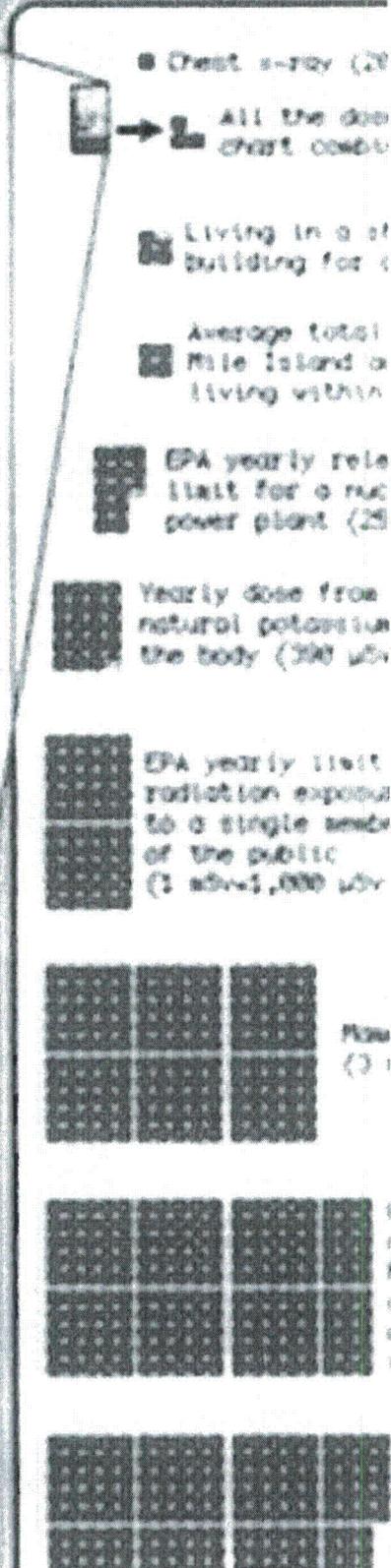
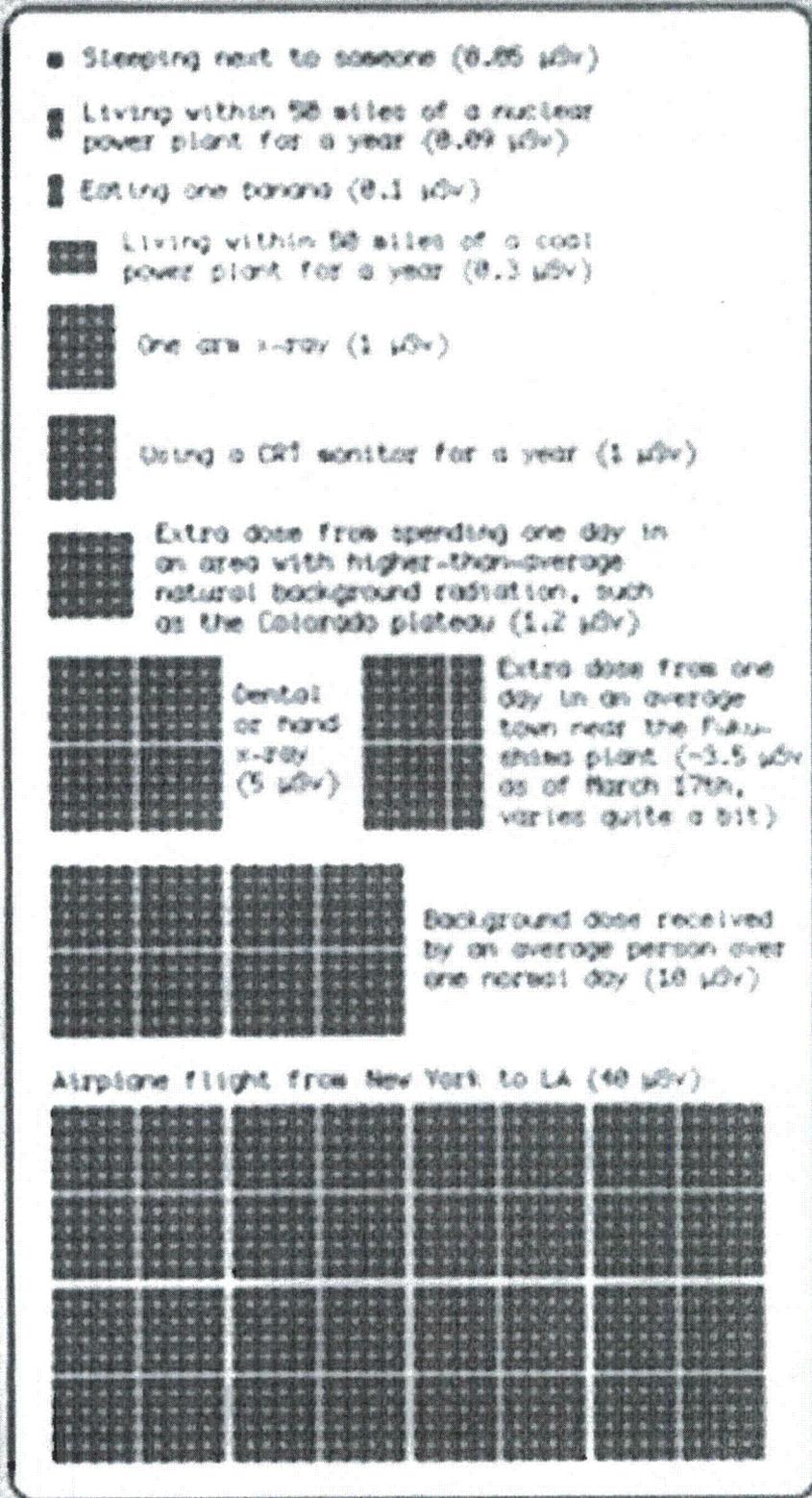
To put these levels in perspective look at the chart and definitions below. So workers at the West gate receiving 70 $\mu$ Sv/h can be exposed to this level for 30 days before they exceed CNSC limits of (50,000  $\mu$ Sv) in any given year. Now the water in the basement of Unit 2 turbine building is a different story. Although JAIF indicated an exposure of 1000 mSV, it is not clear if this is total or hourly. If this is hourly, a worker standing in this water would exceed the CNSC limits in about 3 minutes. It is obvious that workers in these areas must have heavy shielding to stay very long. Some workers at the site are probable exceeding CNSC limits

### Radiation Definitions

- 1 Sv = 1000 mSv (millisieverts) = 1,000,000  $\mu$ Sv (microsieverts) = 100 rem = 100,000 mrem (millirem)
- The effective dose limit for Nuclear Energy Workers, as prescribed by the CNSC, is 100 mSv (10,000 mrem) (100,000  $\mu$ Sv) for 5 years (with a maximum of 50 mSv (50,000  $\mu$ Sv) in any given year or an average of 20 mSv/yr for 5 years) for whole-body exposure.
- Natural background radiation comes from two primary sources: cosmic radiation and terrestrial sources. The worldwide average background dose for a human being is about 2.4 millisievert (mSv) per year or 2400  $\mu$ Sv . This exposure is mostly from cosmic radiation and natural radionuclides in the environment (including those within the body). This is far greater than human-caused background radiation exposure, which in the year 2000 amounted to an average of about 5  $\mu$ Sv per year (which is a 1000 times smaller than natural occurring radiation) from historical nuclear weapons testing, nuclear power accidents and nuclear industry operation combined and is greater than the average exposure from medical tests, which ranges from 0.04 to 1 mSv per year.

# Radiation Dose Chart

This is a chart of the ionizing radiation dose a person can absorb from various sources. All the doses listed are in microsieverts (μSv). One sievert (all at once) will make you sick, and for Note: The same number of sieverts absorbed in a shorter time will generally cause more damage.



Using a cell phone (0.1 μSv)-a cell phone's transmitter does

See <http://holbert.faculty.asu.edu/eee460/bwr.html> for simulation on how BWR operates.

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### An email from my Japanese Friend on March 30, 2011

The condition is still severe, and now advancing and now retreating.

The electric power was supplied to the all units and the lights are on in the central control rooms. However the cooling systems were not recovered yet.

The radioactivity was found to leak in the Units 1 to 3, and the level of Unit 2. was very high, its maximum radioactive dose of 1000 mSv/h was measured at the surface of water accumulated in the tunnel for laying piping outside the Unit 2 turbine. It is expected that the reactor vessel was damaged.

The engineers of 700 from Toshiba and 1000 from Hitachi were arranged against this accident and they deployed each 100 men to the Fukushima-dai-ichi site. However, the workers become exhausted. We, Japanese, express appreciation for them.

The highest priority is to keep cooling the cores and prevent the radioactivity diffusion. The next step is both of exchanging temporary methods to the usual cooling system and cleaning the radioactive waste for improvement of working surroundings. These procedure are difficult and their action seems careful and slow, I think.

It might be that the cabinet, the NISA and TEPCO do not function well and do not communicate with each other. Nuclear Safety Commission or Atomic Energy Commission do not appear. It is no doubt that Japan lacks leadership in spite of this emergency, which Japanese feel irritated at.

Best regards

Kazumi IKEDA

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NHK's English website has gotten enriched and now you can see movies and English scripts at <http://www3.nhk.or.jp/daily/english/society.html>.

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From JAIF summaries

**Today's NHK news regarding status of Fukushima Daiichi nuclear power station as of 21:00 on March 30**

#### ●Kaieda urges safety steps at other nuclear plants

Japan's industry minister has urged power companies across the country to secure emergency energy sources for their nuclear power stations. Banri Kaieda told reporters on Wednesday that the accident at the Fukushima Daiichi plant was due to a failure to secure emergency electricity and a loss of cooling systems at the reactors. Kaieda urged utility companies to secure mobile generators as a source of emergency power that can safely cool nuclear reactors, and to ensure water-supply routes for fire engines. He demanded that the companies confirm emergency steps and conduct drills within a month, or stop operating their nuclear power plants. Kaieda added that putting an immediate end to operations at nuclear power plants is out of the question, because Japan relies on them for about 30 percent of its

electricity. NHK has learned that 90 percent of the 15 nuclear power stations nationwide, excluding the 2 quake-hit plants in Fukushima, have decided to introduce new emergency power generators, including mobile generators. Some utilities have already conducted simulations for cooling procedures based on a scenario in which emergency generators have failed to work at their nuclear reactors.

Wednesday, March 30, 2011 16:57 +0900 (JST)

### ●TEPCO halts work to remove radioactive water

The operator of the troubled Fukushima Daiichi nuclear power plant has suspended work to move highly radioactive water from the basement of the turbine building into the turbine condenser at the No. 1 reactor. Tokyo Electric Power Company suspended the operation on Tuesday morning after the condenser became full of water. The work began on Thursday after water in the basement of the turbine building was found to contain radiation about 10,000 times higher than would normally be found inside an operating nuclear reactor. The Nuclear and Industrial Safety Agency says the water is now about 20 centimeters deep, half the initial level. TEPCO is studying a plan to move water from a tunnel outside the turbine building into an on-site waste disposal facility with a capacity of more than 25,000 tons. The water contains radioactive substances, and its level is only 10 centimeters below the top of the tunnel. TEPCO also planned to move highly radioactive water from the basements of the turbine buildings of the No. 2 and No. 3 reactors into turbine condensers with a capacity of 3,000 tons each. But both condensers turned out to be full. Plant workers are now using pumps that can draw 10 to 25 tons of water per hour to move water from the condensers' storage tanks into other tanks. They then hope to move water inside the condensers into the storage tanks and fill the condensers with the highly radioactive water from the basements.

Wednesday, March 30, 2011 16:37 +0900 (JST)

### ●Air may be leaking from reactors No. 2 and 3

Japan's Nuclear and Industrial Safety Agency says air may be leaking from the No 2 and No 3 reactors at the Fukushima Daiichi power plant. The agency was responding at a news conference on Wednesday to speculation that low pressure inside the 2 reactors was due to possible damage to the reactors' pressure vessels. It said some of their data show pressure is low, but there is no indication of large cracks or holes in the reactor vessels. The agency said fluctuations in temperature and pressure are highly likely to have weakened valves, pipes and openings under the reactors where the control rods are inserted.

Wednesday, March 30, 2011 15:15 +0900 (JST)

### ●Radioactive elements in No.1 reactor tunnel

Japanese nuclear safety officials say radioactive iodine and cesium have been found in water at the Fukushima Daiichi power plant coming from a tunnel outside the turbine building of the No.1 reactor. The Nuclear and Industrial Safety Agency says the levels of radioactive substances detected are low, at one-to-ten percent of those occurring in an operating nuclear reactor. The agency says the type of radioactive substances found in the water in the tunnel indicates some relation to the contaminated water in the basement of the No.1 reactor turbine building. It says the water in the tunnel will not be released into the sea.

Wednesday, March 30, 2011 12:57 +0900 (JST)

### ●High radiation levels in waters off Fukushima

The Nuclear and Industrial Safety Agency says radioactive iodine in excess of 3,300 times the national limit was found in seawater near the troubled Fukushima Daiichi nuclear plant on Tuesday afternoon. This was the highest measured in waters off the plant. The level of radioactive iodine-131 found 330 meters south of a water outlet of the plant was 3,355 times regulated standards at 1:55 PM on Tuesday. The outlet is used to drain water from the plant's No.1 to No. 4 reactors. Radioactive iodine-131

measured 50 meters north of the water outlet of the No. 5 and No. 6 reactors was 1,262 times the regulated standards at 2:10 PM on Tuesday. This was also the highest reading at this location. An agency official told reporters on Wednesday morning that people in a 20-kilometer radius area from the troubled plant have been ordered to evacuate and the radioactive substance will be significantly diluted in the ocean by the time people consume marine products. The official added that efforts need to be made to prevent the contaminated water from flowing into the sea. Airborne radiation levels continue to decline in most prefectures, including Fukushima and nearby Ibaraki. Municipalities measured the radiation levels between 00:00 AM and 9:00 AM on Wednesday.

Wednesday, March 30, 2011 12:23 +0900 (JST)

### ● Radiation levels falling in waters off Fukushima

The science ministry says levels of radiation in seawater near the crippled Fukushima Daiichi Nuclear Power Plant are on the decline. The ministry has been collecting seawater samples at 4 locations 30 kilometers off the coast of Fukushima Prefecture since March 23rd. The locations were at intervals of 20 kilometers from north to south. The ministry started the research after waters near the plant's drain outlets were found to be contaminated with a high density of radioactive substances. The ministry said 1.5 to 3.9 becquerels of radioactive cesium-137 per liter were found in seawater samples taken on Sunday. The amounts represent 1,000 to 2,600 times the levels measured in the same area 2 years ago. But the current levels are only one-fifth to one-tenth of those detected on March 23rd. The density of radioactive iodine-131 is also decreasing. It now stands at 5.4 to 15 becquerels per liter. The ministry said radiation density in the seawater is higher than normal, but it is declining. Cesium-137 is said to remain in the environment for a longer time than other substances as it takes roughly 30 years to lose half of its radioactive intensity. The Marine Ecology Research Institute says cesium-137 will not be directly absorbed into fish through gills but some species can accumulate the element by eating plankton and smaller fish. It's believed that through this process, the density of cesium in fish can increase 10 to 100 times the level in the seawater. It usually takes some time for radioactive material to be detected in fish after it flows into the sea. In many cases, such substances are found in flatfish and Japanese seaperch 2 to 3 months after a confirmed leak into the sea. However, unlike mercury, such elements are eliminated from fish in several weeks.

Wednesday, March 30, 2011 06:25 +0900 (JST)

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## March 28 PM, 2011 Update

Please note that I am moving most of my discussions concerning "Battle to stabilize earthquake reactors" to my Blog site at <http://profile.typepad.com/6p014e86f76033970d>

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Joe Miller Comments

Here is the way I see it. As long as they have water in the three reactors, Unit 1, 2 & 3, they should not have an further melting of the fuel. I Understand the news media said one of the reactors was melting down. I believe the fuel in all three reactors has melted by varying amounts. We will not know by how much until we get the units under complete control, drain the containments and drain the reactors. This will be something greater than 6 months. Well, I believe they all have core damage to certain degrees like TMI, but right now water is cooling the fuel in all of these reactors. There is no containment venting going so this means that there is very little pressure build-up in the containment, which means the fuel is relatively cool in the reactors. The torus in Unit 3 has been

damaged and is leaking. Probably not a large amount of leakage. Now the fuel pools are another story. There are some serious problems in Unit 4 spent fuel pool and since they don't seem to know what is going on in the other fuel pools, there may be problems with Units 1, 2 & 3 SFPs at a later date. I believe the inflatable seals that keep water from draining out of the pool and into the containment has been deflated and water is draining into the containment. This causes the pools to lose water inventory. Here a summary for each Unit as taken from JAIF (See JAIF Summary for March 27<sup>th</sup> in attachment).

| Unit 1                                                                      | Unit 2                                                                   | Unit 3                                                                   | Unit 4                                             |
|-----------------------------------------------------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------------------------|----------------------------------------------------|
| Core damaged has occurred                                                   | Core damaged has occurred                                                | Core damaged has occurred                                                | No fuel in the Core                                |
| Reactor Vessel Damage is unknown                                            | Reactor Vessel Damage is unknown                                         | Reactor Vessel Damage is unknown                                         | NA                                                 |
| Cooling systems are not functional                                          | Cooling systems are not functional                                       | Cooling systems are not functional                                       | NA                                                 |
| Reactor building damaged due to hydrogen explosion                          | Reactor building slightly damaged                                        | Reactor building damaged due to hydrogen explosion                       | Reactor building damaged due to hydrogen explosion |
| small changes of pressure in containment or reactor pressure - they are low | No changes of pressure in containment or reactor pressure - they are low | No changes of pressure in containment or reactor pressure - they are low | safe                                               |
| No containment venting - Temporary Stopped                                  | No containment venting - Temporary Stopped                               |                                                                          | safe                                               |
| Fresh water being injected into reactor vessel                              | Fresh water being injected into reactor vessel                           | Fresh water being injected into reactor vessel                           | No necessary                                       |
| Fuel Pool Integrity                                                         | Unknown                                                                  | Unknown                                                                  |                                                    |
|                                                                             |                                                                          |                                                                          |                                                    |

●Progress of the work to recover injection function

Water injection to the reactor pressure vessel by temporary pumps were switched from seawater to freshwater at unit-1, 2 and 3, since adverse effect such as erosion is concerned.

High radiation makes difficult the work to restore originally installed pumps for injection. Removing water with high concentration of radioactive nuclides in the buildings of Unit 1 through 3 was partly begun on 26th but is considered to take time to complete. (3 workers were sent to the hospital after heavily exposed on March 24 and discharged on March 28.)

●Function of containing radioactive material inside the containment vessel

It is presumed that radioactive material inside the reactor vessel would have leaked outside the containment vessel at unit-1, 2 and unit-3, based on the investigation of the water sampled at turbine building.

●Cooling the spent fuel pool

Steam like substance rose from the reactor building at unit 1, 2, 3 and 4 is being observed. Operation of spraying water to the spent fuel pool is being conducted..

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## March 28, 2011 Update

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**I would like to share this editorial in the San Diego Union with you that was provided to me by Robert Rains of the ASME Energy Committee**

**Rep. Bilbray Op-Ed: Science, Not Fear, Should Drive America's Energy Policies**

*Rep. Brian Bilbray (CA-50)*

**San Diego Union-Tribune, Mar 27** - The 9.0 magnitude earthquake that struck off the coast of Japan on March 11 was more than 10 times stronger than the 1906 San Francisco earthquake. In the wake of this horrible disaster and the nuclear emergency that ensued, an alarm over nuclear power has once again entered our national dialogue.

Americans haven't experienced this kind of hysteria over nuclear power since the incident at Three Mile Island, in which there were no fatalities and which today safely produces clean energy and provides recreational space. Many hope to capitalize on public fear and build prejudice against the only large-scale, clean-air electricity source available for our future. Science, not fear, should be driving America's energy policies.

The U.S. Nuclear Regulatory Commission has a long-standing record of safety. Our robust regulatory infrastructure has accounted for the possibility of a "station blackout" like what occurred at the Fukushima Daiichi plant. The Japanese lost on-site and off-site power, which paralyzed their cooling systems. Our plants, however, are prepared for such an event.

Consider the safety standards of the San Onofre Nuclear Generating Station. San Onofre has redundant safety systems to provide cooling for its reactors. These systems are able to avoid combustion should a hydrogen surge occur similar to those that caused explosions at Fukushima Daiichi. San Onofre's facilities have systems that can recombine hydrogen with oxygen to form water and avoid venting hydrogen gas.

We have built our plants based on ground motion criteria where the probability of disaster is so low that, according to Energy Secretary Steven Chu, we meet expectations for the kind of earthquake that could only occur every 7,000 to 10,000 years. Fear-mongers will laugh at those odds and point to Japan. What they don't mention is that the ensuing tsunami that devastated the Daiichi plant was the real cause of the nuclear emergency, not the earthquake, because it drowned their backup generators in salt water. San Onofre's tsunami walls are 50 percent higher than those at the Daiichi plant. Additionally, equipment necessary to safely shut down the San Onofre plant is protected in structures that are built to withstand both seismic and tsunami catastrophe.

Speaking as someone who lives downwind from a nuclear power plant, I feel much better about my children's future having San Onofre than relying on energy that picks our pockets while polluting our air. The United Nations' Intergovernmental Panel on Climate Change has declared there is no credible scenario for reducing greenhouse gas emissions and our carbon footprint that does not include nuclear power. America's 104 nuclear plants produce more than twice the electricity as our national output of wind, hydro and solar combined.

Nuclear energy doesn't just power American homes; it creates jobs and stimulates local and national economies. The Nuclear Energy Institute estimates private investment in nuclear power plants has created up to 15,000 jobs in the past three years. Additionally, a nuclear power plant produces \$20 million in state and local tax revenue annually, money that can fund schools, roads and other state and local infrastructure.

We've confronted this anxiety before. On Dec. 8, 1953, President Dwight D. Eisenhower proclaimed in his "Atoms for Peace" speech, "This greatest of destructive forces can be developed into a great boon, for the benefit of all mankind." Eight years had passed since the destruction of Hiroshima and Nagasaki, the Soviet Union and the United States were locked in a threatening arms race, and yet our president was determined to reconcile what the world thought of the atom's destructive force with the potential benefit it held for all mankind. I believe President Barack Obama has that same opportunity today.

We should all support reviews of the accident in Japan and incorporating the lessons we learn into the design and operation of U.S. nuclear power plants, but we should not tolerate fear-mongering. As of this writing, the death toll as a result of the quake and tsunami in Japan is estimated to be more than 10,000. It could then be argued that living on the coast is much more dangerous than living next to a nuclear power plant. Requiring residents of San Diego's coastal communities to abandon their homes would be as absurd as asking our nation to abandon a clean, inexpensive source of energy.

We need to be intelligent enough to go with next generation designs for nuclear power plants that are even safer than what we have today. It has been more than 30 years since we halted construction of our plants; think of the scientific and technological advances we have made. We should be saying let's build more, let's build new ones.

Online: San Diego Union-Tribune

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**I would like to pass this power point presentation along. It has a lot of technical detailed information, and very informative for us geeks. Also I am sending a release of info from ANS.**

**Joe Miller**

**+++++**

**March 27, 2011 Update**

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### **Comments by Joe Miler**

Now with all the discussion about spent fuel, the press and other groups are demanding that utilities move all of our spent fuel off site. The industry has been trying to do this for the last 30 year. The technology has been available for many years, but because of politics, the government has not allowed the industry to do this so the spent fuel pools continue to fill up. The nuclear power industry has built dry storage facilities on site that do not need water to cool the fuel. These are air cooled structures that houses the spent fuel bundles. A photo of one of these facilities is shown below.



These are referred to as independent spent fuel storage installations (ISFSIs). Such storage may be either at the reactor site or elsewhere. The spent fuel may be stored in wet or dry ISFSIs. On-site storage of spent fuel in dry casks has become increasingly popular among utilities in the US needing additional capacity for storing spent fuel. Fuel that has been stored for at least five years in water has cooled sufficiently, and its radioactivity decreased enough, for it to be removed from the spent fuel pool and loaded into casks. This frees up additional space in the pool for storing spent fuel newly removed from the reactor. For this to happen at a off-site facility, government approval must be given. This approval has not been granted.

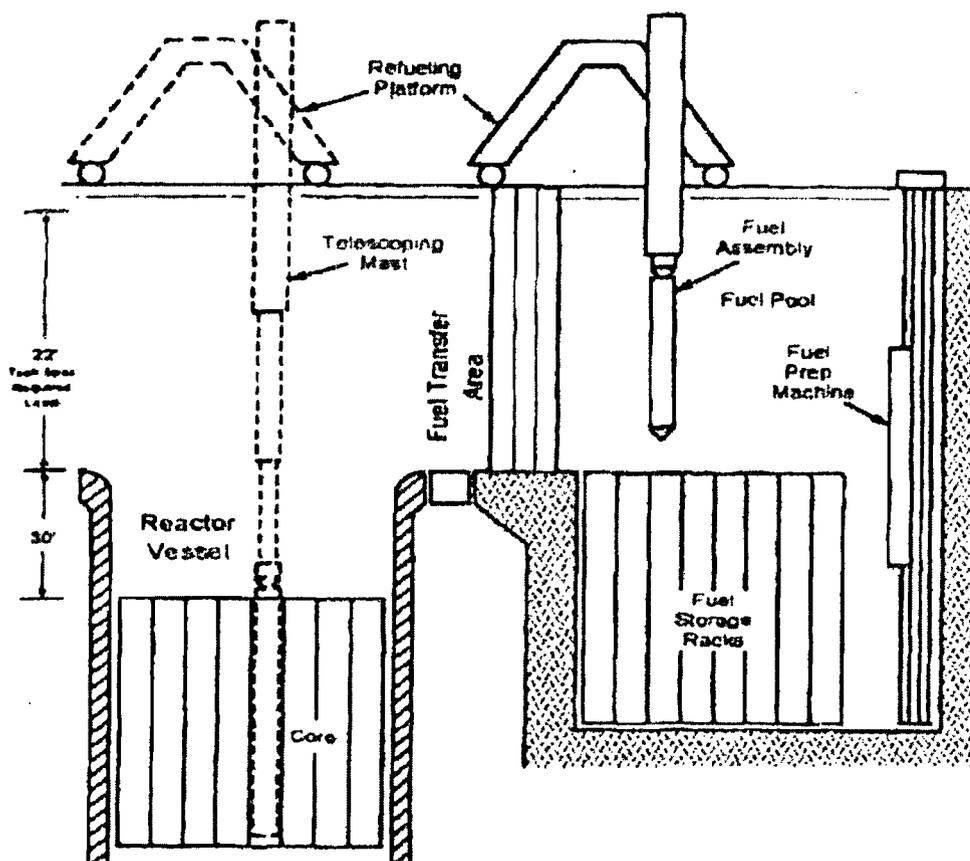
Therefore, the move to air cooled facilities is not something new, the fuel has to spend time in the water cooled spent fuel pool for 5-10 years to get the decay heat low enough so air can adequately remove the heat from the fuel. It is a process that is being performed by the US utilities so it isn't anything new. Because of new requirements implement by the Nuclear regulatory Commission (NRC), I believe the SFPs in the US are much more capable in surviving a fire and a possible breach of the SFP. They have fire equipment positioned outside the fuel pool area and in cases of low accessible to the pool area, fire hoses can be used to spray water on the fuel pool through doors and hatches. They also have a portable high pressure water pump that can be used almost immediately after a potential loss of power to the plan to can get water to the pool. Remember, it normally does not require a significant amount of water to keep the spent fuel cool. In the case of a fuel core off load like at Unit 4 at the Fukushima Daiichi Site, due t the higher decay heat load, the response time must be faster to ensure that water remains above the spent fuel rack.

### **Unit 4 SFP**

**No temperature measurement has been take of the pool water of Unit 4 as of March 27.**

On 23 March it was reported that low level neutron radiation (reported as "neutron beam") was observed several times, which may indicate damaged fuel reaching criticality somewhere at the plant.

We have been discussing the significance of the Unit 4 SFP dry out. Significant water has been put into the pool, after the dry out occurred and it doesn't seem to be cooling the fuel adequately. A colleague of my suggested that maybe the transfer gates were not raised after the fuel had been transferred into the SFP. A diagram of the these transfer canals from the reactor core to the SFP is shown in the Figure below. Now to ensure that the water stays in the pool area, a large diaphragm is placed in the containment to stop the water in the pool from entering the drywell adjacent to the reactor vessel. It is postulated, if the transfer gates were down, the hydrogen explosion may have punctured the diaphragm separating the pool from the reactor dry well and water that workers are pumping into the pool area is actually flowing into the reactor drywell. This is complete speculation and I hope to have more details tomorrow.




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### Status of Unit 4 SFP

- In periodic inspection outage when the earthquake occurred.
- 14th04:08 Water temperature in the Spent Fuel Pool (SFP), 84C
- 15th06:14 Partial damage of wall in the 4th floor confirmed
- 15th09:38 Fire occurred in the 3rd floor. (12:25 extinguished)
- 16th05:45 Fire occurred. TEPCO couldn't confirm any fire on the ground. (06:15)
- 20th08:21 ~ 09:40 Water spray over SFP by Self-Defense Force
- 20th around 18:30 ~ 19:46 Water spray over SFP by Self-Defense Force
- 21st06:37 ~ 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

**No temperature measurement has been taken of the pool water of Unit 4 as of March 27.**

**On 23 March it was reported that low level neutron radiation (reported as "neutron beam") was observed several times, which may indicate damaged fuel reaching criticality somewhere at the plant.**

---

From a Japanese Friend Black smoke stops the recovery work. I-131 and Cs-137 are detected in water and on vegetables.

Information of Fukushima-Dai-ichi can be obtained.

Cabinet

<http://www.kantei.go.jp/foreign/incident/index.html>

JAIF: Japan Atomic Industry Forum

<http://www.jaif.or.jp/english/index.php>

NISA: Nuclear and Industrial Safety Agency <http://www.nisa.meti.go.jp/english/index.html>

MEXT: Radioactivity of local area in Japan

[http://www.mext.go.jp/english/radioactivity\\_level/detail/1303986.htm](http://www.mext.go.jp/english/radioactivity_level/detail/1303986.htm)

TEPCO

<http://www.tepco.co.jp/en/index-e.html>

Newspaper

The Japan Times

<http://www.japantimes.co.jp/>

Asahi

<http://www.asahi.com/english/>

Mainichi

<http://mdn.mainichi.jp/>

Regards

Kazumi IKEDA

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## March 26, 2011 Update

### Comments by Joe Miler

The Unit 4 spent fuel pool (SFP) is still a serious issue. I think the question of the fuel being exposed and overheating is a mute point since there was a hydrogen explosion in the Unit 4 Reactor building. The only place the hydrogen could come from is the SFP since there is no fuel in the reactor. That means the fuel had to exceed 2000 F to cause the Zr-Water reaction that creates the hydrogen gas. No water was put in the Unit 4 SFP for almost 3 days after the explosion so I suggest that some of the fuel has melted and now the workers are trying to cool the molten mass, which is very difficult, but not impossible if you put enough water on it. There may be another question concerning the integrity of the UNIT 4 SFP. It may be leaking since a significant amount of water has apparently been put in the pool and there seems to be significant flashing steam still coming from the pool, which indicates that the fuel is still extremely hot.

Another issue that has come up is the possible criticality of the fuel in the fuel rack, which was probably changed shape when the fuel began to melt (remember there is much speculation here).

You can read my write-up that I provided below or on my blog at

<http://profile.typepad.com/6p014e86f76033970d> .

I provide a discuss below that I recently had among friends concerning the criticality issue. You can read about criticality in one of my previous emails or at by blog

<http://profile.typepad.com/6p014e86f76033970d> .

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Joe,

A question popped into my head this morning – Why do we not store control rod blades between the spent fuel rods? When you say some fission products were released when the fuel was uncovered, has the fuel gone critical? Would moderating the fuel preclude the extreme temperatures from occurring? If my memory serves me correctly, I thought the fuel at Three Mile Island melted into a molten mass that shut its own reaction down.

Can boron be dropped into the pool to shut down the reaction? I know we still need water covering the fuel for cooling purposes, but I would think that boron would do a better job of preventing boiling. Please let me know what you think. Feel free to use my ideas if they are useful. Being an electrical engineer I only know the basics of nuclear topics even though Scott Young coerced me into going to General Electric's Station Nuclear Engineering Course for two weeks.

**G Alan Bysfield**

Sr Staff Electrical Engineer

System Engineering

Cooper Nuclear Station

72676 648A Avenue

Brownville, NE 68321

Alan,

Nice hearing from you.

This is my shot at answering your questions.

First I will give an exchange that I had with one of my friends about criticality when I suggested that the spent fuel had begun to melt.

From Clifford R. Marks

Information Systems Laboratories, Inc.

Spent Fuel critical? Lost the geometric spacing perhaps?

From Joe Miller

Cliff,

Good question about the spent fuel geometry. Back in my earlier days, I did many high density fuel rack calculations for thermal hydraulics and criticality using Keno and PDQ. I know there can be a criticality problem when the spent fuel is packed close together. I guess if the fuel slumps into a mass without geometry it could temporarily become closely packed and approach a critical mass and because of the high energy caused by the additional neutrons, the mass would separate again. Of course, the spent fuel mass would need a source of neutrons to approach critical. I don't think it could blow up, but it could cause more heat. Hopefully, they are getting a lot of water on Unit 4 SFP, which will solidify what is left of the spent fuel rack and it will become stable.

Still looks like the Unit 4 SFP has real problems, although they put 150 tones of water in the pool (they think) on March 22 from 17:17 to 20:32. Also started spraying water from the high capacity Concrete Pump Truck at 10:00 March 23. A little late to be doing it, but better late than never.

Sounds like they also sprayed some water in there on March 20 at 9:43. They still don't have a temperature measurement of Unit 4 pool. It was 184 F on March 14, but sometime after that they lost the read out.

To address some of your other questions I am providing the following:

At TMI, the fuel in the reactor did melt, but because water was eventually inserted into the reactor vessel relatively soon, and the reactor vessel and containment stayed intact, the molten mass became solid and remained that way.

The Japanese used borated sea water to inject into the containment/reactor. It is more important to get the criticality issue under control in the core because the newer fuel that is located there has a significant amount of fissile material such as U235 available to form a critical mass. In the fuel pool, the fuel assemblies are spaced out more than in the core and much of the fuel is spent U235 so it would be very unlikely that, even the fuel rack geometry was lost due to melting fuel, a molten mass would approach a critical configuration. Now in Unit 4, with a full core off load, this is the same fuel that is in the core except it has decayed by 110 days. The Unit 4 spent fuel pool would have a better chance of approaching criticality due to the presence of this core off load.

Hope this helps,

Joe

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**Here is a good summary of events surrounding Unit 4 from [http://en.wikipedia.org/wiki/Fukushima\\_I\\_nuclear\\_accidents](http://en.wikipedia.org/wiki/Fukushima_I_nuclear_accidents)**

### **Explosion of reactor 4 building**

At approximately 06:00 JST on 15 March, an explosion—thought to have been caused by hydrogen accumulating near the spent fuel pond—damaged the 4th floor rooftop area of the Unit 4 reactor as well as part of the adjacent Unit 3. At 09:40 JST, the Unit 4 spent fuel pool caught fire, likely releasing radioactive contamination from the fuel stored there. TEPCO said workers extinguished the fire by 12:00. As radiation levels rose, some of the employees still at the plant were evacuated.

On the morning of 15 March 2011 (JST), Secretary Edano announced that according to the Tokyo Electric Power Company, radiation dose equivalent rates measured from the reactor unit 4 reached 100 mSv per hour. Government speaker Edano has stated that there was no continued release of "high radiation".

Japan's nuclear safety agency reported two holes, each 8 meters square (64 m<sup>2</sup> or 689 sq. feet) in a wall of the outer building of the number 4 reactor after an explosion there. Further, at 17:48 JST it was reported that water in the spent fuel pool might be boiling.

As of 15 March 2011 21:13 JST, radiation inside unit 4 had increased so much inside the control room that employees could not stay there permanently any more. Seventy staff remained on site but 800 had been evacuated. By 22:30 JST, TEPCO was reported to be unable to pour water into No. 4 reactor's storage pool for spent fuel. At around 22:50 JST, it was reported that the company was considering the use of helicopters to drop water on the spent fuel storage pool but this was postponed because of concerns over safety and effectiveness, and the use of high-pressure fire hoses was considered instead. A fire was discovered at 05:45 JST on 16 March in the north west corner of the reactor building by a worker taking batteries to the central control room of unit 4.<sup>1</sup> This was reported to the authorities, but on further inspection at 06:15 no fire was found. Other reports stated that the fire was under control. At 11:57 JST, TEPCO released a photograph of No. 4 reactor showing that "a large portion of the building's outer wall has collapsed."<sup>1</sup> Technicians reportedly considered spraying boric acid on the building from a helicopter.

On 18 March, it was reported that water sprayed into the spent fuel pool was disappearing faster than evaporation could explain, suggesting leakage.

SDF trucks sprayed water onto the building to try to replenish the pool on 20 March

On 22 March, the Australian military flew in Bechtel-owned robotic equipment for remote spraying and viewing of the pool. The Australian reported this would give the first clear view of the pool in the "most dangerous" of the reactor buildings.

### **Possibility of criticality in the spent fuel pool**

A Tokyo Metropolitan Police Department Kidotai (Riot Police) water cannon; this type was used to help fight the fires.

At approximately 14:30 on 16 March, TEPCO announced that the storage pool, located outside the containment area, might be boiling, and if so the exposed rods could reach criticality. The BBC commented that *criticality would not mean a nuclear bomb-like explosion, but could cause a sustained release of radioactive materials*. Around 20:00 JST it was planned to use a police water cannon to spray water on unit 4.

On 16 March the chairman of United States Nuclear Regulatory Commission (NRC), Gregory Jaczko, said in Congressional testimony that the NRC believed all of the water in the spent fuel pool had boiled dry. Japanese nuclear authorities and TEPCO contradicted this report, but later in the day Jaczko stood by his claim saying it had been confirmed by sources in Japan.<sup>[225]</sup> At 13:00 TEPCO claimed that helicopter observation indicated that the pool had not boiled off. The French Institut de radioprotection et de sûreté nucléaire agreed, stating that helicopter crews diverted planned water dumps to unit 3 on the basis of their visual inspection of unit 4.

On 18 March, Japan was reportedly planning to import about 150 tons of boric acid, a neutron poison, from South Korea and France to counter the threat of criticality.

On 23 March it was reported that low level neutron radiation (reported as "neutron beam") was observed several times, which may indicate damaged fuel reaching criticality somewhere at the plant.

+++++

## **March 25, 2011 PM Update**

I found some inaccurate information in the last write-up I sent you in Section entitled "What Happened to the Spent Fuel Storage Pools after the Earthquake?"

The changes are as follows:

"Since there was no fuel in Unit 4 reactor, the fuel in the SFP of the secondary containment heated to a temperature of over 2000 °F . This caused a Zr-water reaction to occurred that released significant amounts of hydrogen gas in the secondary containment. The hydrogen accumulated in the secondary containment located at the top of the reactor building and exploded caused significant damage to the top of the reactor building as shown in Figure 15. The fire/explosion took place at about 09:38 on March 15th. The building damage and the high radiation from the exposed spent and off loaded fuel in Unit 4 SFP created significant accessibility problems. In most cases a small amount of water can keep the SFP covered. A fire hose delivering 200-300 gpm of water can typically keep the fuel cool. With the full core off load, it could be 30% more because of the additional decay heat. Without this cooling, the pool will heat up and eventually boil and loss water inventory. I believing the of loss of water because of the boiling in Unit 4 SFP caused the fuel to be exposed, which created high radiation levels. Because of the accessibility issues caused by the explosion and high radiation, no one could get to the pool area to put water in the pool and the pool became dry for some time. This caused some of the fuel to melt and release fission products. Some spray by fire water cannons began on March 20th at 19:46, which was about 10 days after the event began. This is a

significant time period where the fuel in the Unit 4 SFP could have melted. As I write this paper it is not clear what is happening in Unit 4 SFP."

Written by Joe Miller

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**Helton, Donald**

**From:** Helton, Donald  
**Sent:** Tuesday, April 05, 2011 4:14 PM  
**To:** Golla, Joe  
**Cc:** Dinsmore, Stephen  
**Subject:** RE: questions from the WSJ  
**Attachments:** EPGSAG Rev2.pdf; AppB2 Rev2.pdf; AppB1 Rev2.pdf

Joe,

What little info I can provide is below...it probably isn't useful, except perhaps for corroborating any information you get from other sources...

Best,  
Don

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**From:** Golla, Joe  
**Sent:** Tuesday, April 05, 2011 3:49 PM  
**To:** Helton, Donald  
**Subject:** FW: questions from the WSJ

This is the incoming Don. Thank you for getting back and for any help you're able to lend. Joe G, NRR/DPR

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**From:** Burnell, Scott  
**Sent:** Tuesday, April 05, 2011 10:16 AM  
**To:** Bailey, Stewart; Golla, Joe  
**Cc:** Nelson, Robert; Dennig, Robert  
**Subject:** RE: questions from the WSJ

Thanks, I tend to widen my shotgun pattern at first to make sure I find the right folks.

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**From:** Bailey, Stewart  
**Sent:** Tuesday, April 05, 2011 10:14 AM  
**To:** Golla, Joe  
**Cc:** Nelson, Robert; Burnell, Scott; Dennig, Robert  
**Subject:** FW: questions from the WSJ

I'm forwarding this to Joe Golla, BWROG lead PM, hoping he can help with the historic information on the generic operating procedures.

My branch doesn't really have information on these issues.

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**From:** Burnell, Scott  
**Sent:** Tuesday, April 05, 2011 10:10 AM  
**To:** Dennig, Robert; Bailey, Stewart  
**Cc:** Nelson, Robert  
**Subject:** FW: questions from the WSJ  
**Importance:** High

Gentlemen;

EF / 205

17

Are we in a position to provide substantive answers (or the requested excerpts) on these questions? The letter in question is ML003678152. The reporter is in Tokyo, so I'm hoping we can reply one way or another, OCB, so that the reporter will have it first thing tomorrow. Thanks

Scott

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**From:** Dvorak, Phred [mailto:Phred.Dvorak@wsj.com]  
**Sent:** Tuesday, April 05, 2011 9:51 AM  
**To:** Burnell, Scott  
**Subject:** questions from the WSJ

Scott, hi --

It's Phred Dvorak at the Wall Street Journal in Tokyo, with those questions about BWR accident guidelines.

As I mentioned, I'm looking into the idea that some actions that are required by the "generic" BWR severe accident guidelines in the U.S. don't seem to have been performed by the Fukushima Daiichi operators in Japan. So to follow up, I'm trying to first pin down what those standard protocols are in the U.S. -- specifically with regard to venting the primary containment vessel and injecting water.

- I'm told that the latest version of those protocols is this: "BWR Owners' Group Emergency Procedure and Severe Accident Guidelines - Rev 2, 2001 - 03". Can you confirm that's true? And are they publically available?

That is the version that I have (attached), but that does not necessarily mean that it is the latest version. I would imagine that they are not publicly available, but don't know that for certain.

- If they're not, could I obtain excerpts from the parts concerning venting the primary containment vessel (when, how and how long to vent, venting philosophy -- how to factor in risk of radiation release etc, who's responsible for the decision) and injecting water (similarly: when it's absolutely necessary to inject, who's responsible for the decision).

I've no idea if it is appropriate to provide such information, and it obviously is related to whether or not they are publicly available. It is also worth noting that the generic guidelines will not have plant-specific values...from page I-3:

"The EPGs/SAGs are applicable to General Electric product lines BWR/1 through BWR/6, but no single plant includes all of the systems addressed. Sample plant data is included to illustrate typical numerical values and step wordings and sample curves are shown in the Figures section at the end of the guidelines. Brackets enclose text that must be replaced with plant specific information and instructions that apply only to certain plant designs. The source of each bracketed numerical variable is identified in parentheses following the sample value. It is expected that each utility will replace all bracketed expressions with plant specific values, calculate plant specific curves, delete non-applicable instructions, and substitute plant specific terms for generic designations during conversion of the EPGs/SAGs to plant specific guidelines."

Regarding the more philosophical issues, these are presumably covered in Appendix B (Technical Basis; also attached) under Primary Containment Control, but I haven't had a chance to verify that. The assignment of decision makers is probably only covered in a generic sense.

- Further to the "venting philosophy" question, I found in your public documents database a Jan. 28, 2000 letter from the BWR Operators' Group to the NRC expressing some concerns about wording in the (then) proposed Revision 2. The wording in question was that vents should be opened "irrespective of the offsite radioactivity release rate." The BWROG asked the wording be softened. Can you tell me how this issue was resolved? (What was the final wording?)

No firsthand knowledge of this issue.

- The same letter also noted the need for guidance that "clearly established responsibilities within the licensee's management organization for authorizing containment venting under accident conditions." Could you please tell me whether that happened, and what the resulting guidance was?

I presume this will be plant-specific, but have no firsthand knowledge.

- In the venting and water injection instructions, are there parts of the generic SAG (the BWROG Severe Accident Guidelines referred to above) that are modifiable by the operators and parts that are not? What are the NRC rules concerning how such SAGs can or should be modified with plant-specific information?

It is expected (in fact necessary) that the generic SAGs be tailored to the plant-specific application, particularly for incorporating design-specific limits, computational aids, etc. (see embedded quote from response to 2<sup>nd</sup> question), as well as for accommodating the plant-specific organizational and decision-making structure. This tailoring would have been part of the original implementation, and there is an expectation that the Accident Management Program be maintained as a living program such that design or organizational changes would be incorporated, to the extent that they affect the guidelines.

Many thanks in advance for your help!  
Phred

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Phred Dvorak  
Wall Street Journal  
(b)(6) (cellphone)  
[phred.dvorak@wsj.com](mailto:phred.dvorak@wsj.com)

**Lee, Richard**

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**From:** Lee, Richard  
**Sent:** Tuesday, April 05, 2011 5:40 PM  
**To:** 'Douglas.Burns@inl.gov'  
**Subject:** RE: 4/5 Science Expert Call Briefing  
**Attachments:** image001.gif

Thx, Doug.  
Richard

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**From:** [Douglas.Burns@inl.gov](mailto:Douglas.Burns@inl.gov) [<mailto:Douglas.Burns@inl.gov>]  
**Sent:** Tuesday, April 05, 2011 5:34 PM  
**To:** Lee, Richard  
**Subject:** Fw: 4/5 Science Expert Call Briefing

Fyi.

Douglas E Burns

----- Original Message -----

**From:** Douglas E Burns  
**Sent:** 04/05/2011 02:16 PM MDT  
**To:** [Alex.Larzelere@nuclear.energy.gov](mailto:Alex.Larzelere@nuclear.energy.gov)  
**Subject:** 4/5 Science Expert Call Briefing

Here's today's Science Expert briefing for distribution.

Doug

*(See attached file: 0405 S-1 Briefing.pptx)*

Douglas E. Burns  
INL Fuel Cycle Science & Technology  
208-526-2051 (office)

(b)(6) (cell) Ex 6

FF/2660

**From:** [Johnson, Michael](#)  
**To:** [Akstulewicz, Frank](#); [Matthews, David](#)  
**Subject:** FW: FYI: Mid-Year Input for Eric Oesterle  
**Date:** Tuesday, April 05, 2011 11:29:00 PM  
**Attachments:** [image001.png](#)

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FYI.

**From:** Nelson, Robert  
**Sent:** Tuesday, April 05, 2011 3:42 PM  
**To:** Holahan, Gary  
**Cc:** Johnson, Michael; Leeds, Eric; Glitter, Joseph; Boger, Bruce; Oesterle, Eric; Markley, Michael  
**Subject:** FYI: Mid-Year Input for Eric Oesterle

He's only been supporting NRR for a few weeks but I honestly don't know what we'd have done without him. What a blessing! To modify a well-used cliché, he hit the ground in a sprint and hasn't stopped. He's been a highly valuable member of our Comm Team, developing communications strategies, developing and reviewing Qs & As, coordinating reviews with other divisions/offices, categorizing them and loading them into our searchable database, reviewing/commenting on draft testimony, responding promptly to quick turnaround requests, and generally being a "go-to" person. An outstanding performer by every definition of the word.

Thanks for making him available to us.

*Robert Nelson*

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



United States Nuclear Regulatory Commission  
*Protecting People and the Environment*

E-mail: [robert.nelson@nrc.gov](mailto:robert.nelson@nrc.gov) |

Office: (301) 415-1453 | Cell: (b)(6)

Fax: (301) 415-2102 |

FF/267

# U.S. NRC

United States Nuclear Regulatory Commission

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Protecting People and the Environment

**From:** [Nelson, Robert](#)  
**To:** [Holahan, Gary](#)  
**Cc:** [Johnson, Michael](#); [Leeds, Eric](#); [Glitter, Joseph](#); [Boger, Bruce](#); [Oesterle, Eric](#); [Markley, Michael](#)  
**Subject:** FYI: Mid-Year Input for Eric Oesterle  
**Date:** Tuesday, April 05, 2011 3:41:35 PM  
**Attachments:** [image001.png](#)

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He's only been supporting NRR for a few weeks but I honestly don't know what we'd have done without him. What a blessing! To modify a well-used cliché, he hit the ground in a sprint and hasn't stopped. He's been a highly valuable member of our Comm Team, developing communications strategies, developing and reviewing Qs & As, coordinating reviews with other divisions/offices, categorizing them and loading them into our searchable database, reviewing/commenting on draft testimony, responding promptly to quick turnaround requests, and generally being a "go-to" person. An outstanding performer by every definition of the word.

Thanks for making him available to us.

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



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Office: (301) 415-1453 | Cell (b)(6) Fax: (301) 415-

*Handwritten:* F/268

**Helton, Donald**

**From:** Helton, Donald  
**Sent:** Tuesday, April 05, 2011 5:44 PM  
**To:** Dinsmore, Stephen; Golla, Joe  
**Subject:** RE: questions from the WSJ

Steve,

I did not get Rev. 2 from ADAMS...not to say it isn't there, but that isn't where I got it from. I have a collection of various AMG documents that I've collected over the years. Several of the plant-specific documents I have came from the eLibrary initiative. I probably got the BWROG Rev. 2 from either Devo Devercelly at the TTC or from someone associated with the SOARCA project, but I honestly don't remember.

On the related question, this may be what you are saying below...but just in case...NEI-91-04 is the generic commitment along with letters on each licensee's docket from the 1994 timeframe (at least that is my understanding)...in the 1994-1995 timeframe, each of the (then) 4 owners groups developed generic guidelines (e.g., the BWROG generic guidelines that these emails are talking about). Each licensee took those generic guidelines and developed plant-specific guidelines. Those will look like the Owners Group generic guidelines but will be populated with plant-specific values and will be tailored to the plant. In some cases, this results in minor structural differences (e.g., the WOG SAMGs have 8 Severe Accident Guidelines, but the 8th (flooding containment) doesn't apply to all plants, so some plants don't have it).

Don

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**From:** Dinsmore, Stephen  
**Sent:** Tuesday, April 05, 2011 4:47 PM  
**To:** Dinsmore, Stephen; Helton, Donald; Golla, Joe  
**Subject:** RE: questions from the WSJ

So NEI 91-04, "Severe Accident Issue Closure Guidelines " is the document that describes industry's commitment to develop SAMGs and probably has only one revision. The Emergency Procedure and Severe Accident Guidelines look like the procedures themselves.

**From:** Dinsmore, Stephen  
**Sent:** Tuesday, April 05, 2011 4:27 PM  
**To:** Helton, Donald  
**Subject:** FW: questions from the WSJ

Did you get Rev 2 from ADAMs?

**From:** Dinsmore, Stephen  
**Sent:** Tuesday, April 05, 2011 3:46 PM  
**To:** Golla, Joe; Lobel, Richard  
**Cc:** Cheek, Michael; Wang, Alan; Harrison, Donnie; Laur, Steven  
**Subject:** RE: questions from the WSJ

All I could find in available time – see red text.

EF/269

It's Phred Dvorak at the Wall Street Journal in Tokyo, with those questions about BWR accident guidelines.

As I mentioned, I'm looking into the idea that some actions that are required by the "generic" BWR severe accident guidelines in the U.S. don't seem to have been performed by the Fukushima Daiichi operators in Japan. So to follow up, I'm trying to first pin down what those standard protocols are in the U.S. -- specifically with regard to venting the primary containment vessel and injecting water.

- I'm told that the latest version of those protocols is this: "BWR Owners' Group Emergency Procedure and Severe Accident Guidelines - Rev 2, 2001 - 03". Can you confirm that's true? And are they publically available? The industry committed to implement severe accident management (A/M) guideline enhancements pursuant to a "formal position" (November 21, 1994 NEI letter). Each licensee would assess current capabilities to respond to severe accident conditions using Section 5 of NEI-91-04, Revision 1, "Severe Accident Issue Closure Guidelines." This includes implementing appropriate improvements identified in the assessment and developing and implementing severe accident management guidelines (SAMGs). Revision 1 of BWROG guidelines are publically available at ML072850981. Revision 1 may still be used according to the industry commitment.

- If they're not, could I obtain excerpts from the parts concerning venting the primary containment vessel (when, how and how long to vent, venting philosophy -- how to factor in risk of radiation release etc, who's responsible for the decision) and injecting water (similarly: when it's absolutely necessary to inject, who's responsible for the decision).

- Further to the "venting philosophy" question, I found in your public documents database a Jan. 28, 2000 letter from the BWR Operators' Group to the NRC expressing some concerns about wording in the (then) proposed Revision 2. The wording in question was that vents should be opened "irrespective of the offsite radioactivity release rate." The BWROG asked the wording be softened. Can you tell me how this issue was resolved? (What was the final wording?)

- The same letter also noted the need for guidance that "clearly established responsibilities within the licensee's management organization for authorizing containment venting under accident conditions." Could you please tell me whether that happened, and what the resulting guidance was?

- In the venting and water injection instructions, are there parts of the generic SAG (the BWROG Severe Accident Guidelines referred to above) that are modifiable by the operators and parts that are not? What are the NRC rules concerning how such SAGs can or should be modified with plant-specific information? Each plant is required by 10 CFR 50.47 to have an Emergency plan to provide assurance that adequate protective measures can and will be taken in the event of a radiological emergency. As described above, industry has committed to implement Section 5 of NEI-91-04, Revision 1, which includes developing plant-specific SAMGs and integrate SAMGs with Emergency Operating Procedures and the Emergency Plan. Emergency plans are developed specific to each facility and the community and environment around the facilities. 10 CFR 50.54(q) provide that licensee may make revision to the plan without prior NRC review provide the revision does not decrease the effectiveness of the plan and that the plan, as changed, continue to meet the standards of 10 CFR 50.47(b) and the requirements of 110 CFR 50, Appendix E. The Emergency plan, and all changes to the plan, are provided to the NRC in accordance with 10 CFR 50.4(b)(5). These submittals are not publically available. The SAMGs need not be submitted to the NRC.

Many thanks in advance for your help!  
Phred

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Phred Dvorak  
Wall Street Journal  
(b)(6) (cellphone)

phred.dvorak@wsj.com<mailto:phred.dvorak@wsj.com>

NSIB

**Rosales-Cooper, Cindy**

**From:** Rosales-Cooper, Cindy  
**Sent:** Wednesday, April 06, 2011 3:10 PM  
**To:** Flanders, Scott; Williams, Donna  
**Cc:** Johnson, Michael  
**Subject:** RE: ACTION: Identify 4th wave of NRC staff to Japan  
**Attachments:** FW: Background 3rd team to Japan - NRO Updated list

Scott,  
Attached is the list I provided Michelle last week which includes persons with the skill set she's looking for. None of our folks were asked to support any of the previous teams, so my recommendation is that we submit the same list again.

Cindy

**From:** Flanders, Scott  
**Sent:** Wednesday, April 06, 2011 3:08 PM  
**To:** Rosales-Cooper, Cindy; Williams, Donna  
**Cc:** Johnson, Michael  
**Subject:** Fw: ACTION: Identify 4th wave of NRC staff to Japan

Do we have any folks on our list that fit this description?

Sent from my NRC Blackberry  
Scott Flanders

(b)(6)

EX. C

**From:** Evans, Michele  
**To:** Howell, Art; McCree, Victor; Dean, Bill; Satorius, Mark; Haney, Catherine; Moore, Scott; Sheron, Brian; Johnson, Michael; Leeds, Eric  
**Cc:** Pederson, Cynthia; Lew, David; Wiggins, Jim; Ordaz, Vonna; Uhle, Jennifer; Ruland, William; Boger, Bruce; Virgilio, Martin; Weber, Michael; Flanders, Scott; Lewis, Robert; Muessle, Mary; Mamish, Nader  
**Sent:** Wed Apr 06 14:57:56 2011  
**Subject:** ACTION: Identify 4th wave of NRC staff to Japan

ODs and RAs:

There is discussion of potentially sending an additional 6 or so staff to Japan.

These individuals would likely depart the USA on April 12 or 13, with a return date of about April 27. (For awareness, this time period spans religious holidays)

Specifically Chuck is looking for 4 individuals with severe accident experience. Lots of EOP/SAMG experience. He is looking for two protective measures staff. Specifically an ingestion pathway person and a "plume" person.

As always, looking for these skill sets combined with the best interpersonal skills.

**OD/RA ACTION:**

1. Please confirm that you received this email.
2. Please identify potential candidates to me by COB Friday April 8.

FF/270

If you have any questions or need any clarification, please call me. Thank you.

*Michele Evans*  
Acting Deputy OD, NSIR  
301-415-3236

**Lee, Richard**

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**From:** Lee, Richard  
**Sent:** Wednesday, April 06, 2011 8:28 AM  
**To:** 'Joy L Rempe'  
**Subject:** RE: Plots Related to Fukushima  
**Attachments:** image001.jpg

Thanks, Joy:  
Richard

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**From:** Joy L Rempe [<mailto:Joy.Rempe@inl.gov>]  
**Sent:** Tuesday, April 05, 2011 3:55 PM  
**To:** Hackett, Edwin; [sudhamy.basu@nrc.gov](mailto:sudhamy.basu@nrc.gov); Nourbakhsh, Hossein; Tinkler, Charles; Lee, Richard  
**Cc:** Harold Finley McFarlane  
**Subject:** Plots Related to Fukushima

Hi,

I received approval to send the attached plots to you. Please ask if you need to send beyond NRC. Also, they are based on our compilation of available data (in the case of pressure, water level, and temperature data), injection data (with some simple analyses), and decay heat (with some simple analyses). If you think that there are errors, please let us know.

I think that the pressure increases in Units 2 and 3 are of interest (based on early data that we didn't see on the IAEA plots). We update these each day. We are hoping to soon have a timeline of events.

Joy



Joy Rempe • Idaho National Laboratory  
Phone: (208) 526-2897 Cell: (b)(6)  
Email: [Joy.Rempe@inl.gov](mailto:Joy.Rempe@inl.gov)

EX 6

Fax: (208) 526-2930 •

4/27/11

## Shuaibi, Mohammed

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**From:** Shuaibi, Mohammed  
**Sent:** Wednesday, April 06, 2011 9:33 AM  
**To:** Roach, Edward  
**Cc:** Dudes, Laura; Tappert, John  
**Subject:** RE: Analysis support for Pacific-Alaskan water

Thanks Ed. Really appreciate all you're doing on this, supporting RHEP, supporting the Ops Center, willingness to go to Japan if needed, and all.

Thanks again.

**From:** Roach, Edward  
**Sent:** Wednesday, April 06, 2011 7:55 AM  
**To:** Shuaibi, Mohammed  
**Cc:** Dudes, Laura; Tappert, John  
**Subject:** FW: Analysis support for Pacific-Alaskan water

FYI...we are just supporting DSER (Rich Raione) in trying to answer his questions related to sampling seawater near Alaska/West coast.  
Ed

**From:** Raione, Richard  
**Sent:** Wednesday, April 06, 2011 7:37 AM  
**To:** LaVera, Ronald; Roach, Edward  
**Cc:** Jones, Henry; Chokshi, Nilesh; Nicholson, Thomas; Dehmel, Jean-Claude; Schaffer, Steven  
**Subject:** RE: Analysis support for Pacific-Alaskan water

Hi Ron, thanks for your time and input yesterday afternoon.

I agree that baseline sampling, depth specific, should be conducted asap. Discrete vs composite samples, biased vs unbiased sampling, analyte selection (gross alpha/beta, gamma spec with library search) etc., all need to be planned. I would think a CERCLA type of approach and documentation, including at a minimum the FSP and QAPP, would be appropriate in this case. Notwithstanding the effects of dilution, having baseline data that indicates and hopefully proves rad is less than instrument MDAs would be beneficial to several stakeholders.

I think the question will be, who will take the lead for the sampling/analysis program, and who will pay for it (i.e., US Coast Guard, EPA, NOAA/NOS, USGS, COE, State of Alaska, NRC, etc. ??) if this activity actually moves forward.

As Vice Chair of the Federal Subcommittee on Hydrology, I could bring this up (with senior manager approval) at our next meeting on April 21- this is a topic that would generate much interest among the 20 or so participant federal agencies.

At the moment, I am unclear what the status and plans are for this work, if any at all. RHEB will keep CHPB and RES in the loop should any action be forthcoming.

Richard Raione, PG, CPG, CGWP  
US NRC, Office of New Reactors  
Chief, Hydrologic Engineering Branch

EF/2/12

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[richard.raione@nrc.gov](mailto:richard.raione@nrc.gov)

EX-6

**From:** LaVera, Ronald  
**Sent:** Wednesday, April 06, 2011 7:03 AM  
**To:** Raione, Richard  
**Cc:** Roach, Edward  
**Subject:** Analysis support for Pacific-Alaskan water

Rich

I spoke with Ed Roach this morning about possible assistance should you all be asked to evaluate potential contamination of waters near Alaska resulting from Pacific current transport of material from the Japan. The best person in CHPB for providing this type of assistance is Jean-Claude Dehmel. Unfortunately, he is doing an audit of AREVA over the next couple of days, so I was not able to talk to him this morning.

Ed did suggest that you contact Dr. Stephen Schaffer who works for Stephanie Bush-Goddard in Research. Prior to transferring to Research, Dr. Schaffer worked in the effluents portion of CHPB, so I believe that he would be familiar with the type of support that you seek.

You may want to contact Dr. Schaffer earlier, rather than later to see if any baseline sampling needs to be done, prior to the projected plume arrival. Since some of the sample target values are pretty low and may not be routinely performed, collection of baseline samples may aid in the evaluation of data scatter.

Please let me know if there is anything else we can do to assist your efforts.

Ron LaVera

**Helton, Donald**

---

**From:** Helton, Donald  
**Sent:** Wednesday, April 06, 2011 4:04 PM  
**To:** Ghosh, Tina  
**Subject:** RE: questions from the WSJ

Tina,

I don't necessarily disagree, though I think ideally we should be in a position to answer these types of questions. And honestly, with a little more lead time, we could have.

Regarding the SAGs being non-public, I assumed they weren't but wasn't sure...

Best,  
Don

---

**From:** Ghosh, Tina  
**Sent:** Wednesday, April 06, 2011 3:23 PM  
**To:** Helton, Donald  
**Cc:** Wagner, Katie  
**Subject:** RE: questions from the WSJ

Hi Don,

Thanks for all your help.

FYI, my knee-jerk response to Steve Dinsmore yesterday was the following:

"The BWROG is the proper organization to answer these questions (except the last one), but let me know if you still want assistance with this.

SAGs are NOT publicly available."

Let me know if you don't agree (for my future reference).

Thanks,  
Tina

---

**From:** Helton, Donald  
**Sent:** Wednesday, April 06, 2011 2:08 PM  
**To:** Santiago, Patricia  
**Cc:** Ghosh, Tina; Wagner, Katie; Lee, Richard  
**Subject:** RE: questions from the WSJ

Pat,

FYI - Regarding the below... I provided a kneejerk response to NRR yesterday afternoon (attached), and I was told that NRR/DRA was working the issue. That was the last I had heard until now.

Don

---

**From:** Santiago, Patricia  
**Sent:** Wednesday, April 06, 2011 2:01 PM  
**To:** Blount, Tom

FF/273

**Cc:** Golla, Joe; Gibson, Kathy; Ghosh, Tina; Wagner, Katie; Lee, Richard; Helton, Donald

**Subject:** RE: questions from the WSJ

Tom

I understand that Don Helton was able to assist and that there was a recommendation to forward questions to the BWR Owner's group. For clarity, this was not a SAMA question rather it related to SAMG. If you need any further assistance, we are directing all requests through Richard Lee and Katie Wagner to ensure prompt and priority for all requests.

Thanks again

Pat

---

**From:** Gibson, Kathy

**Sent:** Tuesday, April 05, 2011 6:41 PM

**To:** Blount, Tom; Santiago, Patricia

**Cc:** Golla, Joe

**Subject:** RE: questions from the WSJ

Tom,

My blackberry is dead, so I am now at a touchdown station in TWFN catching up on email. Sorry.

By copy of this email I am asking Pat Santiago to see tomorrow whether her staff (Tina or Jason/Charlie) can answer these questions. We are not SAMA experts so I am reluctant to offer our staff, but we will see what we feel comfortable doing. If we can't help, I suggest you refer them to NEI or the BWROG.

---

**From:** Blount, Tom

**Sent:** Tuesday, April 05, 2011 11:45 AM

**To:** Gibson, Kathy

**Cc:** Golla, Joe

**Subject:** RE: questions from the WSJ

Hi Kathy – Hope all is well with you and you're not spending too much time on shift at the Ops Center... I know you're in a meeting all day today so I'm hoping you see this on a break...

We have some questions raised by a reporter over in Japan for the Wall Street Journal regarding SAMGs. I just learned that NRR no longer has an "in-house" expert in this area since Bob Palla retired. I was wondering, (hoping actually) if Charlie Tinkler or Jason Schaperow could give us (OPA actually) a hand with these background basis type questions....?

Would you let us know....

Thanks,

Tom

415-5710

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**From:** Golla, Joe

**Sent:** Tuesday, April 05, 2011 10:25 AM

**To:** Blount, Tom

**Subject:** FW: questions from the WSJ

**Importance:** High

Tom- please see below. Should I follow up on this?? -or someone in EP?

**From:** Bailey, Stewart

**Sent:** Tuesday, April 05, 2011 10:14 AM

**To:** Golla, Joe

**Cc:** Nelson, Robert; Burnell, Scott; Dennig, Robert

**Subject:** FW: questions from the WSJ

I'm forwarding this to Joe Golla, BWROG lead PM, hoping he can help with the historic information on the generic operating procedures.

My branch doesn't really have information on these issues.

---

**From:** Burnell, Scott

**Sent:** Tuesday, April 05, 2011 10:10 AM

**To:** Dennig, Robert; Bailey, Stewart

**Cc:** Nelson, Robert

**Subject:** FW: questions from the WSJ

**Importance:** High

Gentlemen;

Are we in a position to provide substantive answers (or the requested excerpts) on these questions? The letter in question is ML003678152. The reporter's in Tokyo, so I'm hoping we can reply one way or another by COB so that the reporter will have it first thing tomorrow. Thanks.

Scott

---

**From:** Dvorak, Phred [mailto:Phred.Dvorak@wsj.com]

**Sent:** Tuesday, April 05, 2011 9:51 AM

**To:** Burnell, Scott

**Subject:** questions from the WSJ

Scott, hi --

It's Phred Dvorak at the Wall Street Journal in Tokyo, with those questions about BWR accident guidelines.

As I mentioned, I'm looking into the idea that some actions that are required by the "generic" BWR severe accident guidelines in the U.S. don't seem to have been performed by the Fukushima Daiichi operators in Japan. So to follow up, I'm trying to first pin down what those standard protocols are in the U.S. -- specifically with regard to venting the primary containment vessel and injecting water.

- I'm told that the latest version of those protocols is this: "BWR Owners' Group Emergency Procedure and Severe Accident Guidelines - Rev 2, 2001 - 03". Can you confirm that's true? And are they publically available?

- If they're not, could I obtain excerpts from the parts concerning venting the primary containment vessel (when, how and how long to vent, venting philosophy -- how to factor in risk of radiation release etc, who's responsible for the decision) and injecting water (similarly: when it's absolutely necessary to inject, who's responsible for the decision).

- Further to the "venting philosophy" question, I found in your public documents database a Jan. 28, 2000 letter from the BWR Operators' Group to the NRC expressing some concerns about wording in the (then) proposed Revision 2. The wording in question was that vents should be opened "irrespective of the offsite radioactivity release rate." The BWROG asked the wording be softened. Can you tell me how this issue was resolved? (What was the final wording?)

- The same letter also noted the need for guidance that "clearly established responsibilities within the licensee's management organization for authorizing containment venting under accident conditions." Could you please tell me whether that happened, and what the resulting guidance was?

- In the venting and water injection instructions, are there parts of the generic SAG (the BWROG Severe Accident Guidelines referred to above) that are modifiable by the operators and parts that are not? What are the NRC rules concerning how such SAGs can or should be modified with plant-specific information?

Man, thanks in advance for your help.  
Phred

-----  
Phred Dvorak  
Wall Street Journal

(b)(6) cellphone  
[phred.dvorak@wsj.com](mailto:phred.dvorak@wsj.com)

Hsui, Yi-Hsiung

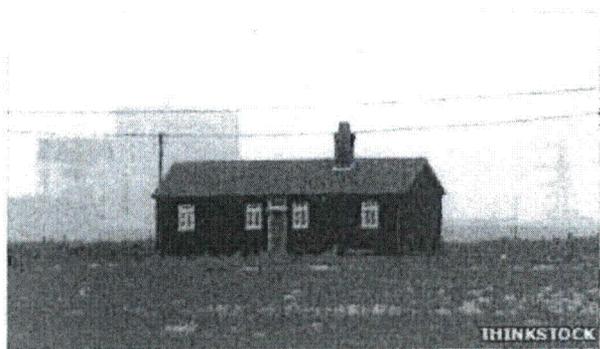
Joe Miller

From: Joe Miller (b)(6) Ex 6  
Sent: Thursday, April 07, 2011 4:51 PM  
To: Joe Miller  
Subject: If you read nothing else about the Japanese accident, you should read this!!! Please pass it on. by Joe Miller  
Attachments: image015.jpg; image018.png

## Viewpoint: We should stop running away from radiation By Wade Allison University of Oxford

Taken from <http://www.bbc.co.uk/news/world-12860842>

More than 10,000 people have died in the Japanese tsunami and the survivors are cold and hungry. But the media concentrate on nuclear radiation from which no-one has died - and is unlikely to.



Modern reactors are better designed than those at Fukushima - tomorrow's may be better still

Nuclear radiation at very high levels is dangerous, but the scale of concern that it evokes is misplaced. Nuclear technology cures countless cancer patients every day - and a radiation dose given for radiotherapy in hospital is no different in principle to a similar dose received in the environment.

What of Three Mile Island? There were no known deaths there.

And Chernobyl? The latest UN report published on 28 February confirms the known death toll - 28 fatalities among emergency workers, plus 15 fatal cases of child thyroid cancer - which would have been avoided if iodine tablets had been taken (as they have now in Japan). And in each case the numbers are minute compared with the 3,800 at Bhopal in 1984, who died as a result of a leak of chemicals from the Union Carbide pesticide plant.

Continue reading the main story  
**Becquerels and Sieverts**

- A becquerel (Bq), named after French physicist Henri Becquerel, is a measure of radioactivity
- A quantity of radioactive material has an activity of 1Bq if one nucleus decays per second - and 1kBq if 1,000 nuclei decay per second

14/274

- A sievert (Sv) is a measure of radiation absorbed by a person, named after Swedish medical physicist Rolf Sievert
- A milli-sievert (mSv) is a 1,000th of a Sievert

- Q&A: Health effects of radiation
- Energy solution or evil curse?

So what of the radioactivity released at Fukushima? How does it compare with that at Chernobyl? Let's look at the measured count rates. The highest rate reported, at 1900 on 22 March, for any Japanese prefecture was 12 kBq per sq m (for the radioactive isotope of caesium, caesium-137).

A map of Chernobyl in the UN report shows regions shaded according to rate, up to 3,700 kBq per sq m - areas with less than 37 kBq per sq m are not shaded at all. In round terms, this suggests that the radioactive fallout at Fukushima is less than 1% of that at Chernobyl.

The other important radioisotope in fallout is iodine, which can cause child thyroid cancer.

This is only produced when the reactor is on and quickly decays once the reactor shuts down (it has a half life of eight days). The old fuel rods in storage at Fukushima, though radioactive, contain no iodine.

But at Chernobyl the full inventory of iodine and caesium was released in the initial explosion, so that at Fukushima any release of iodine should be much less than 1% of that at Chernobyl - with an effect reduced still further by iodine tablets.

Unfortunately, public authorities react by providing over-cautious guidance - and this simply escalates public concern.

Over-reaction

On the 16th anniversary of Chernobyl, the Swedish radiation authorities, writing in the Stockholm daily Dagens Nyheter, admitted over-reacting by setting the safety level too low and condemning 78% of all reindeer meat unnecessarily, and at great cost.



Bottled water was handed out in Tokyo this week to mothers of young babies

Unfortunately, the Japanese seem to be repeating the mistake. On 23 March they advised that children should not drink tap water in Tokyo, where an activity of 200 Bq per litre had been measured the day before. Let's put this in perspective. The natural radioactivity in every human body is 50 Bq per litre - 200 Bq per litre is really not going to do much harm.

In the Cold War era most people were led to believe that nuclear radiation presents a quite exceptional danger understood only by "eggheads" working in secret military establishments.

To cope with the friendly fire of such nuclear propaganda on the home front, ever tighter radiation regulations were enacted in order to keep all contact with radiation As Low As Reasonably Achievable (ALARA), as the principle became known.

This attempt at reassurance is the basis of international radiation safety regulations today, which suggest an upper limit for the general public of 1 mSv per year above natural levels.

This very low figure is not a danger level, rather it's a small addition to the levels found in nature - a British person is exposed to 2.7 mSv per year, on average. My book *Radiation and Reason* argues that a responsible danger level based on current science would be 100 mSv per month, with a lifelong limit of 5,000 mSv, not 1 mSv per year.

#### New attitude

People worry about radiation because they cannot feel it. However, nature has a solution - in recent years it has been found that living cells replace and mend themselves in various ways to recover from a dose of radiation.

These clever mechanisms kick in within hours and rarely fail, except when they are overloaded - as at Chernobyl, where most of the emergency workers who received a dose greater than 4,000 mSv over a few hours died within weeks.

[Continue reading the main story](#)

**"Start Quote**

Some might ask whether I would accept radioactive waste buried 100 metres under my own house?"

End Quote

However, patients receiving a course of radiotherapy usually get a dose of more than 20,000 mSv to vital healthy tissue close to the treated tumour. This tissue survives only because the treatment is spread over many days giving healthy cells time for repair or replacement.

In this way, many patients get to enjoy further rewarding years of life, even after many vital organs have received the equivalent of more than 20,000 years' dose at the above internationally recommended annual limit - which makes this limit unreasonable.

A sea-change is needed in our attitude to radiation, starting with education and public information.

Then fresh safety standards should be drawn up, based not on how radiation can be excluded from our lives, but on how much we can receive without harm - mindful of the other dangers that beset us, such as climate change and loss of electric power. Perhaps a new acronym is needed to guide radiation safety - how about As High As Relatively Safe (AHARS)?

Modern reactors are better designed than those at Fukushima - tomorrow's may be better still, but we should not wait. Radioactive waste is nasty but the quantity is small, especially if re-processed. Anyway, it is not the intractable problem that many suppose.

Some might ask whether I would accept it if it were buried 100 metres under my own house? My answer would be: "Yes, why not?" More generally, we should stop running away from radiation.

*Wade Allison is a nuclear and medical physicist at the University of Oxford, the author of Radiation and Reason (2009) and Fundamental Physics for Probing and Imaging (2006).*

**Bensi, Michelle**

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**From:** Bensi, Michelle  
**Sent:** Thursday, April 07, 2011 3:31 PM  
**To:** Beasley, Benjamin  
**Subject:** RE: FAQ repository in NRR

Ben,  
I haven't had a chance to write up an email indicating which questions in the NRR FAQ are out of date or that have been otherwise changed. I need to finish up some FOIA stuff first because it's due tomorrow.  
Shelby

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**From:** Beasley, Benjamin  
**Sent:** Wednesday, April 06, 2011 9:38 AM  
**To:** Bensi, Michelle  
**Subject:** FW: FAQ repository in NRR

---

**From:** Nelson, Robert  
**Sent:** Wednesday, April 06, 2011 9:31 AM  
**To:** Beasley, Benjamin  
**Cc:** Markley, Michael; Oesterle, Eric  
**Subject:** RE: FAQ repository in NRR

Thanks for your assistance. Please keep me informed of your Q&A progress.

When you forward us your OPA-approved Qs & As, please also provide suggested key words so we can update the database search criteria.

Regarding our Qs & As, they were developed by technical experts, not our Comm Team, or technically reviewed before they were forwarded to OPA for approval. The database now includes over 120 Qs & As. I simply don't have the resources to conduct a wholesale review. If you have comments on specific Qs & As, please forward them to me and we'll review.

Again, thanks for your help.

*Robert A. Nelson*

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



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**From:** Beasley, Benjamin  
**Sent:** Wednesday, April 06, 2011 9:07 AM  
**To:** Hiland, Patrick; Nelson, Robert

*14/27/11*

**Cc:** Kauffman, John; Bensi, Michelle; Hogan, Rosemary; Correia, Richard  
**Subject:** RE: FAQ repository in NRR

Robert,

Regarding the GI-199 Comm Plan Q&As, it was a unanimous feeling among NRR, RES and OPA that we could release them to the public. I think it would be very helpful if they were posted publicly.

Regarding other Q&As, we have an extensive set (see attached outline) of questions that originated from RES staff in the Ops Center. (I believe your Q&As originated from the same source.) We are editing and correcting the set now. We are checking against your SharePoint Q&As to prevent duplicates.

In addition to the OPA review, I recommend that you consider a technical review of your Q&As before releasing them to the public. We have found that not all answers were accurate due to the haste in which they were assembled.

We will complete our set and forward them to OPA as soon as possible.

Regards,  
Ben Beasley

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**From:** Hiland, Patrick  
**Sent:** Wednesday, April 06, 2011 8:42 AM  
**To:** Nelson, Robert  
**Cc:** Beasley, Benjamin; Kauffman, John  
**Subject:** RE: FAQ repository in NRR

Nelson, the GI-199 communication plan (ML081850477) has a number of Qs and As. I believe folks were trying to make the entire communication plan a public document, but inclusion of the Qs and As in your site seems appropriate. Research owns the communication plan, so I've cc'd cognitive folks who could weigh in.

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**From:** Nelson, Robert  
**Sent:** Wednesday, April 06, 2011 7:52 AM

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**Subject:** FAQ repository in NRR

As you may know, NRR has established a very comprehensive SharePoint site for Frequently Asked Questions regarding the Japan event. These questions were initially intended to be used internally so that all staff responding to questions from stakeholders could provide a consistent response and so that similar questions would not have to be researched several times over. The site is located at: <http://portal.nrc.gov/edo/nrr/dor/japan/Shared%20Documents/Questions%20and%20Answers.aspx>

We would like to make this FAQ site available to the public as the primary consolidated site for all FAQs related to the event. To this end, I am asking your assistance by notifying us as to whether FAQs have been gathered in your office and would be appropriate for the public site. The FAQs should be sufficiently "high-level" so that they would typically be asked by a member of the public. We are not seeking very technical, detailed FAQs. They should also be FAQs that do not already appear on the SharePoint site. If your office has developed such FAQs, please send them to Beth Hayden, in OPA, who has agreed to review them to ensure they are appropriate for public release. You should then forward the OPA-approved FAQs to NRR (Eric Oesterle) for incorporation on to the SharePoint site.

Our goal is to make the site available over the course of the next week or so and then incorporate any additional OPA-vetted FAQs on to the site as soon as practicable.

Please let Mindy Landau or I know if you have any questions and thank you for your assistance and thank to NRR for this outstanding initiative!

Mary

**Lee, Richard**

---

**From:** Lee, Richard  
**Sent:** Thursday, April 07, 2011 9:37 AM  
**To:** Marksberry, Don  
**Subject:** RE: Updated Fukushima Plots and Presentations  
**Attachments:** image001.jpg

O.K. I will forward it to RST01.

---

**From:** Marksberry, Don  
**Sent:** Thursday, April 07, 2011 9:27 AM  
**To:** Lee, Richard  
**Subject:** RE: Updated Fukushima Plots and Presentations

I WOULD NOT COUNT ON CONSISTENT INFO EXCHANGES

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**From:** Lee, Richard  
**Sent:** Thursday, April 07, 2011 9:24 AM  
**To:** Marksberry, Don  
**Subject:** RE: Updated Fukushima Plots and Presentations

I can send to them. Don't you think they got it from DOE too? There a DOE guy stationed at the Op Center.

---

**From:** Marksberry, Don  
**Sent:** Thursday, April 07, 2011 8:46 AM  
**To:** Lee, Richard  
**Subject:** RE: Updated Fukushima Plots and Presentations

Richard

Are you sending this to RST01?

---

**From:** Lee, Richard  
**Sent:** Thursday, April 07, 2011 7:55 AM  
**To:** Marksberry, Don  
**Subject:** FW: Updated Fukushima Plots and Presentations

Don:

She is sharing with you the data in a table format which is used to generate plot files..

Richard

---

**From:** Joy L Rempe [<mailto:Joy.Rempe@inl.gov>]  
**Sent:** Thursday, April 07, 2011 12:33 AM  
**To:** John Stetkar; Sanjoy Banerjee; Dennis Bley; Bill Shack; Dana Powers; Sam Armijo; Jack Sieber; Said Abdel-Khalik; Mike Ryan; Charles Brown; Harold Ray; Michael Corradini  
**Cc:** Hackett, Edwin; [sud.basu@nrc.gov](mailto:sud.basu@nrc.gov); Nourbakhsh, Hossein; Tinkler, Charles; Lee, Richard  
**Subject:** Updated Fukushima Plots and Presentations

As long as it stays within the 'federal family', I am still allowed to provide updates. Please don't distribute outside (or ask if

EF/276

there are special reasons for distributing to another individual).

Here are updated plots. Note that NISA and FEPC have not reported values for RPV injection in the last few days. Hence, no recent data are included on this plot, some corrections were made to Unit 1 values for March 25 (and subsequent dates). If you see anything else that appears suspicious, please let me know (we want the information to be as accurate as possible). As before, please note that we recognize that some of the sensors may have failed. We are just trying to help others as they perform their analyses so that they have an appropriate starting point.

Late today, we also found the attached document from NISA. It has plots similar to those that we have been producing. However, we have already observed that there are a few differences/discrepancies/typos:

- They have truncated the peak RPV pressure for Units 2 and 3.
- They have Unit 4 pool temperature data from 3/11 up through 3/24 (including a 100 C value at around that date). It's interesting because this value was reported and then retracted by the Japanese.
- There seems to be other differences in SFP and Common Fuel Pool Temperatures shown here (and with the data that we obtained from Japan). We'll look it over and try to better understand these differences in the next few days. We'll have to compare data in this plot to data that we got from Japan before we update this plot.

See you tomorrow,

Joy



Joy Rempe • Idaho National Laboratory  
Phone: (208) 526-2897 Cell: (b)(6)  
Email: Joy.Rempe@inl.gov

Ex 6  
Fax: (208) 526-2930 •

Ex 6

PTA

13

## Jenkins, Ronaldo

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**From:** Tonacci, Mark  
**Sent:** Thursday, April 07, 2011 12:58 PM  
**To:** Raione, Richard; Jenkins, Ronaldo; Hawkins, Kimberly; Hatchett, Gregory  
**Cc:** Wunder, George; Govan, Tekia; Pal, Amar  
**Subject:** RE: Thoughts on preparation for STP June 21 ACRS

Richard,

You have some good ideas here. I think the best way to handle this is to address these topics at our ACRS dry run for Chapter 2. I have talked the PM, Tekia Govan. She will work with you to invite the broader audience. If there are specific scenarios or what not that can help the other branches prepare in advance, please let them and Tekia know. It is likely that there will be scenarios that we cannot answer on the fly at the dry run - we will just do the best we can and work on things prior to the ACRS on April 21.

All -Please let Tekia know if BCs want to attend this dry run since it will be a bit special.

Mark

-----Original Message-----

**From:** Jenkins, Ronaldo  
**Sent:** Thursday, April 07, 2011 9:14 AM  
**To:** Raione, Richard  
**Cc:** Chokshi, Nilesh; Hawkins, Kimberly; Hatchett, Gregory; Tonacci, Mark; Akstulewicz, Frank; Wunder, George; Govan, Tekia; Pal, Amar  
**Subject:** RE: Thoughts on preparation for STP June 21 ACRS

Richard,

I asked Amar Pal to be our POC on this matter. As we discussed we would need to know the flooding scenario, structural protections and other anticipated environmental considerations. We would also need to examine potential impact on EDG/SBODG support systems.

Who is the person on your staff he can contact for more information?

Ronaldo

-----Original Message-----

**From:** Raione, Richard  
**Sent:** Wednesday, April 06, 2011 5:51 PM  
**To:** Govan, Tekia; Wunder, George; Tonacci, Mark; Akstulewicz, Frank  
**Cc:** Chokshi, Nilesh; Jenkins, Ronaldo; Hawkins, Kimberly; Hatchett, Gregory  
**Subject:** Thoughts on preparation for STP June 21 ACRS

Rheb solicits your help and expertise with various interfaces between hydrology / flooding with other branches where flooding and other hydro parameters are important considerations.

I have already been in communication with Kim's branch to convey maximum flow velocities in the event of a postulated MCR breach. This of course can impact drag forces.

We also confirmed the maximum projected groundwater level of 28 ft msl during all scenarios other than the design basis flood.

Today I contacted R. Jenkins in Electrical Eng to make sure they know the design basis flood of 40 ft msl and for my staff to know how backup generators, station blackout, accessibility, etc, are handled and protected in the event of a flood. Jenkins graciously indicated that he would have staff available to answer these type of hydro / EE questions at the acrs if asked.

Given the situation in Japan, Rheb and others need to be especially informed and situationally prepared to answer any and all related questions at the upcoming acrs.

Thanks for your attention to this matter. I want to ensure that we have all bases covered.

Sent from an NRC BlackBerry  
Richard Raione

(b)(6)

-ex.b

## Lee, Richard

---

**From:** Lee, Richard  
**Sent:** Friday, April 08, 2011 8:30 AM  
**To:** Sheron, Brian  
**Subject:** Re: Email Contact

Alex:  
Sorry for this trouble. I could have our IT staff look into it from our side.  
Richard

Sent from nrc blackberry

(b)(6)

Richard Lee

---

**From:** Sheron, Brian  
**To:** Larzelere, Alex <[alex.larzelere@nuclear.energy.gov](mailto:alex.larzelere@nuclear.energy.gov)>; Lee, Richard  
**Cc:** Kelly, John E (NE) <[JohnE.Kelly@Nuclear.Energy.Gov](mailto:JohnE.Kelly@Nuclear.Energy.Gov)>  
**Sent:** Fri Apr 08 07:13:08 2011  
**Subject:** RE: Email Contact

It is weird because I receive the slides with no problem.

---

**From:** Larzelere, Alex [<mailto:alex.larzelere@nuclear.energy.gov>]  
**Sent:** Thursday, April 07, 2011 6:16 PM  
**To:** Lee, Richard  
**Cc:** Kelly, John E (NE); Sheron, Brian  
**Subject:** Email Contact

Richard,

I am completely baffled by this – but I am going to find the problem. Please confirm that this is a good address. I am sending this email as a reply to one you sent, so hopefully this will work.

If so, I will next start sending files of different sizes to see what gets through.

I am really sorry for the trouble.

Regards,

Alex

EF/278

**Lee, Richard**

---

**From:** Lee, Richard  
**Sent:** Friday, April 08, 2011 3:45 PM  
**To:** Voglewede, John  
**Subject:** FW: QUESTION

**Importance:** High

John:

Uncle Buc responded. Do you have any thing that we should add.

Richard

---

**From:** Aissa, Mourad  
**Sent:** Friday, April 08, 2011 3:37 PM  
**To:** Lee, Richard  
**Cc:** Dion, Jeanne; Scott, Michael; Rihm, Roger  
**Subject:** RE: QUESTION  
**Importance:** High

Roger, I am sorry but I am away from the office today. I check my email on a regular basis but for some reason your did not show the last time I log in (about 11:30am). Here is my personal cell phone, just in case: (b)(6)

I would add the following:

What we want to concentrate on is the impact of MOX on accident consequences. In my fact sheet that I sent last week, I mentioned an extensive DOE study that involved 3 different reactors loaded with 40% MOX (**about 8 times the loading at Fukushima Daiichi Reactor 3**). The consequences were found to be within the uncertainty associated with the consequences analyses methodology. NRC also conducted its own studies to evaluate the MOX lead test assemblies at Catawba, and had a similar conclusion. NRC subsequently authorized the use of the LTAs at Catawba.

I would have phrased the part about the alpha radiation differently: **Both** Uranium and Plutonium are long-lived alpha emitters, and they pose the same biological risk. Alpha radiation is very easy to stop (a sheet of paper is enough) and poses a - significant - health hazard only if ingested/inhaled.

---

**From:** Lee, Richard  
**Sent:** Friday, April 08, 2011 2:34 PM  
**To:** Aissa, Mourad  
**Subject:** FW: QUESTION

Mourad:

Did you see this writeup? Was the language came from previous writeup?

Richard

---

**From:** Dion, Jeanne  
**Sent:** Friday, April 08, 2011 10:59 AM  
**To:** Lee, Richard  
**Cc:** Scott, Michael; Rini, Brett  
**Subject:** FW: QUESTION  
**Importance:** High

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Mike-

If Mourad Aissa is not in the office today can we find someone else in FSTB to provide comments to highlighted portions below?

We need a response ASAP. Sorry for the quick turnaround.

Thanks,

Jeanne

---

**From:** Rihm, Roger  
**Sent:** Friday, April 08, 2011 10:24 AM  
**To:** Dion, Jeanne  
**Subject:** FW: QUESTION

FYI

---

**From:** Rihm, Roger  
**Sent:** Friday, April 08, 2011 10:23 AM  
**To:** Rini, Brett  
**Subject:** FW: QUESTION

FYI

---

**From:** Rihm, Roger  
**Sent:** Friday, April 08, 2011 9:37 AM  
**To:** Aissa, Mourad  
**Cc:** Uhle, Jennifer; Sheron, Brian  
**Subject:** QUESTION

Mourad, are you in today (I called but you were not at your desk). I'm contacting you because I have seen your name on MOX information previously provided to the chairman.

We are rushing today to wrap up some Qs and As for Senator Boxer. One question we had was the following: What increased risk is associated with exposure to MOX? At 10PM last night, the best answer we could come up with was the following:

Mixed oxide (MOX) fuel involves the use of plutonium as a fuel, in addition to enriched uranium. Plutonium is a long-lived alpha emitter, which presents different risks than those presented by uranium fission products. Regarding exposure to mixed oxide fuel, in Japan, prompt evacuation has minimized radiation exposure to the public, so long-term public health consequences from radiation exposure resulting from the events, whether due to MOX or uranium fuel, are expected to be small. Also, 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 is likely that the MOX fuel has had and will have no perceptible impact on any consequences from the event.

Do you have corrections/edits/additions to suggest for this response? Need to wrap this up by about 11AM. Thank you.

**Roger S. Rihm**  
Communications and Performance Improvement Staff  
Office of the Executive Director for Operations  
US NRC  
301.415.1717  
[roger.rihm@nrc.gov](mailto:roger.rihm@nrc.gov)

**Lee, Richard**

---

**From:** Lee, Richard  
**Sent:** Friday, April 08, 2011 8:28 AM  
**To:** Powers, Dana  
**Subject:** Re: BWR Degradation Sequence

Dana:  
Thx. Pls send to Katie the chemical reaction of Zr with sand. The Op Center asking for the exothermic reactions on this. Sand is still coming back. Richard

Sent from nrc blackberry

(b)(6)

Richard Lee

---

**From:** Powers, Dana  
**To:** Lee, Richard  
**Sent:** Fri Apr 08 07:08:25 2011  
**Subject:** BWR Degradation Sequence

Richard, Certainly what Ott and ORNL have been preaching for the BWR degradation model – which is the MELCOR BWR model – is that the first thing to slump are channel box farthest from the control blades. This is followed by box walls next to the control blades and, then, the fuel rods. I don't know that we have a lot of experimental validation of the modeling. Dana

FF/280

**From:** [kiyoshi\\_yamauchi@mnes-us.com](mailto:kiyoshi_yamauchi@mnes-us.com)  
**To:** Johnson, Michael  
**Cc:** Holahan, Gary; Matthews, David; Akstulewicz, Frank; frank.gillespie@mnes-us.com; masayuki.fujisawa@mnes-us.com; shinji.kawanago@mnes-us.com  
**Subject:** Mitsubishi Statement on Northeastern Earthquake and Tsunami in Japan  
**Date:** Friday, April 08, 2011 3:37:48 PM  
**Attachments:** [MNES Statement on North Eastern Earthquake and Tsunami in Japan.pdf](#)

---

U.S. Nuclear Regulatory Commission  
Office of New Reactors  
Director  
Dear Mr. Michael R. Johnson

I highly appreciate the efforts taken by the strong leadership of the NRC to support current nuclear energy fleet with high safety and reliability following the Fukushima Daiichi event caused by the northeastern Japan earthquake and resulting tsunami.

We at Mitsubishi Nuclear Energy Systems(MNES),subsidiary to Mitsubishi Heavy Industries(MHI), posted our statement on our home page attached below (<http://www.mnes-us.com/>) expressing our sympathies to all victims affected by the disaster and also describing Mitsubishi contribution our technology and experience wherever possible to help resolve the situation at the Fukushima Daiichi site. It is noted that Mitsubishi is also continuing to give complete technical support to the clients of the 24 PWR units in Japan, which Mitsubishi supplied, in order to immediately implement the new highest safety measures required by the Japanese government.

We also emphasize that we have formed the "MNES Response & Support Team for Fukushima Event", collecting and sharing related information, investigating US-APWR design considering the NRC instructions, supporting US customers and enhancing public relations.

We think co-operation with the same direction between US and Japan to overcome this event is quite important not only in the area of government but also in the area of industries. Lessons learned should be shared timely and good results should be obtained as the best practice by the co-operated activities.

Our responsibility is quite large in continuing to provide the highest level of safety and reliable nuclear plants here in the USA.

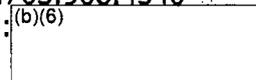
We will be pleased to be advised if you have any comments or you need any support.

Best Regards, Kiyoshi Yamauchi

President and CEO  
Mitsubishi Nuclear Energy Systems, INC.  
1001 19th Street North, Suite 2000  
Arlington, VA 22209

Tel: 703.908.4340

Cell: (b)(6)



Handwritten signature/initials: *FF/281*

Fax:703.908.4399

cc:Gary M. Holahan, NRC  
David B. Matthews, NRC  
Frank M. Akstulewicz, NRC  
Frank Gillespie, MNES  
Shinji Kawanago, MNES  
Masayuki Fujisawa, MNES

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## MNES Statement on North Eastern Earthquake and Tsunami in Japan

We at Mitsubishi Heavy Industries (MHI) and Mitsubishi Nuclear Energy Systems (MNES) send our deepest sympathies to all victims affected by the earthquake and the resulting tsunami that devastated the coast of northeastern Japan on Friday, March 11th.

Since the day of the events, the Japanese Government and Tokyo Electric Power Company have been making every possible effort to ensure plant safety for the Fukushima Daiichi site that was severely impacted by the earthquake and tsunami.

As an expression of our grave concern and strong desire to offer our utmost assistance at this tragic time, MHI, which is a leading pressurized water reactor (PWR) nuclear power plant supplier, and its group companies including MNES pledged on Monday, March 14th, to contribute an amount equivalent to \$6 million to support relief and recovery efforts in the affected areas.

Mitsubishi will continue to contribute our technology and experience wherever possible to help resolve the situation at the Fukushima Daiichi site. In addition, on Thursday, March 30th, the Japanese government ordered all utilities operating nuclear power plants in Japan to implement emergency safety measures by the end of April based on the Fukushima incidents. Mitsubishi has supplied 24 PWR units in Japan and although these units were not impacted by the earthquake and tsunami, Mitsubishi is continuing to give its complete technical support to its client utilities in order to immediately implement the new emergency safety measures.

Through these activities, MNES, as MHI's U.S. affiliate, will ensure that US-APWR plants planned for construction in the United States are of the highest level of safety and reliability.

###

**PRESS CONTACTS:**

Patrick Boyle  
703-528-5493  
Patrick@longbottomcommunications.com

**From:** Evans, Michele  
**To:** Evans, Michele; Howell, Art; McCree, Victor; Dean, Bill; Satorius, Mark; Haney, Catherine; Moore, Scott; Sheron, Brian; Johnson, Michael; Leeds, Eric; Ferrell, Kimberly  
**Cc:** Pederson, Cynthia; Lew, David; Wiggins, Jim; Ordaz, Vonna; Uhle, Jennifer; Ruland, William; Boger, Bruce; Virgilio, Martin; Weber, Michael; Flanders, Scott; Lewis, Robert; Muessle, Mary; Mamish, Nader; Howell, Linda; FOIA Response.hoc Resource  
**Subject:** Names of staff being deployed to Japan  
**Date:** Saturday, April 09, 2011 12:29:12 PM

---

The following individuals have been identified for deploying to Japan for the 4<sup>th</sup> wave.

Steve Reynolds (RIII) will replace Elmo Collins. He will leave USA 4/12 and I have spoken to him.

I will be contacting the following individuals within an hour or so and asking them to travel on April 12:

Steve Garchow (RIV) – EOP/SAMG  
Carl Moore (RIII) – EOP/SAMG  
Jeff Mittman (NRR) – EOP/SAMG  
Dr. Heather Gepford (RII) – HP to assist in briefings and communicate to lay audience.  
Tony Huffert (RES)

I still need to identify 3 more staff and I will send another email to you with the details within an hour.

If you have any questions call me at (b)(6) Thank you.

Michele

EX. 6

**From:** Evans, Michele  
**Sent:** Friday, April 08, 2011 2:51 PM  
**To:** Evans, Michele; Howell, Art; McCree, Victor; Dean, Bill; Satorius, Mark; Haney, Catherine; Moore, Scott; Sheron, Brian; Johnson, Michael; Leeds, Eric  
**Cc:** Pederson, Cynthia; Lew, David; Wiggins, Jim; Ordaz, Vonna; Uhle, Jennifer; Ruland, William; Boger, Bruce; Virgilio, Martin; Weber, Michael; Flanders, Scott; Lewis, Robert; Muessle, Mary; Mamish, Nader; Howell, Linda; FOIA Response.hoc Resource  
**Subject:** RE: ACTION: Identify 4th wave of NRC staff to Japan

ODs/RAs

Thanks for all of the input I have received so far. Since Wednesday, views regarding composition and length of stay of the site team to Japan have evolved.

First, be aware that the staff selected to go to Japan will be expected to be deployed for up to 3 weeks, instead of the previous 2 week commitment. Therefore, staff leaving the country on April 12/13, would return around May 3/4.

Second, approval has been given for Chuck to maintain a team of about 11 people for the immediate future. It has been decided that the protective measures component of the team, does not need to have the specific expertise that was previously noted. Any

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modeling work/analysis that would need to be done, would be completed here at HQs. Instead, Chuck has indicated that he is looking for **someone with a health physics background that could assist in briefings and can effectively communicate radiation exposure and contamination to a lay audience.**

I will be in contact with Chuck over the next 24 hours to further discuss the composition of his team of 11. If there is a skill set needed that hasn't been identified in this email or the one below, I will send you that information tomorrow.

I still plan to be able to identify at least 4 staff to support Chuck's original request by Sunday, so their travel could start on 4/12 or 4/13.

With regard to the new request above and any additional request that I learn from Chuck in the next 24 hours, please provide all nominees by COB on Monday 4/11. Those individuals would be expected to travel later in the week (target 4/14 or 4/15).

Sorry about this lengthy email. If something is not clear, feel free to call me or email.

Michele

*Michele Evans*

**Acting Deputy OD, NSIR**

**301-415-3236**

**From:** Evans, Michele

**Sent:** Wednesday, April 06, 2011 2:58 PM

**To:** Howell, Art; McCree, Victor; Dean, Bill; Satorius, Mark; Haney, Catherine; Moore, Scott; Sheron, Brian; Johnson, Michael; Leeds, Eric

**Cc:** Pederson, Cynthia; Lew, David; Wiggins, Jim; Ordaz, Vonna; Uhle, Jennifer; Ruland, William; Boger, Bruce; Virgilio, Martin; Weber, Michael; Flanders, Scott; Lewis, Robert; Muessle, Mary; Mamish, Nader

**Subject:** ACTION: Identify 4th wave of NRC staff to Japan

ODs and RAs:

There is discussion of potentially sending an additional 6 or so staff to Japan.

These individuals would likely depart the USA on April 12 or 13, with a return date of about April 27. (For awareness, this time period spans religious holidays)

Specifically Chuck is looking for 4 individuals with severe accident experience. Lots of EOP/SAMG experience. He is looking for two protective measures staff. Specifically an ingestion pathway person and a "plume" person.

As always, looking for these skill sets combined with the best interpersonal skills.

**OD/RA ACTION:**

**1. Please confirm that you received this email.**

**2. Please identify potential candidates to me by COB Friday April 8.**

If you have any questions or need any clarification, please call me. Thank you.

*Michele Evans*

**Acting Deputy OD, NSIR**

301-415-3236

**From:** [Johnson, Michael](mailto:Johnson, Michael)  
**To:** "[kiyoshi\\_yamauchi@mnes-us.com](mailto:kiyoshi_yamauchi@mnes-us.com)"  
**Cc:** [Holahan, Gary](mailto:Holahan, Gary); [Matthews, David](mailto:Matthews, David); [Akstulewicz, Frank](mailto:Akstulewicz, Frank); [frank\\_gillespie@mnes-us.com](mailto:frank_gillespie@mnes-us.com); [masayuki\\_fujisawa@mnes-us.com](mailto:masayuki_fujisawa@mnes-us.com); [shinji\\_kawanago@mnes-us.com](mailto:shinji_kawanago@mnes-us.com)  
**Subject:** RE: Mitsubishi Statement on Northeastern Earthquake and Tsunami in Japan  
**Date:** Sunday, April 10, 2011 8:11:00 PM

---

Mr. Yamauchi

Thank you very much for your note. We remain committed to supporting Japan as it continues to restore the Country in the wake of the earthquake and tsunami. I agree that cooperation between our countries has been and will continue to be important as we learn lessons that will enable us to identify any necessary improvements.

Miike

**From:** [kiyoshi\\_yamauchi@mnes-us.com](mailto:kiyoshi_yamauchi@mnes-us.com) [mailto:[kiyoshi\\_yamauchi@mnes-us.com](mailto:kiyoshi_yamauchi@mnes-us.com)]  
**Sent:** Friday, April 08, 2011 3:38 PM  
**To:** Johnson, Michael  
**Cc:** [Holahan, Gary](mailto:Holahan, Gary); [Matthews, David](mailto:Matthews, David); [Akstulewicz, Frank](mailto:Akstulewicz, Frank); [frank\\_gillespie@mnes-us.com](mailto:frank_gillespie@mnes-us.com); [masayuki\\_fujisawa@mnes-us.com](mailto:masayuki_fujisawa@mnes-us.com); [shinji\\_kawanago@mnes-us.com](mailto:shinji_kawanago@mnes-us.com)  
**Subject:** Mitsubishi Statement on Northeastern Earthquake and Tsunami in Japan

U.S. Nuclear Regulatory Commission  
Office of New Reactors  
Director  
Dear Mr. Michael R. Johnson

I highly appreciate the efforts taken by the strong leadership of the NRC to support current nuclear energy fleet with high safety and reliability following the Fukushima Daiichi event caused by the northeastern Japan earthquake and resulting tsunami.

We at Mitsubishi Nuclear Energy Systems(MNES),subsidiary to Mitsubishi Heavy Industries(MHI), posted our statement on our home page attached below (<http://www.mnes-us.com/>) expressing our sympathies to all victims affected by the disaster and also describing Mitsubishi contribution our technology and experience wherever possible to help resolve the situation at the Fukushima Daiichi site. It is noted that Mitsubishi is also continuing to give complete technical support to the clients of the 24 PWR units in Japan, which Mitsubishi supplied, in order to immediately implement the new highest safety measures required by the Japanese government.

We also emphasize that we have formed the "MNES Response & Support Team for Fukushima Event", collecting and sharing related information, investigating US-APWR design considering the NRC instructions, supporting US customers and enhancing public relations.

We think co-operation with the same direction between US and Japan to overcome this event is quite important not only in the area of government but also in the area of industries. Lessons learned should be shared timely and good results should be obtained as the best

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practice by the co-operated activities.

Our responsibility is quite large in continuing to provide the highest level of safety and reliable nuclear plants here in the USA.

We will be pleased to be advised if you have any comments or you need any support.

Best Regards, Kiyoshi Yamauchi

President and CEO  
Mitsubishi Nuclear Energy Systems, INC.  
1001 19th Street North, Suite 2000  
Arlington, VA 22209

Tel: 703.908.4340

Cell: (b)(6) **EX 6**

Fax: 703.908.4399

cc: Gary M. Holahan, NRC  
David B. Matthews, NRC  
Frank M. Akstulewicz, NRC  
Frank Gillespie, MNES  
Shinji Kawanago, MNES  
Masayuki Fujisawa, MNES

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=====

**From:** Holahan, Patricia  
**To:** Uhle, Jennifer; Wiggins, Jim; Boger, Bruce; Zimmerman, Roy; Johnson, Michael; Dyer, Jim; Carpenter, Cynthia; Weber, Michael; Virgilio, Martin  
**Cc:** Evans, Michele; Masse, Todd; Erlanger, Craig; Westreich, Barry; Holahan, Vincent; eugene.holahan@pacom.mil; Stapleton, Bernard  
**Subject:** FYI: ILTAB support for Japan  
**Date:** Monday, April 11, 2011 4:47:52 PM

---

Given the relative and substantial decrease in the flow of intelligence related to the situation in Japan, and consistent with the initiative to have NRC line organizations continue to support the NRC team in Japan, NSIR's Intelligence Liaison and Threat Assessment (ILTAB) Branch is taking the following actions:

- ILTAB will discontinue its own Situation Report (SitRep). The branch will, however, continue to coordinate the classified *Defense Intelligence Report* with the NRC Protective Measures and Reactor Safety Teams, as well we with the Intelligence Community and Pacific Command (PACOM). The once daily produced NRC Emergency Operations Center Status Update is included in the *Defense Intelligence Report*.
- ILTAB will continue to monitor intelligence related to Japan for any items which remain high priority intelligence requirements. Any such items will be provided immediately to the Chairman, the ET, and will be included in the intelligence pouch for provision to the Commission and others as deemed necessary.
- ILTAB will continue to coordinate secure teleconferences and secure calls with PACOM and DNI representatives to ensure they are receiving appropriate technical assessments of reactor safety and health to inform their decision-making processes. Reactor safety team members will be requested to participate in these calls.
- ILTAB will no longer staff the TWF SCIF on the weekends. The ILTAB SCIF will be staffed from 5:30 to 18:00, Tuesday, Wednesday, and Friday, and from 5:30 until 16:00 Monday and Thursday.
- ILTAB will have a duty officer on 24x7 who can be reached through the Operations Center.

Thanks, Trish

Patricia K. Holahan  
Director, Division of Security Operations  
Office of Nuclear Security and Incident Response  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555

(301) 415-6828 (work)

(b)(6)

(cell)

6/10/11

11/28/11

patricia.holahan@nrc.gov

Joe Miller

Hsii, Yi-Hsiung

From: Joe Miller (b)(6) Ex 6  
Sent: Monday, April 11, 2011 9:50 PM  
To: Joe Miller  
Subject: Battle to stabilize earthquake reactors  
Attachments: image015.jpg; image018.png; oledata.mso; Fukuchima.ppt; ANS-Technical-Brief-MOX-Fukushima.pdf; Trend Data Unit 1 To March 30 page 16.jpg; JAIF Earthquake Report 49 April 11 20\_00.pdf; JAIF Status April 11 at 21\_00.pdf

+++++

### April 11, 2011 Update –

If you do not want to receive this email any longer, please reply to and ask to be removed.

Please note that I am moving most of my discussions concerning "Battle to stabilize earthquake reactors" to my Blog site at <http://josephmiller.typepad.com/>  
My LinkedIn at <http://www.linkedin.com/in/josephsmiller>  
You can Tweet me at <http://twitter.com/#!/jsmeda>

If you are interested in keeping up with these discussions, please go to the blog site and sign up as a follower. That way when I issue a new blog, you will be notified.

### Latest in on Japanese Nuclear Accidents

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#### The current situation by Joe Miller (Remember much of this is speculation based on the information that I have and experience)

Another 7.0 earthquake hits Japan again. It's hard to think of these as aftershocks, but if you compare it to the 9.0, these recent earthquakes are quite small. I read in USA Today's newspaper a head line entitled "Five US nuclear reactors in earthquake zones".

Well, how about that!!! You guys in the newspaper business need to keep your eye on the ball. A large flood called a Tsunami just a month ago killed more than 15,000 people in Japan. Now a 9.0 earthquake cause the massive flood, but most of the people were killed by the flooding, not the earthquake. The same holds true for the nuclear power plants at the Fukushima Daiichi nuclear power plant. The emergency equipment worked fine for the most part and was basically not affected by the earthquake, but the flood 1 hour later wiped out all of the equipment at the plant in addition to eliminating help from fire and other outside sources of water pumps that the operators could use to cool the reactors. They could not get to the site for days because of all the debris and blocked roads. All the other plants in the area, which were not impacted by the 40 foot wall of water went into cold shutdown and all emergency equipment work. All of these plants were exposed to the earthquake, yet their equipment work fine. We shouldn't be worried about earthquakes, we should be worried about flooding.

Right now, the Fukushima Daiichi plants do not have AC power connected to their emergency equipment. The plants are being cooled by what some call feed & bleed, which is a process where water is put into the reactor and steam is created because of heat removal from the nuclear fuel. This steam pressurizes the primary containment and this is vented directly to the atmosphere. A diagram of this process is shown in Figure 1a. Once the operators get the AC back to the emergency

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equipment, they can start using this equipment to cool the reactor and venting to the outside will stop. So will the offsite releases. They are hoping to do this in the next week. The use of emergency equipment is shown in Figure 1b.

# Bleed & Feed Core Cooling Established

Seawater Injection Started Using Fire Engine Pump  
 Shift to Fresh Water Injection ~3/26-Present: To Dissolve

Vapor Venting

Possible Salt Cakes

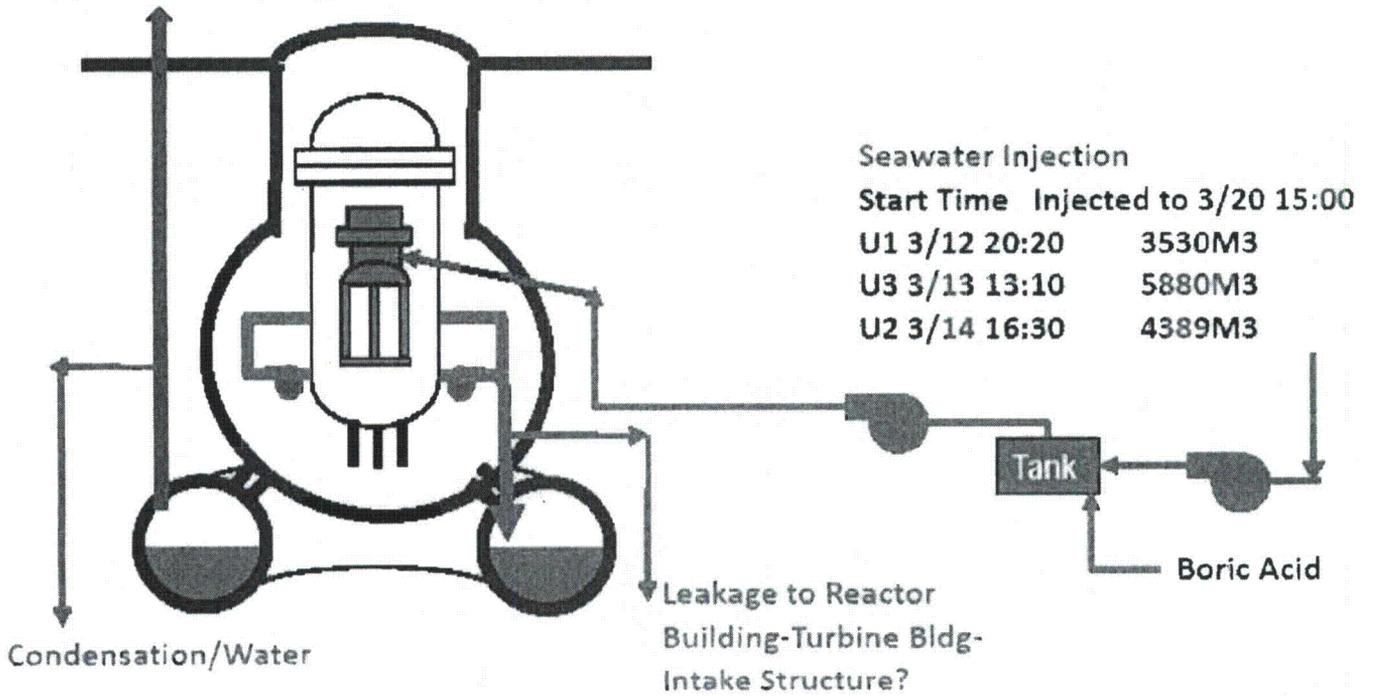


Figure 1a Feed and Bleed Venting to Cool the Reactor

# Need Electric Motors To Establish Recirculation Cooling-Ongoing Effort

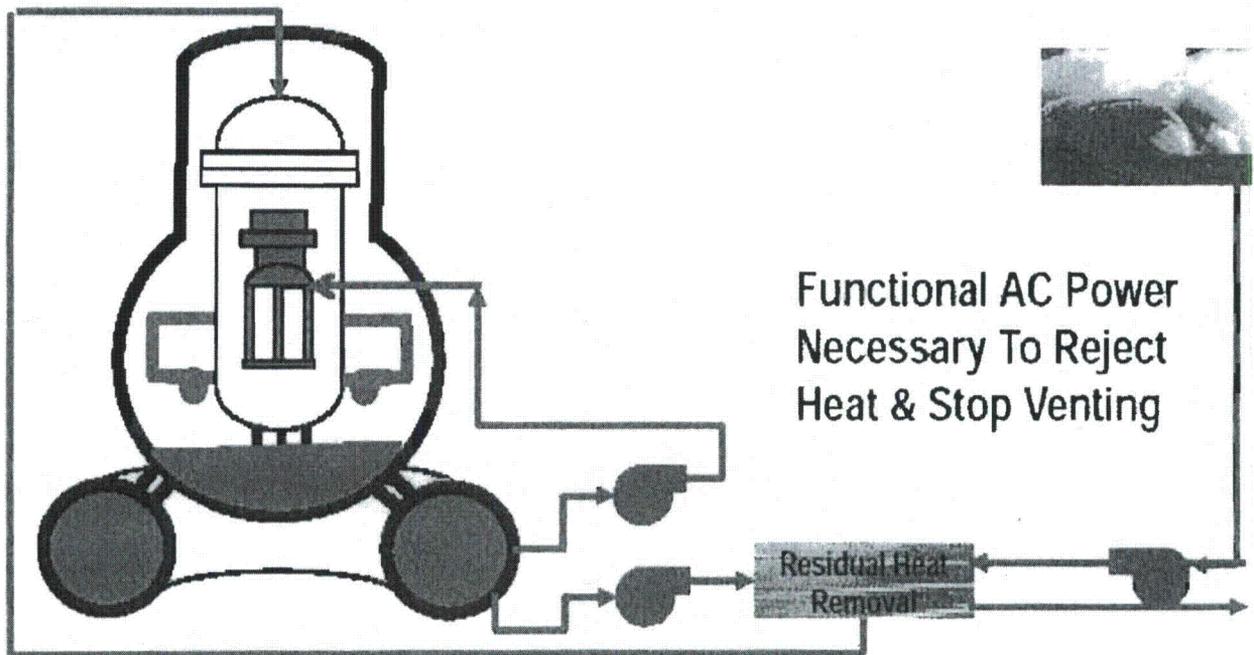


Figure 1b Use of AC Power to Drive Emergency Cooling Equipment to Cool the Reactor

## Radiation Levels

Radiation levels continue to decrease on site by JAIF (some local hot spots are still very high)

- Radiation level: 0.59mSv/h at the south side of the office building, 80 $\mu$ Sv/h at the Main gate, 35 $\mu$ Sv/h at the West gate, as of 15:00, Apr. 11th
- Radiation level: 0.62mSv/h at the south side of the office building, 86 $\mu$ Sv/h at the Main gate, 37 $\mu$ Sv/h at the West gate, as of 07:00, Apr. 10th
- Radiation level: 0.62mSv/h at the south side of the office building, 86 $\mu$ Sv/h at the Main gate, 38 $\mu$ Sv/h at the West gate, as of 15:00, Apr. 9th
- Radiation level: 0.65mSv/h at the south side of the office building, 94 $\mu$ Sv/h at the Main gate, 40 $\mu$ Sv/h at the West gate, as of 15:00, Apr. 8th
- Radiation level: 0.67mSv/h at the south side of the office building, 43 $\mu$ Sv/h at the West gate, as of 15:00, Apr. 7th
- Radiation level 0.69mSv/h at the south side of the office building, 47 $\mu$ Sv/h at the West gate, as of 15:00, Apr. 6th, 108 $\mu$ Sv/h at the Main gate, as of 10:00, Apr. 6th
- Radiation level: 0.78mSv/h at the south side of the office building, 121 $\mu$ Sv/h at the Main gate, 55 $\mu$ Sv/h at the West gate, as of 09:00, Apr. 4rd.

- Radiation level: 0.83mSv/h at the south side of the office building, 127 $\mu$ Sv/h at the Main gate, 59 $\mu$ Sv/h at the West gate, as of 09:00, Apr. 3rd.
- Radiation level: 0.91mSv/h at the south side of the office building, 144 $\mu$ Sv/h at the Main gate, 65 $\mu$ Sv/h at the West gate, as of 15:00, Apr. 1<sup>st</sup>
- Radiation level: 1.00mSv/h at the south side of the office building, 156 $\mu$ Sv/h at the Main gate, 72 $\mu$ Sv/h at the West gate, as of 21:00, Mar. 30<sup>th</sup>
- Radiation level: 132.5 $\mu$ Sv/h at the West gate at 16:00, Mar. 27

A good discussion about radiation <http://www.bbc.co.uk/news/world-12860842>

## Radiation Definitions

- 1 Sv = 1000 mSv (millisieverts) = 1,000,000  $\mu$ Sv (microsieverts) = 100 rem = 100,000 mrem (millirem)
- The effective dose limit for Nuclear Energy Workers, as prescribed by the CNSC, is 100 mSv (10,000 mrem) (100,000  $\mu$ Sv) for 5 years (with a maximum of 50 mSv (50,000  $\mu$ Sv) in any given year or an average of 20 mSv/yr for 5 years) for whole-body exposure.

## Other summaries from JAIF (See summaries attached)

### ●M 7.0 quake hits northeastern Japan

A strong earthquake struck north-eastern Japan at 5:16 PM, local time, on Monday. The Meteorological Agency at one time issued tsunami warnings for the coastal areas of Ibaraki Prefecture. The agency said the earthquake's magnitude was 7.0, and that its focus was in Fukushima Prefecture at a depth of 10 kilometers. Intensities of 6 minus on the Japanese scale of 0 to 7 were registered in some areas of Fukushima and Ibaraki prefectures, including Furudono Town, Nakajima Village and Hokota City. An intensity of 5 plus was registered in many areas in the southern Tohoku and northern Kanto regions. The Meteorological Agency lifted the tsunami warnings about fifty minutes later. A tsunami advisory for the coastal areas of neighboring prefectures was also lifted. Several minor quakes occurred following the major quake at 5:16. The agency is also warning of possible aftershocks with intensities of 6 plus or 6 minus. The operator of the crippled Fukushima Daiichi nuclear power plant, Tokyo Electric Power Company, says radiation figures at monitoring posts around the plant remain unchanged. The utility firm also says outdoor workers had been ordered to temporarily evacuate.  
Monday, April 11, 2011 18:46 +0900 (JST)

### ●Water injection resumed at Fukushima Daiichi plant

The operator of Fukushima Daiichi nuclear power plant says water injection into the crippled reactors was briefly suspended after outside power lines were shut down by a magnitude 7.0 earthquake on Monday evening. Tokyo Electric Power Company said that outside power was restored for reactors No.1, 2 and 3. Water injection was resumed for these reactors after a suspension of about 50 minutes.  
Monday, April 11, 2011 18:34 +0900 (JST)

### ●One month since disaster hits nuclear plant

One month after the Fukushima Daiichi nuclear plant was crippled by the quake and tsunami that devastated Japan's northeastern coast, the plant's operator is still struggling to regain control. Tokyo Electric Power Company has been striving to restore reactor cooling systems since the March 11th

disaster knocked out electricity at the plant. The power station continues to release radioactive substances into the air and sea. Heavily contaminated water in turbine buildings and a concrete tunnel has been hampering restoration efforts and preventing workers from even inspecting the pumping systems. On Sunday, TEPCO began removing debris from the plant using unmanned heavy machinery. It plans to start moving highly radioactive water from the concrete tunnel to another storage facility on Monday. At a news conference on Sunday, TEPCO said it is studying using air instead of seawater for cooling. It said cooling the reactors' containment vessels with water is also under consideration. But a TEPCO executive said that at this point, the company is still examining viable options and cannot say when it will be able to achieve stable cooling and control the radiation.

Monday, April 11, 2011 10:22 +0900 (JST)

**●TEPCO uses unmanned equipment to remove rubble**

Tokyo Electric Power Company has begun using unmanned heavy equipment to remove radioactive rubble at the tsunami-hit Fukushima Daiichi nuclear plant. Hydrogen explosions blew off the ceilings and walls of the Number One and Number Three reactor buildings. The debris is emitting hundreds of millisieverts of radiation per hour in some places, hindering the restoration work. The utility started using remote-controlled power shovels and bulldozers to remove the rubble on Sunday afternoon. Operators are using cameras attached to the equipment as well as 6 fixed cameras at the site to carry out the work from hundreds of meters away. A lead-covered mobile operating room will be used to remove debris from places that cannot be reached by radio waves. TEPCO says the rubble will be put into containers and stored at the plant under strict supervision, as it may be contaminated with high levels of radiation.

Sunday, April 10, 2011 18:40 +0900 (JST)

**●Fukushima prefecture to measure radiation levels**

Fukushima Prefecture has decided to measure radiation levels at 2,700 locations and disclose the data amid growing concern about radioactive contamination. Many residents have demanded information on the radiation levels in their communities following the radiation leaks from the Fukushima Daiichi nuclear plant.

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**April 10, 2011 Update – Unit 1 Water Addition**

If you do not want to receive this email any longer, please reply to and ask to be removed.

Please note that I am moving most of my discussions concerning "Battle to stabilize earthquake reactors" to my Blog site at <http://josephmiller.typepad.com/>

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**Latest in on Japanese Nuclear Accidents**

**The current situation by Joe Miller (Remember much of this is speculation based on the information that I have and experience)**

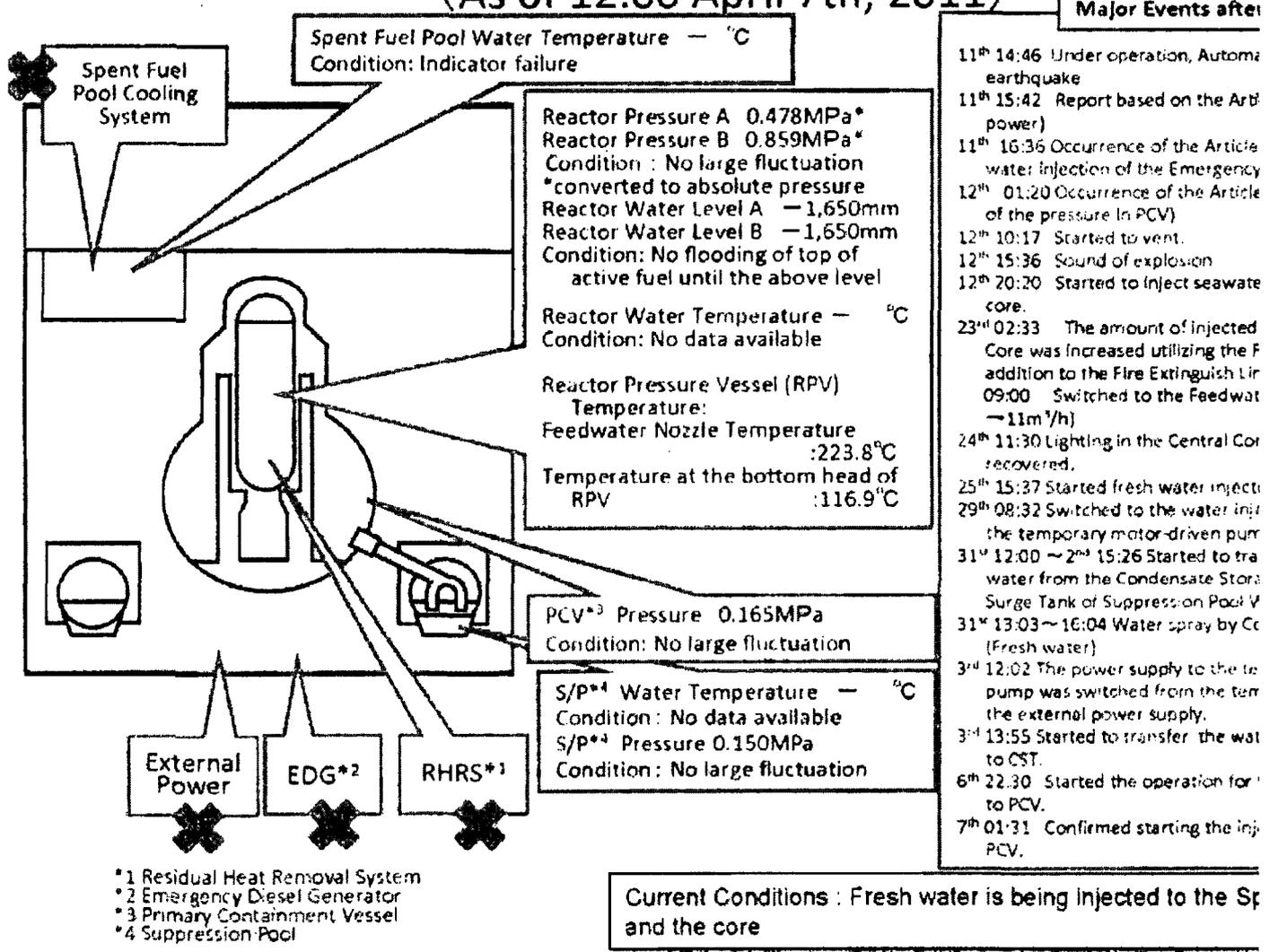
Unit 1 is still very serious, although it may have been saved by the injection of water through the feedwater line on March 23<sup>rd</sup>. A summary of each of the 4 reactors are presented below. Figure 1a shows the complete summary for Unit 1. It is apparent from the Fig 1b, that the Unit 1 reactor dried out quickly and was voided of water about mid-day of March 12. From midday of March 12 until March 23 there was very little water in the reactor vessel, although they were injecting sea water into the core, I guess it was a very low rate. From Fig 1a, it was noted that the feedwater line was used to injection firewater on March 25. Fig 1b shows that injection by a large increase in reactor pressure and drywell pressure. The pressure in the reactor peaks at about 425 kPa (61 psi) after increasing for 2 days , declines by leaking to the drywell. The drywell pressure peak at about 300 kPa ( 43 psi ). The design pressure of the drywell is 56 psid. Prior to injecting feedwater, the pressure in Unit 1 was about 200 kPa ( 29 psi), which is significantly below operating of about 1040 psia. Since the drywell pressure is lagging the reactor pressure increase, I would guess that the reactor pressure vessel is still intact although it may be leaking.. If the reactor vessel had failed, the drywell pressure would be the same as the reactor pressure. I have provided summaries of Units 2, 3 & 4 on Figs 1c, 1d & 1e, respectively.

Looks like spent fuel pools are under water and relatively stable. Expect a significant amount of damage to Unit 4 SFP.

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# Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 1 (As of 12:00 April 7th, 2011)



**Fig 1a Unit 1 Summary to April 7**

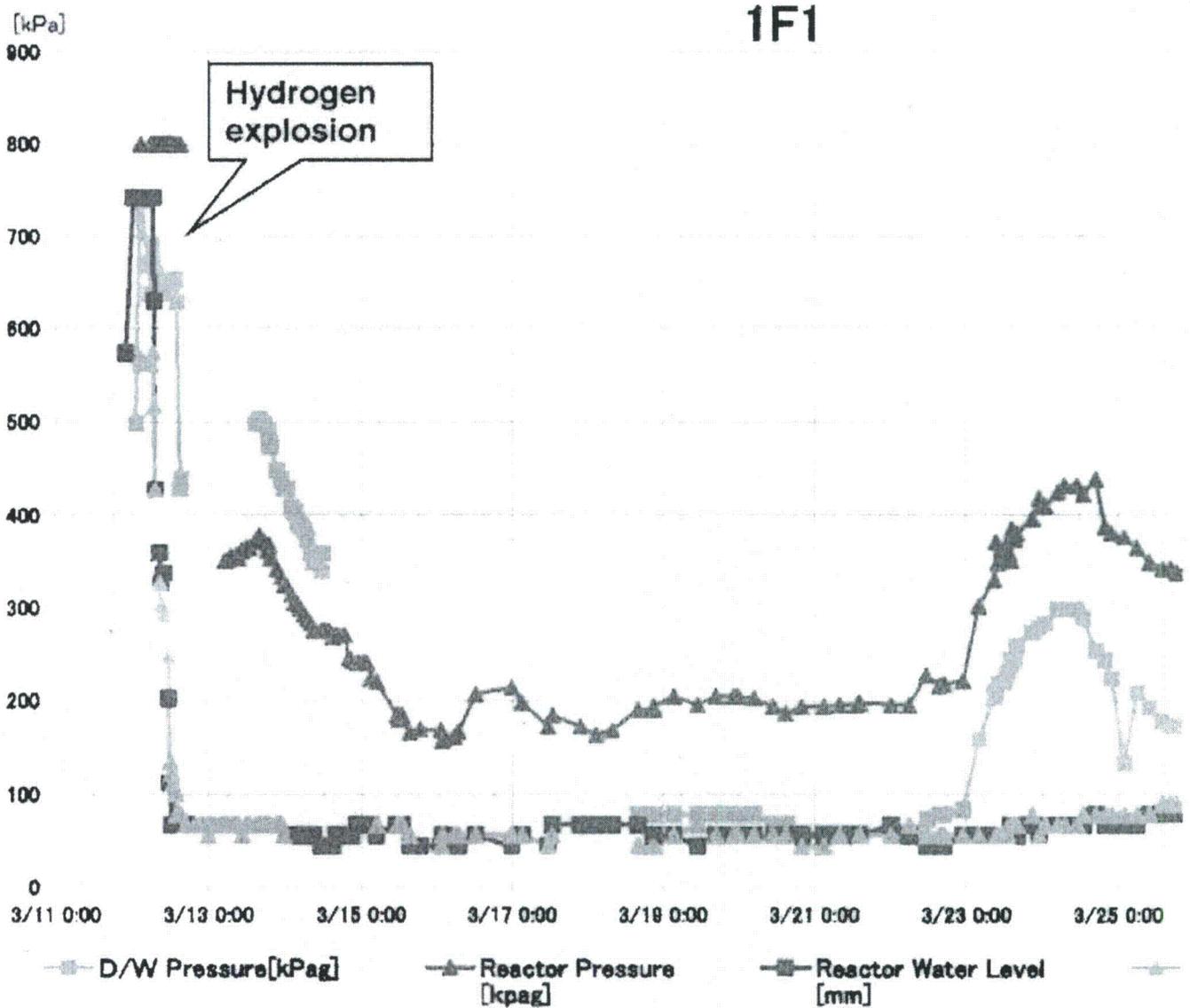
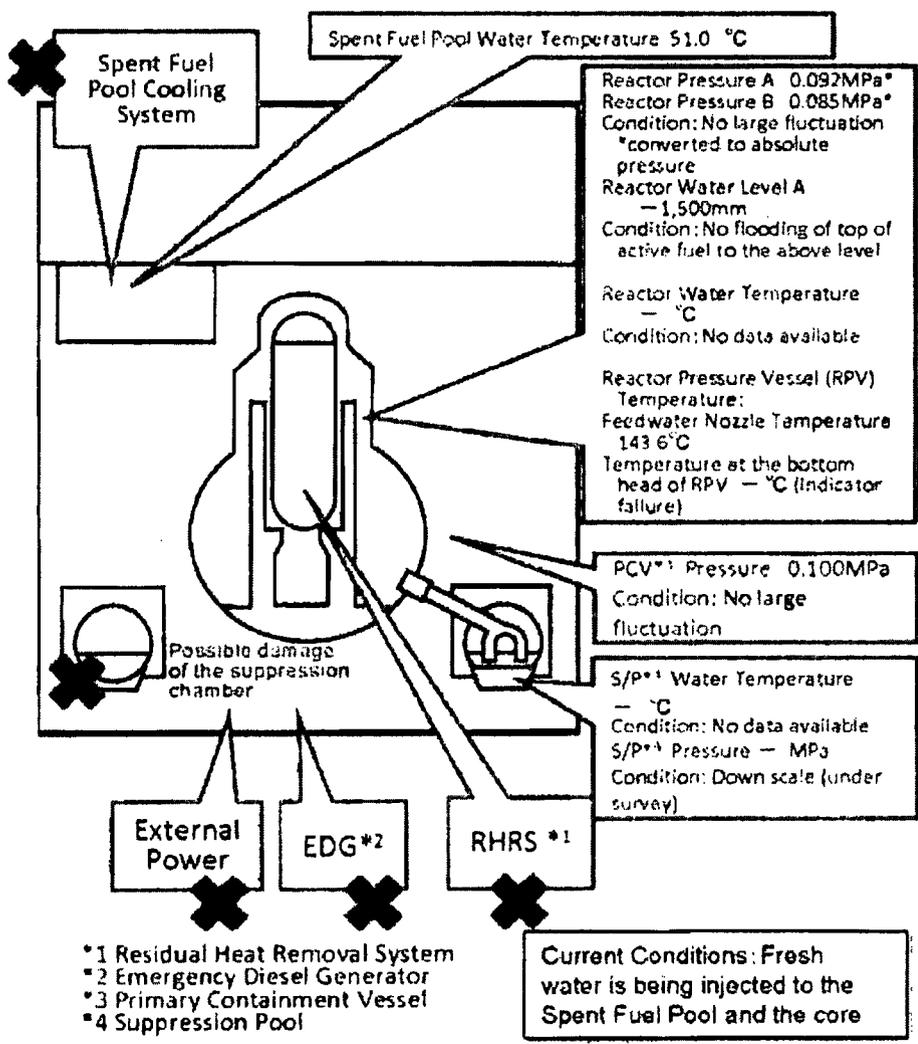


Fig 1b Unit 1 Drywell and Reactor Pressure and Reactor Water Level

# Conditions of Fukushima Dai-ichi Nuclear Power Station Unit ( As of 12:00 April 7th, 2011 )

## Major Events after the earth



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

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

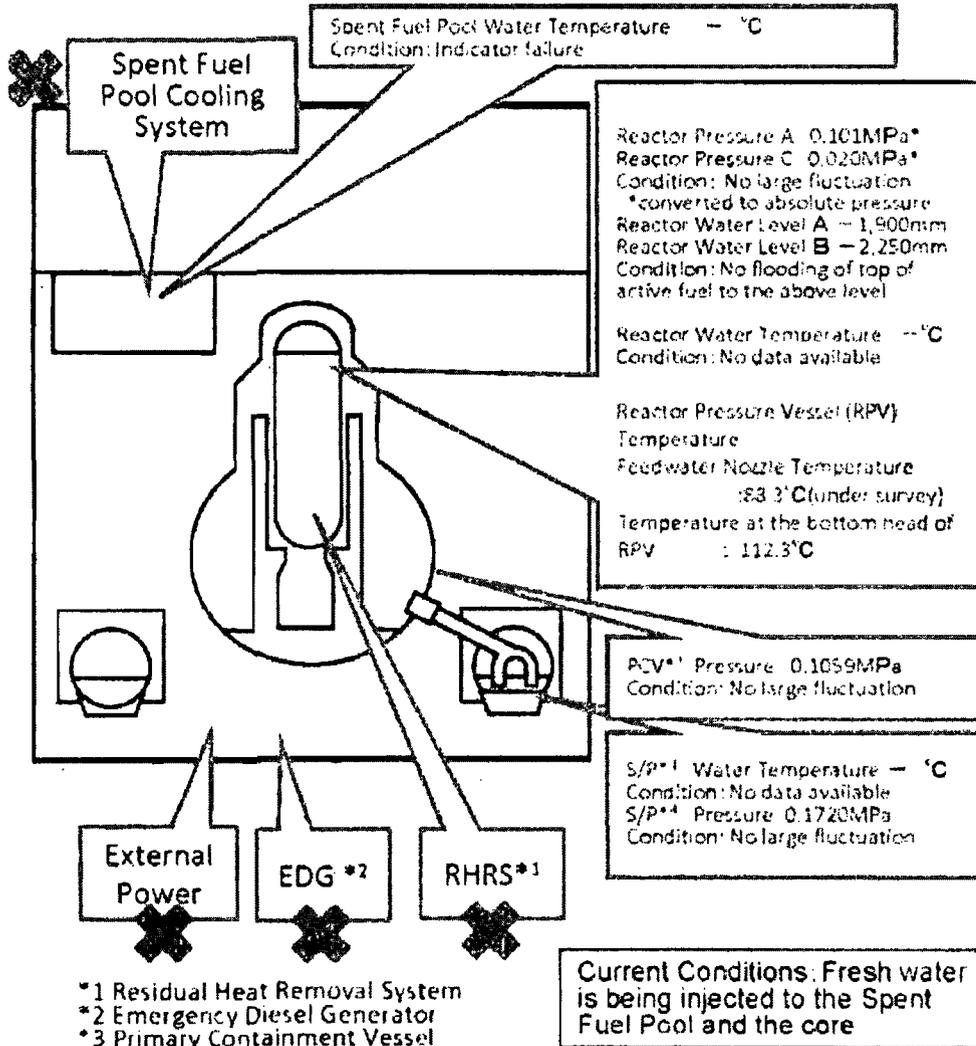
|     |                |                                                                                                                                                                                                  |
|-----|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11' | 14:46          | Under operation, Automatic shutdown by the earth                                                                                                                                                 |
| 11' | 15:42          | Report based on the Article 10 (Total loss of A/C power)                                                                                                                                         |
| 11' | 16:36          | Occurrence of the Article 15 event (Inability of water Core Cooling System)                                                                                                                      |
| 13' | 21:00          | Started to vent.                                                                                                                                                                                 |
| 14' | 13:25          | Occurrence of the Article 15 event (Loss of reactor)                                                                                                                                             |
| 14' | 16:34          | Started to inject seawater to the Reactor Core                                                                                                                                                   |
| 14' | 22:50          | Occurrence of the Article 15 event (Unusual rise of)                                                                                                                                             |
| 15' | 00:02          | Started to vent.                                                                                                                                                                                 |
| 15' | 06:10          | Sound of explosion                                                                                                                                                                               |
| 15' | around 06:20   | Possible damage of the suppression chamber                                                                                                                                                       |
| 20' | 15:05~17:20    | Approximately 40 ton seawater injection to the Fuel Pool Cooling Line (FPC)                                                                                                                      |
| 20' | 15:46          | Power Center received electricity                                                                                                                                                                |
| 21' | 18:22          | White smoke generated. The smoke died down at March 22'                                                                                                                                          |
| 22' | 16:07          | Injection of around 18 tons of seawater to SFP                                                                                                                                                   |
| 25' | 10:30~12:19    | Sea water injection to SFP via FPC                                                                                                                                                               |
| 26' | 10:10          | Started to inject fresh water to the Reactor Core.                                                                                                                                               |
| 26' | 15:46          | Lighting in the Central Control Room was recovered                                                                                                                                               |
| 27' | 19:31          | Switched to the water injection to the core using temporary pump.                                                                                                                                |
| 29' | 16:30~19:25    | Switched to the temporary motor-driven pump SFP                                                                                                                                                  |
| 29' | 16:45~17:11:50 | Transferred the water from the Condenser to the Surge Tank of Suppression Pool Water (SPW)                                                                                                       |
| 30' | 9:25~23:50     | Confirmed malfunction of the temporary motor-driven pump (fresh water to SFP) (9:45). Switched to the injection using suspended as cracks were confirmed in the hose (12:47 fresh water) (19:05) |
| 1'  | 16:56~17:05    | Injection of fresh water from FPC to SFP using driven pump.                                                                                                                                      |
| 2'  | around 9:30    | The water, of which the dose rate was at the 1,000mSv/h, was confirmed to be collected in the pit located at Unit 2. The outflow from the lateral surface of the pit is confirmed.               |
| 2'  | 17:10          | Started to transfer the water from the condenser tank (CST)                                                                                                                                      |
| 2'  | 12:12          | The power supply to the temporary motor-driven pump temporary power supply to the external power supply.                                                                                         |
| 3'  | 13:47~14:30:20 | bags of sand/dust, 80 bags of high polymer cutting-processed newspaper were put into the Pit for the                                                                                             |
| 4'  | 7:08~7:11      | Approximately 15kg of tracer (bath agent) was Duct for Seawater Pipe.                                                                                                                            |
| 4'  | 11:05~13:37    | Injection of fresh water from FPC to SFP using driven pump.                                                                                                                                      |
| 5'  | 16:15          | Tracer is confirmed to outflow through the permeable the sea.                                                                                                                                    |
|     | 15:07          | Started to inject coagulant                                                                                                                                                                      |
| 6'  | around 5:38    | The water outflow from the lateral surface of stopped.                                                                                                                                           |
| 7'  | 13:29~14:34    | fresh water injection to SFP via FPC (approx.                                                                                                                                                    |

Fig 1c Unit 2 Summary

# Conditions of Fukushima Dai-ichi Nuclear Power Station

( As of 12:00 April 7th, 2011 )

## Major Events after the



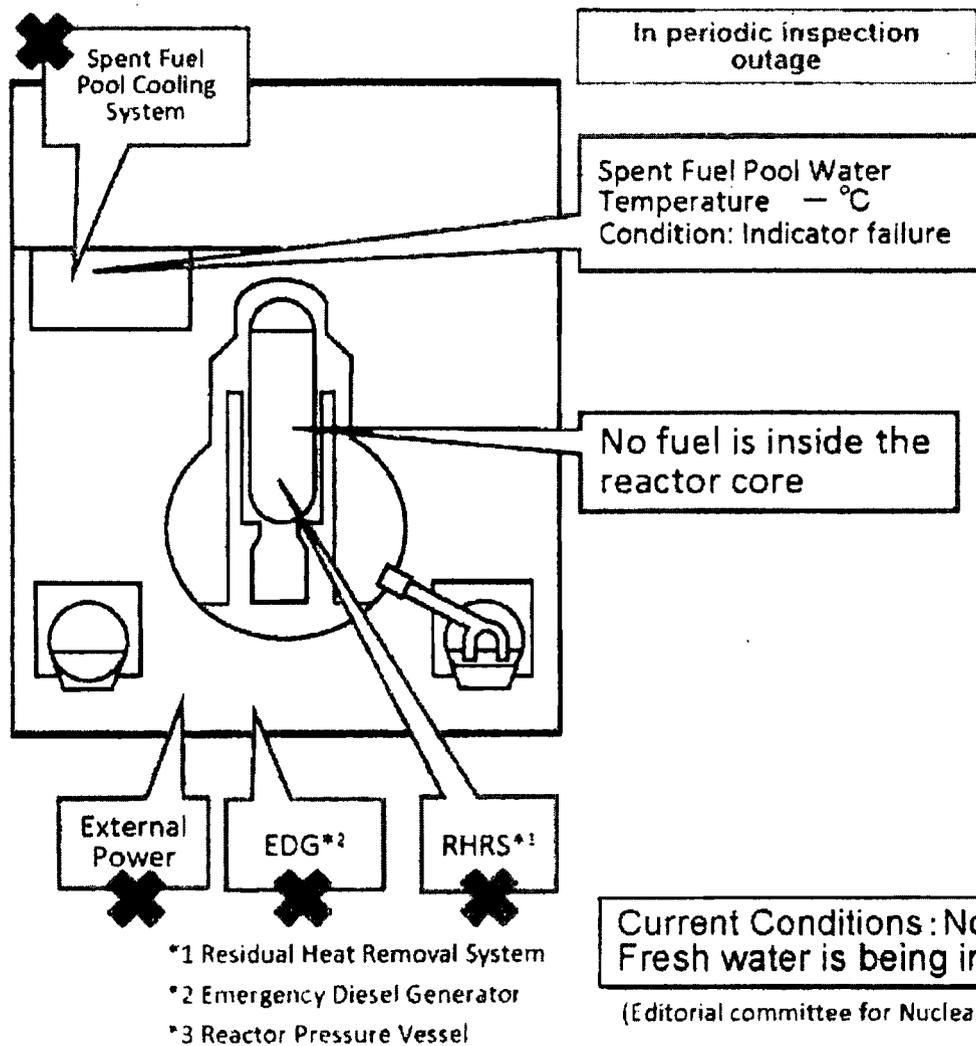
- 11<sup>h</sup> 14:46 Under operation. Automatic shutdown
- 11<sup>h</sup> 15:42 Report based on the Article 10 (To
- 13<sup>h</sup> 05:10 Occurrence of the Article 15 event of the Emergency Core Cooling System)
- 13<sup>h</sup> 08:41 Started to vent.
- 13<sup>h</sup> 13:12 Started to inject seawater and bor
- 14<sup>h</sup> 05:20 Started to vent
- 14<sup>h</sup> 07:44 Occurrence of the Article 15 event (pressure in PCV)
- 14<sup>h</sup> 11:01 Sound of explosion
- 16<sup>h</sup> around 08:30 White smoke generated.
- 17<sup>h</sup> 09:48 ~ 10:01 Water discharge by the he Force
- 17<sup>h</sup> 19:05 ~ 19:15 Water spray from the grou cannon truck of Police
- 17<sup>h</sup> 19:35 ~ 20:09 Water spray from the grou Defense Force
- 18<sup>h</sup> before 14:00 ~ 14:38 Water spray from of Self-Defense Force
- 18<sup>h</sup> ~ 14:45 Water spray from the ground by Military
- 19<sup>h</sup> 00:30 ~ 01:10 Water spray by Hyper Res Department
- 19<sup>h</sup> 14:10 ~ 20<sup>h</sup> 03:40 Water spray by Hyper Department
- 20<sup>h</sup> 11:00 Pressure of PCV rose (320kPa) After
- 20<sup>h</sup> 21:36 ~ 21<sup>h</sup> 03:58 Water spray by Hyper Department
- 21<sup>h</sup> around 15:55 Grayish smoke generated died down at 17:55.
- 22<sup>h</sup> 15:10 ~ 16:00 Water spray by Hyper Res Department and Osaka City Fire Bureau
- 22<sup>h</sup> 22:46 Lighting in the Central Control Room
- 23<sup>h</sup> 11:03 ~ 12:20 Injection of about 35ton of Pool (SFP) via the Fuel Pool Cooling Line (F)
- 23<sup>h</sup> around 16:20 Black smoke generated at down at around 23:30 and 24<sup>h</sup> 04:50.
- 24<sup>h</sup> 05:35 ~ 16:05 Approximately 120 ton per FPC
- 25<sup>h</sup> 13:28 ~ 16:00 Water spray by Kawasaki C Tokyo Fire Department
- 25<sup>h</sup> 18:02 Started fresh water injection to the
- 27<sup>h</sup> 12:34 ~ 14:36 Water spray by Concrete P
- 28<sup>h</sup> 17:40 ~ 21<sup>h</sup> around 8:40 Transferring the Storage Tank (CST) to the Surge Tank of Sur
- 28<sup>h</sup> 20:30 Switched to the water injection to 1 motor-driven pump.
- 29<sup>h</sup> 14:17 ~ 18:18, 31<sup>h</sup> 16:30 ~ 19:33, 2<sup>h</sup> 09: Water spray by Concrete Pump Truck (fresh
- 3<sup>h</sup> 12:18 The power supply to the temporary switched from the temporary power supply
- 7<sup>h</sup> 08:53 ~ 08:53 Water spray by Concrete ( Around 70 ton)

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

(Editorial committee for Nuclear Energy Handbook, Nuclear E)

Fig 1d Unit 3 Summary

# Conditions of Fukushima Dai-ichi Nuclear Power Station ( As of 12:00 April 7th, 2011 )



## Major events aft earthquake

In periodic inspection outage w occurred

14<sup>th</sup> 04:08 Water temperature (SFP), 84°C

15<sup>th</sup> 06:14 Confirmed the partial 4<sup>th</sup> floor.

15<sup>th</sup> 09:38 Fire occurred in the extinguished)

16<sup>th</sup> 05:45 Fire occurred. TEPCO fire on the ground. (06:15)

20<sup>th</sup> 08:21~09:40 Water spray Defense Force

20<sup>th</sup> around 18:30~19:46 Water Self-Defense Force

21<sup>st</sup> 06:37~08:41 Water spray Defense Force

21<sup>st</sup> around 15:00 Work for laying Center was completed.

22<sup>nd</sup> 10:35 Power Center received

22<sup>nd</sup> 17:17~20:32, 23<sup>rd</sup> 10:00~17:30, 25<sup>th</sup> 19:05~22:07, 27<sup>th</sup> Water spray by Concrete Pump

25<sup>th</sup> 06:05~10:20 Sea water injected Fuel Pool Cooling Line (FPC)

29<sup>th</sup> 11:50 Lighting in the Center recovered.

30<sup>th</sup> 14:04~18:33, 1<sup>st</sup> 8:28~15<sup>th</sup> 17:35~18:22 Water spray by Concrete Pump

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

(Editorial committee for Nuclear Energy Handbook, Nuclear Energy)

**Fig 1e Unit 4 Summary**

## Radiation Levels

Radiation levels continue to decrease on site by JAIF (some local hot spots are still very high)

- Radiation level: 0.62mSv/h at the south side of the office building, 86µSv/h at the Main gate, 37µSv/h at the West gate, as of 07:00, Apr. 10th
- Radiation level: 0.62mSv/h at the south side of the office building, 86µSv/h at the Main gate, 38µSv/h at the West gate, as of 15:00, Apr. 9th
- Radiation level: 0.65mSv/h at the south side of the office building, 94µSv/h at the Main gate, 40µSv/h at the West gate, as of 15:00, Apr. 8th
- Radiation level: 0.67mSv/h at the south side of the office building, 43µSv/h at the West gate, as of 15:00, Apr. 7th

- Radiation level 0.69mSv/h at the south side of the office building, 47µSv/h at the West gate, as of 15:00, Apr. 6th, 108µSv/h at the Main gate, as of 10:00, Apr. 6th
- Radiation level: 0.78mSv/h at the south side of the office building, 121µSv/h at the Main gate, 55µSv/h at the West gate, as of 09:00, Apr. 4rd.
- Radiation level: 0.83mSv/h at the south side of the office building, 127µSv/h at the Main gate, 59µSv/h at the West gate, as of 09:00, Apr. 3rd.
- Radiation level: 0.91mSv/h at the south side of the office building, 144µSv/h at the Main gate, 65µSv/h at the West gate, as of 15:00, Apr. 1<sup>st</sup>
- Radiation level: 1.00mSv/h at the south side of the office building, 156µSv/h at the Main gate, 72µSv/h at the West gate, as of 21:00, Mar. 30<sup>th</sup>
- Radiation level: 132.5µSv/h at the West gate at 16:00, Mar. 27

A good discussion about radiation <http://www.bbc.co.uk/news/world-12860842>

## Radiation Definitions

- 1 Sv = 1000 mSv (millisieverts) = 1,000,000 µSv (microsieverts) = 100 rem = 100,000 mrem (millirem)
- The effective dose limit for Nuclear Energy Workers, as prescribed by the CNSC, is 100 mSv (10,000 mrem) (100,000 µSv) for 5 years (with a maximum of 50 mSv (50,000 µSv) in any given year or an average of 20 mSv/yr for 5 years) for whole-body exposure.

## Other summaries from JAIF (See summaries attached)

### ●15-meter waves hit Fukushima

The operator of the troubled Fukushima Daiichi nuclear power plant says the facility was hit by a tsunami as high as 15 meters on March 11th.

Tokyo Electric Power Company was reporting on Saturday on its survey of highwater marks left on the plant's buildings.

It says it found that the tsunami reached up to 15 meters on the ocean side of the reactor and turbine buildings. The figure is far beyond the company's originally estimated height of 5.7 meters.

TEPCO confirmed that the 6 reactors at Fukushima Daiichi power plant had been under as much as 5 meters of water.

Saturday, April 09, 2011 22:09 +0900 (JST)

### ●Nuclear safety review

Japan's Nuclear and Industrial Safety Agency says the safety measures for nuclear plants compiled before the problem at the Fukushima Daiichi facility are not sufficient.

Senior agency official Hidehiko Nishiyama spoke to reporters on Saturday. He said he thought nuclear power plants across Japan were completely safe because they included multiple layers of protection systems.

But he said it is necessary to re-examine safety protocols beyond the regulations formulated in the past and to review the measures based on what happened to the nuclear power plants in the quake-hit areas.

The reactors at the Fukushima plant lost their emergency generators as well as their external power supply after the March 11th earthquake and tsunami.

Plant operator Tokyo Electric Power Company has not yet restored the reactors' cooling systems.

Thursday's major aftershock disabled all outside power lines at Higashidori nuclear power plant in Aomori Prefecture.

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## April 9, 2011 Update –

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## Latest in on Japanese Nuclear Accidents

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**The current situation by Joe Miller (Remember much of this is speculation based on the information that I have and experience)**

Not too much to report today. It seems like they make progress every day, Unit 1 is still very serious. Looks like spent fuel pools are under water and relatively stable. Expect a significant amount of damage to Unit 4 SFP.

No abnormality were found in the plants after an earthquake (7.4 R) occurred off the shore of Miyagi prefecture at 23:32, Apr. 7th.

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## Other summaries from JAIF (See summaries attached)

### ●TEPCO: Aftershock did not affect Fukushima efforts

The operator of the crippled Fukushima Daiichi nuclear power plant in northeastern Japan says the strong earthquake on Thursday night has not hampered the ongoing work to restore reactor cooling systems at the plant. The powerful tremor was one of the largest since the devastating quake on March 11th. Tokyo Electric Power Company evacuated all staff from the plant after an intensity 5-minus on the Japanese scale of 0 to 7 was registered in Futaba Town, where the plant is located, and a tsunami evacuation advisory was issued. TEPCO says no new irregularities have been detected in radiation readings or other indicators, except for the surface temperature of the No. 1 reactor. Before the quake, that reading stood at 223 degrees Celsius at 7 PM on Thursday. Just after the tremor, it rose to about 260 degrees at midnight -- up nearly 40 degrees -- but fell back to 246 degrees at 1 PM on Friday. The government's nuclear safety agency says the sudden rise in temperature cannot be explained at the moment, but that it will continue close monitoring. TEPCO continued operations to pump water into No.1, No. 2 and No. 3 reactors, as well as work to inject nitrogen into the containment vessel of the No. 1 reactor to prevent a possible hydrogen explosion. The company says the pressure inside the vessel rose by 0.35 compared to the reading before the nitrogen injection, suggesting the work is going as planned. TEPCO also says there have been no fresh leaks of highly contaminated water into the sea from a pit near the No. 2 reactor. Leakage from the concrete pit stopped on Wednesday after workers injected a hardening agent beneath it. The operator also continued discharging water contaminated with relatively lower-level radiation into the sea from a storage facility. Some 7,400 of the 8,500 tons of contaminated water had been released by Thursday.

### ●US nuclear unit drill

The US military has demonstrated to the public drills by a special unit dispatched to deal with the troubled Fukushima Daiichi nuclear power plant. About 150 members of the unit, which specializes in dealing with the effects of nuclear-related disasters, carried out the drills at Yokota Air Base in Tokyo on Saturday. In an exercise to rescue people trapped in a building, members wearing protective gear first carefully carried out procedures to measure radiation levels. In a tent set up near the building, radioactive materials were washed off the rescued people, and doctors performed physical examinations. The drill included rescuing people trapped in a car, and a surveillance robot was

unveiled that can operate in hazardous environments. In preparation for a joint operation, the special unit confirmed various procedures with its Self-Defense Force counterpart, including ways to wash off nuclear contamination. The unit's commander says his team is working day and night along with the Self-Defense Forces to utilize their abilities to the fullest, and that their morale is high. The United States has also dispatched experts to help the Japanese government bring the situation under control at the Fukushima Daiichi nuclear power plant.

Saturday, April 09, 2011 16:42 +0900 (JST)

●TEPCO steps up effort to remove contaminated water

The operator of the damaged Fukushima Daiichi nuclear power plant has stepped up its effort to remove highly radioactive water that is hampering restoration of reactor cooling systems. Tokyo Electric Power Company says contaminated water in a concrete tunnel of the Number 2 reactor has risen 10 centimeters since leakage of the water into the ocean stopped on Wednesday. The company says the gap between the surface of the waste water and the top of the tunnel was 94 centimeters as of 7 AM on Saturday. It denies any possibility that the water could overflow from the tunnel. The source of the contaminated water has not been identified.

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## April 8, 2011 Update – Unit 1 and Unit 4 SFP

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A good discussion about radiation <http://www.bbc.co.uk/news/world-12860842>

## Radiation Definitions

- 1 Sv = 1000 mSv (millisieverts) = 1,000,000  $\mu$ Sv (microsieverts) = 100 rem = 100,000 mrem (millirem)
- The effective dose limit for Nuclear Energy Workers, as prescribed by the CNSC, is 100 mSv (10,000 mrem) (100,000  $\mu$ Sv) for 5 years (with a maximum of 50 mSv (50,000  $\mu$ Sv) in any given year or an average of 20 mSv/yr for 5 years) for whole-body exposure.

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### **The current situation by Joe Miller (Remember much of this is speculation based on the information that I have and experience)**

The NISA released a report explaining why it was necessary to pump nitrogen into the Unit 1 containment (See attached report). I think this would be OK as long as it used to keep a positive pressure in the primary containment. This would ensure that air does not leak back into the primary containment and would not pressurize primary containment. I still don't understand why they haven't fill the primary containment with water. This would be the surest way to cool the reactor pressure vessel so it will not fail.

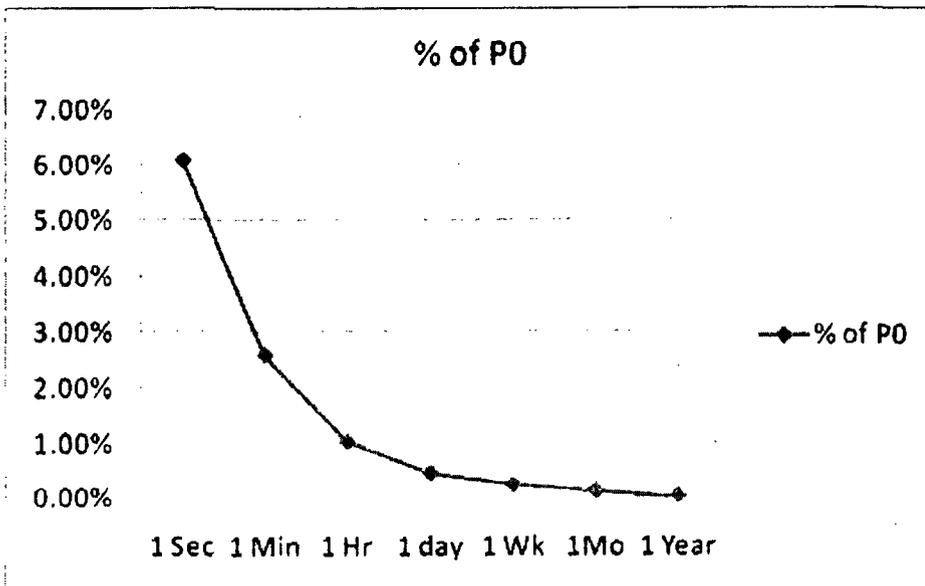
Thursday's quake causes slight damages Onagawa nuclear plant. Tohoku Electric Power Company says Thursday night's strong earthquake caused water to overflow from spent fuel storage pools at one of its nuclear power plants. I suspect that the other plants are so upset at the lost of cooling for the spent fuel pools, that they are filling them as high as possible. These small aftershocks are also causing off site power to be lost. The utility also found water leaks at 5 locations in the plant, including inside buildings housing the reactors. This doesn't seem very significant, although loss of offsite power is!

Work to get Fukushima plant under control goes on even after quake. Work to restore reactor cooling systems at the Fukushima Daiichi nuclear power plant will continue on Friday following a strong earthquake overnight. The magnitude 7.4 tremor was one of the largest since the devastating quake on March 11th. 7.4 – no big deal anymore!!!

As we have suggested before, Unit 1 reactor is in the most serious condition. NHK reported that inside the No. 1 reactor dropped to 45 centimeters above the fuel rods, or about one-tenth the normal level, nearly 7 hours after the March 11th earthquake and tsunami. The fuel rods become exposed 11 hours later. Water levels in the No. 2 and No. 3 reactors were kept at around 4 meters through the use of emergency generators despite the power outages. It was a day and a half to 3 days before their fuel rods were exposed. This means that the emergency diesel generation Units 2 & 3 worked for at least day and a half before they failed. It does sound like the emergency diesel generators (EDGs) for each unit were exposed to different situations that caused their failure. We were told early that the diesel fuel was lost and the inlets to the RHRS were blocked so it seems that the cause for failure at each Unit may be different.

Back to Unit 4 spent fuel pool. I found an old analysis that we did at River Bend Station (RBS) (See report at [http://www.josephsmiller.com/Papers/postulated\\_effects\\_spent\\_fuel0001.pdf](http://www.josephsmiller.com/Papers/postulated_effects_spent_fuel0001.pdf)). RBS is a

BWR6 with 624 fuel assemblies (fairly closer to the Unit 4's 548 fuel assemblies except Unit 4 is a BWR4). The initial decay heat load used for this model was 30 MBtu/hr, which is 7500 kcal/hr. This represents a full core off load as you take it out of the core. (the projected decay heat is shown in the Figure below) The BWR6 is different from a BWR4, since the BWR6 has a transfer tube that brings the fuel up from the service floor. In the BWR6 there are two pools adjacent to the spent fuel pool. These are connected by the transfer canal. The decay heat load in the model changed in accordance to the ANS decay heat. As shown in the Figure below, the heat load would reduce significantly in the first hour and would be in the range of the decay heat load of 1,600 kcal/hr given for the heat load of Unit 4. The BWR6 pool probably has more water in it because of the adjacent pools. It is interesting to note that the RBS model showed boiling in about 10 hours and the exposure of the top of the rack at about 96 hours where as the hydrogen fire/explosion occurred in Unit 4 Reactor Building in about 87 hours and 14 minutes. This means that the top of the fuel was exposed in about 77 hours and I assume it took about 10 hours to expose the top part of the core, which allowed a dryout condition in the fuel and hydrogen was being created from the Zr-Water reactions. This hydrogen escaped into the reactor building and eventually burned/explored at 87 hours. So, I would say that the figure below is fairly accurate except that more water was available in the BWR6 pool which allowed it more time before hydrogen would be created. (80 hours is a long time to ignore a spent fuel pool that had a full core off load in it)



Spent Fuel Pool (Elevation Views)

Figure 2.

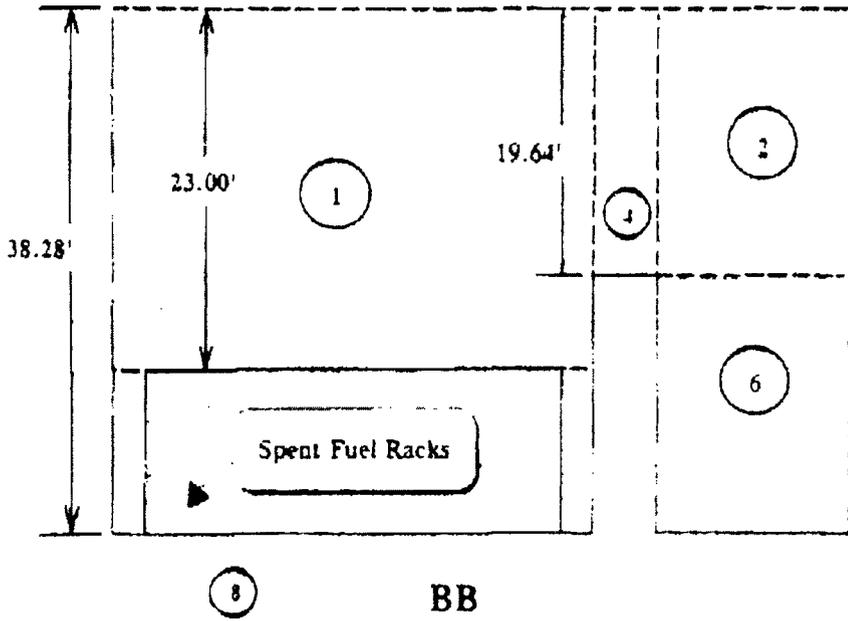
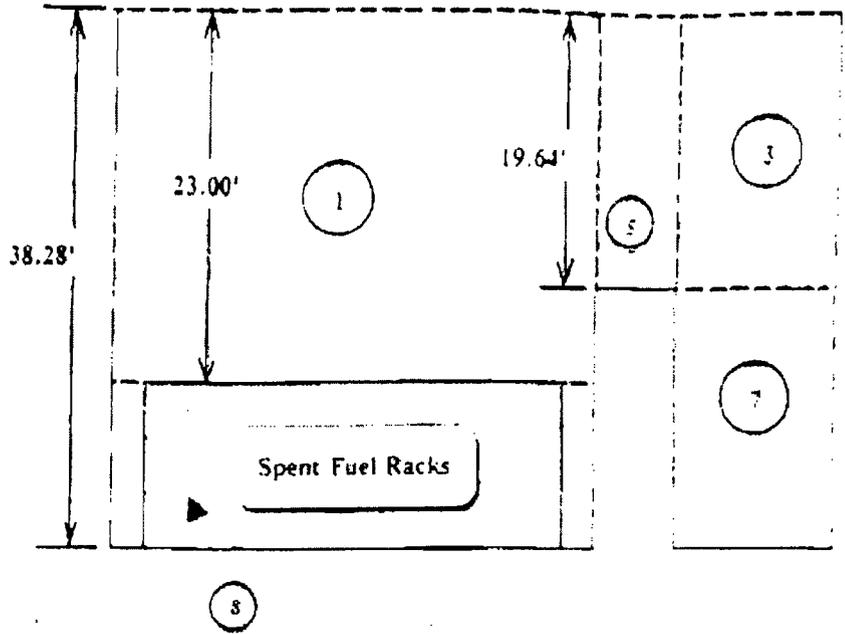
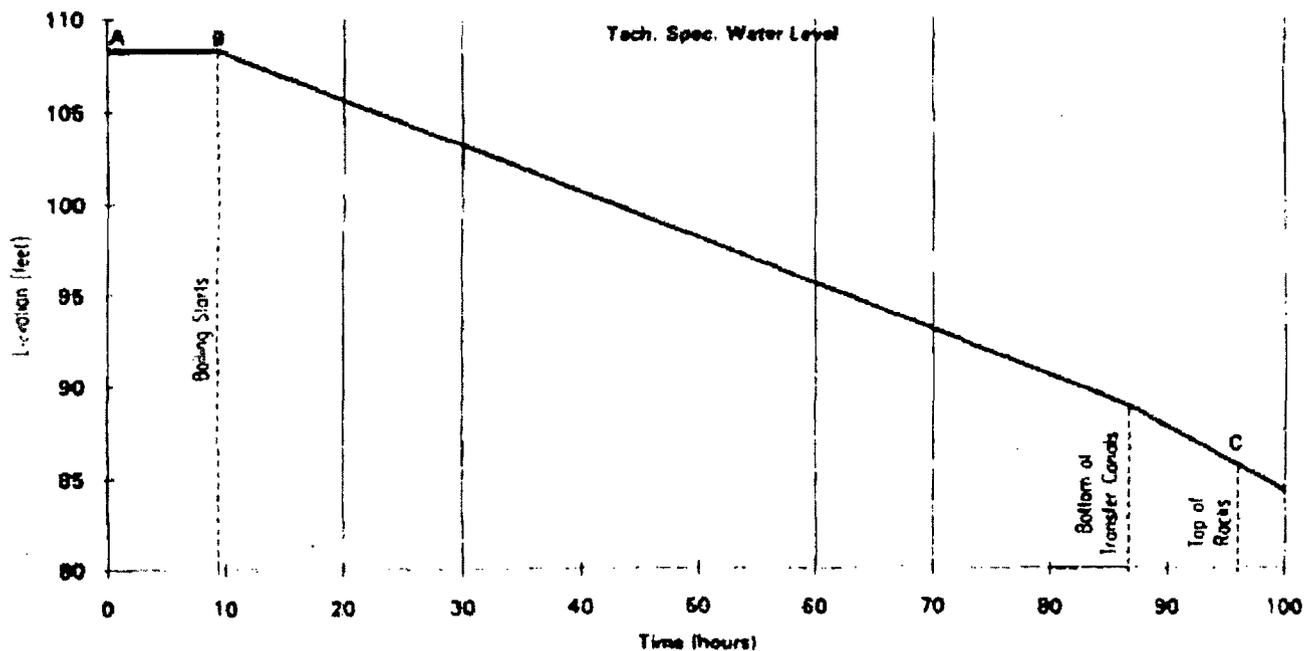


Figure 6

**Spent Fuel Pool Water Level After Loss of Cooling**



**Other summaries from JAIF (See summaries attached)**

**•Aftershock batters nuclear plants**

Nuclear power plants and related facilities in the coastal areas of northeastern Japan were forced to rely on emergency power after their electricity was cut off in Thursday night's quake. Operations have been suspended at all nuclear power plants from Aomori to Ibaraki prefectures since the March 11th earthquake and tsunami. But electricity is still crucial to keep their cooling systems operating. Japan's nuclear agency says all external power lines at Higashidori nuclear power plant in Aomori Prefecture were knocked out in Thursday's quake. The plant switched to emergency diesel power generators for some hours, but power was later restored. The quake shut down 3 of the 4 external power lines at Onagawa nuclear power plant in Miyagi Prefecture. It is still operating on the one remaining power line. The Onagawa plant also suffered water leaks at 8 locations, including water that spilled from spent fuel storage pools at each of its 3 reactors. A device to control pressure inside a turbine building was also damaged. In addition, the quake disabled all external power lines at a nuclear fuel reprocessing plant in Aomori Prefecture. The cooling systems here are still running on emergency diesel power.

Friday, April 08, 2011 14:01 +0900 (JST)

**•Thursday's quake damages Onagawa nuclear plant**

Tohoku Electric Power Company says Thursday night's strong earthquake caused water to overflow from spent fuel storage pools at one of its nuclear power plants. The power company reported on Friday that water had spilled onto the floor at all 3 reactors at the Onagawa nuclear power plant in Miyagi Prefecture. The amount of water spilled was 3.8 liters at the most. The utility firm also found water leaks at 5 locations in the plant, including inside buildings housing the reactors. The company

added that blowout panels--devices designed to control pressure inside the buildings--were damaged at the turbine building of the Number 3 reactor. The newly reported problems add to the downing of 3 of 4 external power lines at the Onagawa plant. The plant is maintaining its cooling capabilities with the remaining power line. Tohoku Electric Power Company is continuing its efforts to determine the extent of the damage caused by the latest quake. But it says no change has yet been seen in radiation levels around the plant.

Friday, April 08, 2011 11:59 +0900 (JST)

**•No. 1 reactor lost cooling function on March 11**

Unreleased data obtained by NHK suggest that the failure to maintain the cooling functions of the No. 1 reactor at the troubled Fukushima Daiichi nuclear power plant possibly triggered a hydrogen explosion at an early stage. The data show that the water level inside the No. 1 reactor dropped to 45 centimeters above the fuel rods, or about one-tenth the normal level, nearly 7 hours after the March 11th earthquake and tsunami. The fuel rods become exposed 11 hours later. Water levels in the No. 2 and No. 3 reactors were kept at around 4 meters through the use of emergency generators despite the power outages. It was a day and a half to 3 days before their fuel rods were exposed. University of Tokyo Professor Naoto Sekimura says the loss of cooling functions at the No.1 reactor and the subsequent exposure of the fuel rods may have caused the hydrogen explosion as early as the next day. The plant's operator, Tokyo Electric Power Company, has so far only disclosed data from the day after the quake.

Friday, April 08, 2011 11:24 +0900 (JST)

**•Work to get Fukushima plant under control goes on**

Work to restore reactor cooling systems at the Fukushima Daiichi nuclear power plant will continue on Friday following a strong earthquake overnight. The magnitude 7.4 tremor was one of the largest since the devastating quake on March 11th. The plant operator, Tokyo Electric Power Company, says no new irregularities have been detected in radiation readings or the facilities. It says it will continue discharging lower-level radioactive water into the sea from a storage facility on Friday. The work is designed to make room for highly radioactive water that leaked into the basement of the turbine building next to the plant's No. 2 reactor and a concrete tunnel.

On Thursday, about 7,700 tons of lower-level radioactive water was released, and the remaining 300 tons will be discharged on Friday. TEPCO says the latest quake has not caused further leakage of contaminated water into the sea from a concrete pit outside the No. 2 reactor. The company says it will also continue work to inject nitrogen into the containment vessel of the No. 1 reactor to prevent a possible hydrogen explosion. Nearly half of the nuclear fuel rods in the reactor are feared to be exposed -- generating hydrogen that could explode if it reacts with oxygen.

Friday, April 08, 2011 11:09 +0900 (JST)

**•IAEA: "Early signs of recovery" at Fukushima plant**

The International Atomic Energy Agency says it has detected early signs of recovery at the crisis-stricken nuclear power plant in Japan. Speaking to reporters in Vienna on Thursday, IAEA deputy director general Denis Flory said there are early signs of recovery in some functions such as electrical power and instrumentation at the Fukushima Daiichi power station. But he added the overall situation remains very serious. Flory said 2 reactor experts from the IAEA visited the Fukushima plant on Wednesday. The experts inspected all reactors at the nuclear complex from outside and were briefed by officials in charge during their 5-hour stay. Flory said the IAEA will continue to carefully analyze the situation based on the information obtained through the visit as well as data provided by Japanese authorities.

Friday, April 08, 2011 09:14 +0900 (JST)

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**April 7, 2011 Update – Unit 1**

Please note that I am moving most of my discussions concerning "Battle to stabilize earthquake reactors" to my Blog site at <http://josephmiller.typepad.com/>

My LinkedIn at <http://www.linkedin.com/in/josephsmiller>

You can Tweet me at <http://twitter.com/#!/jmeda>

**If you are interested in keeping up with these discussions, please go to the blog site and sign up as a follower. That way when I issue a new blog, you will be notified. I will probably discontinue this email delivery in the next 1 days so if you can't do the blog follow, just let me know and I will continue to send you these emails.**

## **Latest in on Japanese Nuclear Accidents**

Radiation levels continue to decrease on site by JAIF

- Radiation level: 0.67mSv/h at the south side of the office building, 43 $\mu$ Sv/h at the West gate, as of 15:00, Apr. 7th, 108 $\mu$ Sv/h at the Main gate, as of 10:00, Apr. 6th.
- Radiation level 0.69mSv/h at the south side of the office building, 47 $\mu$ Sv/h at the West gate, as of 15:00, Apr. 6th, 108 $\mu$ Sv/h at the Main gate, as of 10:00, Apr. 6th
- Radiation level: 0.78mSv/h at the south side of the office building, 121 $\mu$ Sv/h at the Main gate, 55 $\mu$ Sv/h at the West gate, as of 09:00, Apr. 4rd.
- Radiation level: 0.83mSv/h at the south side of the office building, 127 $\mu$ Sv/h at the Main gate, 59 $\mu$ Sv/h at the West gate, as of 09:00, Apr. 3rd.
- Radiation level: 0.91mSv/h at the south side of the office building, 144 $\mu$ Sv/h at the Main gate, 65 $\mu$ Sv/h at the West gate, as of 15:00, Apr. 1<sup>st</sup>
- Radiation level: 1.00mSv/h at the south side of the office building, 156 $\mu$ Sv/h at the Main gate, 72 $\mu$ Sv/h at the West gate, as of 21:00, Mar. 30<sup>th</sup>
- Radiation level: 132.5 $\mu$ Sv/h at the West gate at 16:00, Mar. 27

A good discussion about radiation <http://www.bbc.co.uk/news/world-12860842>

### **Radiation Definitions**

- 1 Sv = 1000 mSv (millisieverts) = 1,000,000  $\mu$ Sv (microsieverts) = 100 rem = 100,000 mrem (millirem)
- The effective dose limit for Nuclear Energy Workers, as prescribed by the CNSC, is 100 mSv (10,000 mrem) (100,000  $\mu$ Sv) for 5 years (with a maximum of 50 mSv (50,000  $\mu$ Sv) in any given year or an average of 20 mSv/yr for 5 years) for whole-body exposure.

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### **The current situation by Joe Miller (Remember much of this is speculation based on the information that I have and experience)**

I still believe that the situation is extremely critical in Unit 1 and a little less in Units 2 & 3. I think the fuel in Units 4 & 3 spent fuel pools is probably damaged, but it appears that water is in the pools covering the fuel now so they should remain cool. The water level in Unit 1 reactor appears to be below top of active fuel (although I don't know about the reliability of the measurement). I suspect that the core has melted somewhat and slumped toward the lower plenum of the reactor. This molten mass may be constrained by part of core structure and unmelted fuel in the lower part of the core, and it may be cooled by water in the lower part of the reactor core and vessel. We do not know the true state based on the data. If this core keeps getting hotter, it will eventually fail the reactor vessel and challenge the primary containment.. If this happens, and they significant water in the

containment, then the hot mass should cool down. If the drywell is void of water, the molten mass will continue to get hotter and start interacting with the concrete in the bottom of the drywell.

I am not too sure about the effectiveness of the nitrogen injection into the primary containment of unit 1. I know initially, steam vacated all air through the venting process so during that time, there was very little air left in the reactor vessel or primary containment. Now if they believe air came back into the containment (which I don't know how), then there may be a chance of getting enough air in the containment to cause a hydrogen -air burn or explosion, but for this to happen you would need an ignition sources. Everything is really wet in the containment with steam and water so ignition sources are hard to come by. I know a flammable mixture hydrogen and air can ignite spontaneously when expose to a large pressure change, but I don't see this happening. I believe they should concentrate on filling all three primary containments with water ASAP. This will provide outside cooling to the reactor vessel and probably prevent a collapse pressure vessel due to overheating. The hydrogen explosions in the reactor building were different. There was a significant amount of air available for the hydrogen and air mixture to reach flammable and explosive levels.

**A great summary of the events is provided in attachment above (Review of experiments and Assessment of... compliments of Rom Duffey from NISA reports at website and presented at IAEA yesterday)**

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## **Other summaries from JAIF (See summaries attached)**

### **●TEPCO: Nitrogen injection going well**

The operator of the crippled Fukushima Daiichi nuclear power plant says it continues to inject nitrogen gas into the containment vessel of the No.1 reactor without problems. The nitrogen gas is being used to prevent a hydrogen blast at the reactor. The Tokyo Electric Power Company, or TEPCO, says that as of 6 AM Thursday pressure inside the containment vessel of the No.1 reactor had risen only slightly and that this indicates the operation is going well. The gas injection began at 1:30 AM Thursday. Fuel rods inside the No.1 reactor are nearly half exposed because coolant water levels remain low. It is thought that the overheated fuel rods have caused a buildup of the volatile mix of hydrogen and oxygen. It is hoped the chemically stable nitrogen will counteract this buildup. TEPCO says it plans to continue the injection for about 6 days and will also consider taking similar measures at the No. 2 and No. 3 reactors. Regarding another problem, TEPCO said the pool of highly contaminated water in the underground tunnel connected to the No. 2 reactor rose 5 centimeters in the 24 hours leading up to 7 AM Thursday. TEPCO says the rise is probably related to stopping the leakage of highly radioactive water from a concrete pit of the No. 2 reactor with the use of a hardening agent on Wednesday. The company says there is still one meter of room to ground level, but will keep a close watch on the situation because an overflow would seriously hamper the already difficult restoration work. TEPCO is also continuing the release of 8,000 tons of low-level radioactive wastewater from the plant to make storage space for more highly contaminated water. Around 6,000 tons have been discharged so far. Thursday, April 07, 2011 12:09 +0900 (JST)

### **●Japan's FM official criticizes foreign media**

A high official of Japan's Foreign Ministry has criticized foreign news media coverage of the problems at the Fukushima Daiichi nuclear plant, saying that some of the reports have been exaggerated and excessive. State Secretary for Foreign Affairs, Chiaki Takahashi, was talking to reporters at a news conference on Thursday. He also said that he has urged foreign news organizations, via Japanese embassies, to provide objective and cool-headed coverage and to make corrections to reports if

necessary. But Takahashi added that he can understand the concerns of foreign countries over recent developments at the nuclear plant, including the radioactive contamination of seawater. He said Chief Cabinet Secretary Yukio Edano has instructed his ministry to do more to give foreign diplomats detailed explanations of what is taking place.

Thursday, April 07, 2011 17:29 +0900 (JST)

#### ●Nuclear evacuation zone may be expanded

The Government says it may order residents of some areas within 20 to 30 kilometers of the troubled Fukushima Daiichi nuclear power plant to evacuate. Residents within 20 kilometers of the plant have been evacuated, while those living between 20 to 30 kilometers have been advised to remain indoors. Chief Cabinet Secretary Yukio Edano told reporters on Thursday that existing evacuation guidelines assume large amounts of radiation being released over a short period of time and are not relevant in considering the impact of long-term exposure. He said that total exposure to radiation is high in some areas in the 20-30

kilometer zone as the accident drags on. Edano said the nuclear safety agency is studying whether to order residents of those areas to evacuate. The Chief Cabinet Secretary also said the government wants to allow evacuees to return temporarily to their homes to gather valuables and necessities as requested, but is still studying safety issues.

Thursday, April 07, 2011 14:07 +0900 (JST)

#### ●Plutonium detected again in Fukushima plant soil

Tokyo Electric Power Company has again detected a very small volume of plutonium in soil samples from the disaster-stricken Fukushima Daiichi nuclear power plant. The operator of the plant collected samples from 4 locations at the compound of the plant on March 25th and 28th for analysis by an outside organization. The utility says the radioactive substance was detected on the soil about 500 meters west-northwest of the No.1 reactor and a site near a solid waste storage facility 500 meters north of the reactor. The first sample measured 0.26 becquerels of plutonium-238 per 1 kilogram of soil, down about 50 percent from the volume found earlier. Highly toxic plutonium, a byproduct of the nuclear power generation process, was also found at the same locations in samples collected on March 21st and 22nd. The plutonium appears to be related to the ongoing nuclear accident. TEPCO says the volume is so small that it does not pose a threat to human health. This level is almost the same as the amount usually in the Japanese soil and also about the same the level of fallout from nuclear tests in the atmosphere outside Japan. TEPCO says the No.3 reactor at the Fukushima plant was powered with uranium-plutonium mixed-oxide fuel. But the company says that it cannot identify which reactor released the plutonium, because plutonium is produced at other reactors using uranium fuel.

Wednesday, April 06, 2011 21:50 +0900 (JST)

#### ●Workers face challenge of water storage

Workers struggling to control the damaged Fukushima Daiichi nuclear plant face the challenge of storing huge amounts of radioactive wastewater found throughout the facility. The Tokyo Electric Power Company, or TEPCO, says at least 50,000 tons of wastewater contaminated with highly radioactive material has pooled in reactor turbine buildings and outdoor trenches. The water has been hampering efforts to restore reactor cooling systems, raising fears that it will leak out and further pollute the sea. TEPCO has been working to determine where the contaminated water can be stored safely. One option is the plant's turbine condensers, which convert steam into water. Another is a processing facility for nuclear waste from the plant's No. 1 through 4 reactors. TEPCO also plans to construct makeshift water tanks. It says that using all three options, it should be able to store more than 60,000 tons of wastewater. But about 500 tons of fresh water is injected into reactor buildings each day to cool down the reactors. Some of the water is believed to be leaking outside after becoming contaminated.

This means the total amount of radioactive wastewater in the compound could exceed the currently estimated 50,000 tons, requiring more storage space.

Wednesday, April 06, 2011 19:50 +0900 (JST)

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From a Japanese Friend Black smoke stops the recovery work. I-131 and Cs-137 are detected in water and on vegetables.

Information of Fukushima-Dai-ichi can be obtained.

Cabinet

<http://www.kantei.go.jp/foreign/incident/index.html>

JAIF: Japan Atomic Industry Forum

<http://www.jaif.or.jp/english/index.php>

NISA: Nuclear and Industrial Safety Agency <http://www.nisa.meti.go.jp/english/index.html>

MEXT: Radioactivity of local area in Japan

[http://www.mext.go.jp/english/radioactivity\\_level/detail/1303986.htm](http://www.mext.go.jp/english/radioactivity_level/detail/1303986.htm)

TEPCO

<http://www.tepco.co.jp/en/index-e.html>

Newspaper

The Japan Times

<http://www.japantimes.co.jp/>

Asahi

<http://www.asahi.com/english/>

Mainichi

<http://mdn.mainichi.jp/>

Regards

Kazumi IKEDA

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## March 26, 2011 Update

### Comments by Joe Miler

The Unit 4 spent fuel pool (SFP) is still a serious issue. I think the question of the fuel being exposed and overheating is a mute point since there was a hydrogen explosion in the Unit 4 Reactor building. The only place the hydrogen could come from is the SFP since there is no fuel in the reactor. That means the fuel had to exceed 2000 F to cause the Zr-Water reaction that creates the hydrogen gas. No water was put in the Unit 4 SFP for almost 3 days after the explosion so I suggest that some of the fuel has melted and now the workers are trying to cool the molted mass, which is very difficult, but not impossible if you put enough water on it. There may be another question concerning the integrity of the UNIT 4 SFP. It may be leaking since a significant amount of water has apparently been put in the pool and there seems to be significant flashing steam still coming from the pool, which indicates that the fuel is still extremely hot.

Another issue that has come up is the possible criticality of the fuel in the fuel rack, which was probably changed shape when the fuel began to melt (remember there is much speculation here).

You can read my write-up that I provided below or on my blog at

<http://profile.typepad.com/6p014e86f76033970d> .

I provide a discuss below that I recently had among friends concerning the criticality issue. You can read about criticality in one of my previous emails or at by blog

<http://profile.typepad.com/6p014e86f76033970d> .

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Joe,

A question popped into my head this morning – Why do we not store control rod blades between the spent fuel rods? When you say some fission products were released when the fuel was uncovered, has the fuel gone critical? Would moderating the fuel preclude the extreme temperatures from

occurring? If my memory serves me correctly, I thought the fuel at Three Mile Island melted into a molten mass that shut its own reaction down.

Can boron be dropped into the pool to shut down the reaction? I know we still need water covering the fuel for cooling purposes, but I would think that boron would do a better job of preventing boiling. Please let me know what you think. Feel free to use my ideas if they are useful. Being an electrical engineer I only know the basics of nuclear topics even though Scott Young coerced me into going to General Electric's Station Nuclear Engineering Course for two weeks.

**G Alan Bysfield**

Sr Staff Electrical Engineer  
System Engineering  
Cooper Nuclear Station  
72676 648A Avenue  
Brownville, NE 68321

Alan,

Nice hearing from you.

This is my shot at answering your questions.

First I will give an exchange that I had with one of my friends about criticality when I suggested that the spent fuel had begun to melt.

From Clifford R. Marks

Information Systems Laboratories, Inc.

Spent Fuel critical? Lost the geometric spacing perhaps?

From Joe Miller

Cliff,

Good question about the spent fuel geometry. Back in my earlier days, I did many high density fuel rack calculations for thermal hydraulics and criticality using Keno and PDQ. I know there can be a criticality problem when the spent fuel is packed close together. I guess if the fuel slumps into a mass without geometry it could temporarily become closely packed and approach a critical mass and because of the high energy caused by the additional neutrons, the mass would separate again. Of course, the spent fuel mass would need a source of neutrons to approach critical. I don't think it could blow up, but it could cause more heat. Hopefully, they are getting a lot of water on Unit 4 SFP, which will solidify what is left of the spent fuel rack and it will become stable.

Still looks like the Unit 4 SFP has real problems, although they put 150 tones of water in the pool (they think) on March 22 from 17:17 to 20:32. Also started spraying water from the high capacity Concrete Pump Truck at 10:00 March 23. A little late to be doing it, but better late than never.

Sounds like they also sprayed some water in there on March 20 at 9:43. They still don't have a temperature measurement of Unit 4 pool. It was 184 F on March 14, but sometime after that they lost the read out.

To address some of your other questions I am providing the following:

At TMI, the fuel in the reactor did melt, but because water was eventually inserted into the reactor vessel relatively soon, and the reactor vessel and containment stayed intact, the molten mass became solid and remained that way.

The Japanese used borated sea water to inject into the containment/reactor. It is more important to get the criticality issue under control in the core because the newer fuel that is located there has a significant amount of fissile material such as U235 available to form a critical mass. In the fuel pool, the fuel assemblies are spaced out more than in the core and much of the fuel is spent U235 so it would be very unlikely that, even the fuel rack geometry was lost due to melting fuel, a molten mass would approach a critical configuration. Now in Unit 4, with a full core off load, this is the same fuel that is in the core except is has decayed by 110 days. The Unit 4 spent fuel pool would have a better chance of approaching criticality do to the presents of this core off load.

Hope this helps,

Joe

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Here is a good summary of events surrounding Unit 4 from [http://en.wikipedia.org/wiki/Fukushima\\_I\\_nuclear\\_accidents](http://en.wikipedia.org/wiki/Fukushima_I_nuclear_accidents)

### Explosion of reactor 4 building

At approximately 06:00 JST on 15 March, an explosion—thought to have been caused by hydrogen accumulating near the spent fuel pond—damaged the 4th floor rooftop area of the Unit 4 reactor as well as part of the adjacent Unit 3. At 09:40 JST, the Unit 4 spent fuel pool caught fire, likely releasing radioactive contamination from the fuel stored there. TEPCO said workers extinguished the fire by 12:00. As radiation levels rose, some of the employees still at the plant were evacuated.

On the morning of 15 March 2011 (JST), Secretary Edano announced that according to the Tokyo Electric Power Company, radiation dose equivalent rates measured from the reactor unit 4 reached 100 mSv per hour. Government speaker Edano has stated that there was no continued release of "high radiation".

Japan's nuclear safety agency reported two holes, each 8 meters square (64 m<sup>2</sup> or 689 sq. feet) in a wall of the outer building of the number 4 reactor after an explosion there. Further, at 17:48 JST it was reported that water in the spent fuel pool might be boiling.

As of 15 March 2011 21:13 JST, radiation inside unit 4 had increased so much inside the control room that employees could not stay there permanently any more. Seventy staff remained on site but 800 had been evacuated. By 22:30 JST, TEPCO was reported to be unable to pour water into No. 4 reactor's storage pool for spent fuel. At around 22:50 JST, it was reported that the company was considering the use of helicopters to drop water on the spent fuel storage pool but this was postponed because of concerns over safety and effectiveness, and the use of high-pressure fire hoses was considered instead. A fire was discovered at 05:45 JST on 16 March in the north west corner of the reactor building by a worker taking batteries to the central control room of unit 4.<sup>1</sup> This was reported to the authorities, but on further inspection at 06:15 no fire was found. Other reports stated that the fire was under control. At 11:57 JST, TEPCO released a photograph of No.4 reactor showing that "a large portion of the building's outer wall has collapsed."<sup>1</sup> Technicians reportedly considered spraying boric acid on the building from a helicopter.

On 18 March, it was reported that water sprayed into the spent fuel pool was disappearing faster than evaporation could explain, suggesting leakage.

SDF trucks sprayed water onto the building to try to replenish the pool on 20 March

On 22 March, the Australian military flew in Bechtel-owned robotic equipment for remote spraying and viewing of the pool. *The Australian* reported this would give the first clear view of the pool in the "most dangerous" of the reactor buildings.

### Possibility of criticality in the spent fuel pool

A Tokyo Metropolitan Police Department Kidotai (Riot Police) water cannon; this type was used to help fight the fires.

At approximately 14:30 on 16 March, TEPCO announced that the storage pool, located outside the containment area, might be boiling, and if so the exposed rods could reach criticality. The BBC commented that criticality would not mean a nuclear bomb-like explosion, but could cause a

sustained release of radioactive materials. Around 20:00 JST it was planned to use a police water cannon to spray water on unit 4.

On 16 March the chairman of United States Nuclear Regulatory Commission (NRC), Gregory Jaczko, said in Congressional testimony that the NRC believed all of the water in the spent fuel pool had boiled dry. Japanese nuclear authorities and TEPCO contradicted this report, but later in the day Jaczko stood by his claim saying it had been confirmed by sources in Japan.<sup>[225]</sup> At 13:00 TEPCO claimed that helicopter observation indicated that the pool had not boiled off. The French Institut de radioprotection et de sûreté nucléaire agreed, stating that helicopter crews diverted planned water dumps to unit 3 on the basis of their visual inspection of unit 4.

On 18 March, Japan was reportedly planning to import about 150 tons of boric acid, a neutron poison, from South Korea and France to counter the threat of criticality.

On 23 March it was reported that low level neutron radiation (reported as "neutron beam") was observed several times, which may indicate damaged fuel reaching criticality somewhere at the plant.

+++++

## March 25, 2011 PM Update

I found some inaccurate information in the last write-up I sent you in Section entitled "What Happened to the Spent Fuel Storage Pools after the Earthquake?"

The changes are as follows:

"Since there was no fuel in Unit 4 reactor, the fuel in the SFP of the secondary containment heated to a temperature of over 2000 °F . This caused a Zr-water reaction to occurred that released significant amounts of hydrogen gas in the secondary containment. The hydrogen accumulated in the secondary containment located at the top of the reactor building and exploded caused significant damage to the top of the reactor building as shown in Figure 15. The fire/explosion took place at about 09:38 on March 15th. The building damage and the high radiation from the exposed spent and off loaded fuel in Unit 4 SFP created significant accessibility problems. In most cases a small amount of water can keep the SFP covered. A fire hose delivering 200-300 gpm of water can typically keep the fuel cool. With the full core off load, it could be 30% more because of the additional decay heat. Without this cooling, the pool will heat up and eventually boil and loss water inventory. I believing the of loss of water because of the boiling in Unit 4 SFP caused the fuel to be exposed, which created high radiation levels. Because of the accessibility issues caused by the explosion and high radiation, no one could get to the pool area to put water in the pool and the pool became dry for some time. This caused some of the fuel to melt and release fission products. Some spray by fire water cannons began on March 20th at 19:46, which was about 10 days after the event began. This is a significant time period where the fuel in the Unit 4 SFP could have melted. As I write this paper it is not clear what is happening in Unit 4 SFP."

Written by Joe Miller

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**Colaccino, Joseph**

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**From:** LIA08 Hoc  
**Sent:** Monday, April 11, 2011 8:52 AM  
**To:** Colaccino, Joseph  
**Subject:** RE: CONSORTIUM CALL AT 2000 EDT TODAY

Great! Thanks!

**From:** Colaccino, Joseph  
**Sent:** Monday, April 11, 2011 8:51 AM  
**To:** LIA08 Hoc  
**Subject:** Re: CONSORTIUM CALL AT 2000 EDT TODAY

Lisa,

That does help. I am going to call my contact in areva and ask her to try to same you all some time.

Thanks.

Sent from NRC Blackberry  
Joe Colaccino

(b)(6)

Ex. 6

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**From:** LIA08 Hoc  
**To:** Colaccino, Joseph  
**Sent:** Mon Apr 11 08:46:43 2011  
**Subject:** FW: CONSORTIUM CALL AT 2000 EDT TODAY

Hey Joe...see the first sentence in this email from Brian W.  
Does that help narrow the field?

Thanks-  
LisaG

Lisa Gibney Wright  
Liaison Team Coordinator  
US Nuclear Regulatory Commission  
Email: [lia08.hoc@nrc.gov](mailto:lia08.hoc@nrc.gov)  
Desk Ph: 301-816-5185

**From:** Wittick, Brian  
**Sent:** Monday, April 11, 2011 7:04 AM  
**To:** LIA08 Hoc; Abrams, Charlotte; Stahl, Eric  
**Cc:** Emche, Danielle  
**Subject:** Re: CONSORTIUM CALL AT 2000 EDT TODAY

Jeff

We are looking to find what activities AREVA has going on in Japan. Whoever can talk to us about that.

The NOC was someone working on my telecom problems. To set up a drive or sharepoint site I think you need to communicate with CSC.

EX/286

Sent from NRC BlackBerry  
Brian Wittick

(b)(6)

Ex 6

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**From:** LIA08 Hoc  
**To:** Wittick, Brian  
**Sent:** Mon Apr 11 06:07:24 2011  
**Subject:** RE: CONSORTIUM CALL AT 2000 EDT TODAY

Brian...a couple of questions. Tony McMurtray left me a task tracker indicating that the site team needs a contact at AREVA. Any idea why or what level at AREVA the team needs a contact for? Also, in your recent emails about your blackberry issues, you copied (or someone did) an internal OIS desk –the NOC??? Rudy from the site team just called and asked us to work on getting you all your own network drive where you could keep japan site team related documents. It was suggested that I start with the place you have been copying....the NOC?

Thanks for any help you can provide on AREVA contacts and on the NOC. Jeff

**From:** Wittick, Brian  
**Sent:** Monday, April 11, 2011 5:13 AM  
**To:** LIA08 Hoc  
**Subject:** RE: CONSORTIUM CALL AT 2000 EDT TODAY

Yes, but it was much less. Are you catching the press briefing on NHK

**From:** LIA08 Hoc  
**Sent:** Monday, April 11, 2011 5:11 AM  
**To:** Wittick, Brian  
**Subject:** RE: CONSORTIUM CALL AT 2000 EDT TODAY

Another aftershock?

**From:** Wittick, Brian  
**Sent:** Monday, April 11, 2011 5:06 AM  
**To:** LIA08 Hoc  
**Subject:** RE: CONSORTIUM CALL AT 2000 EDT TODAY

Here it goes again

**From:** LIA08 Hoc  
**Sent:** Monday, April 11, 2011 5:06 AM  
**To:** Wittick, Brian  
**Subject:** RE: CONSORTIUM CALL AT 2000 EDT TODAY

That's where we are getting our info as well. Please forward any TEPCO press releases or embassy press releases or other info as you receive it. Hope you stay safe. Jeff

**From:** Wittick, Brian  
**Sent:** Monday, April 11, 2011 5:00 AM  
**To:** Emche, Danielle; LIA08 Hoc; LIA02 Hoc; ET02 Hoc  
**Cc:** LIA06 Hoc  
**Subject:** RE: CONSORTIUM CALL AT 2000 EDT TODAY

We also have unconfirmed information that they have fire trucks available to line up for makeup water supplies. Make sure you are tuned to NHK which is where we are getting much of our info.

Thanks  
Brian

---

**From:** Emche, Danielle  
**Sent:** Monday, April 11, 2011 4:55 AM  
**To:** LIA08 Hoc; Wittick, Brian; LIA02 Hoc; ET02 Hoc  
**Cc:** LIA06 Hoc  
**Subject:** RE: CONSORTIUM CALL AT 2000 EDT TODAY

We just heard that units 1-3 lost power and stopped injecting water. We heard from the admiral at the Embassy. It was not a fun earthquake to experience, it was very unsettling.

---

**From:** LIA08 Hoc  
**Sent:** Monday, April 11, 2011 4:50 AM  
**To:** Wittick, Brian; LIA02 Hoc; ET02 Hoc  
**Cc:** Emche, Danielle; LIA06 Hoc  
**Subject:** RE: CONSORTIUM CALL AT 2000 EDT TODAY

Thanks Brian and Danielle. As soon as you can get us any info about the condition of nuclear plants in NE Japan after the aftershock of 7.1 a few minutes ago, please let us know. The White House will be calling soon for info. Jeff Temple

---

**From:** Wittick, Brian  
**Sent:** Monday, April 11, 2011 3:52 AM  
**To:** LIA02 Hoc; ET02 Hoc  
**Cc:** Emche, Danielle; LIA06 Hoc; LIA08 Hoc  
**Subject:** RE: CONSORTIUM CALL AT 2000 EDT TODAY

Request the "liaison japan" group address be updated with the current list of people in Japan. Also, request that the "pre-travel checklist" for new people coming to Japan be updated to identify that people should check in with OIS to ensure they have the correct type of international blackberry. I have an international blackberry and assumed it would work everywhere since it previously had and the carrier said it should, but turns out only specific international blackberries do and OIS knows which ones.

Thanks,  
Brian

---

**From:** Stahl, Eric  
**Sent:** Sunday, April 10, 2011 5:58 PM  
**To:** LIA02 Hoc; Liaison Japan  
**Cc:** Emche, Danielle; Wittick, Brian  
**Subject:** RE: CONSORTIUM CALL AT 2000 EDT TODAY

It is our understanding that the call that is still occurring and that NRC HQ will continue to take the lead (at least for today). Last I heard was that Embassy or DOE will transition to the lead at some point in the near future.

Thanks,  
Eric

**From:** LIA02 Hoc  
**Sent:** Monday, April 11, 2011 6:56 AM  
**To:** Liaison Japan  
**Cc:** Emche, Danielle; Stahl, Eric  
**Subject:** CONSORTIUM CALL AT 2000 EDT TODAY  
**Importance:** High

All,

Please confirm the Consortium call is still on for today at 2000 EDT.

Assuming it is on, please advise as to who will be heading up today's Consortium call.

Thanks,

LIA02

**From:** Colaccino, Joseph  
**To:** LIA08 Hoc  
**Cc:** Johnson, Michael; Akstulewicz, Frank  
**Subject:** Areva Contact for Questons on Areva Response to Japan  
**Date:** Monday, April 11, 2011 4:29:45 PM

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Liaison Team,

I have been touch with Areva in Lynchburg. They have told me that there are a number of individuals from Areva in the US, France, and Germany that are fully engaged in the response to the events in Japan. Areva has designated the following individual in Lynchburg to be the NRC contact for any questions that the NRC has regarding Japan.

Sandra Sloan  
Phone: 434-832-2369  
Cell: (b)(6)

Ex. 6

I have been told that Ms. Sloan will take the request and then direct the NRC contact to the appropriate contact in Areva.

Please let me know if you have any questions.

Thanks

Joseph Colaccino  
Chief, EPR Projects Branch  
Office of New Reactors  
US Nuclear Regulatory Commission  
301-415-7102

**From:** LIA08 Hoc  
**Sent:** Monday, April 11, 2011 8:47 AM  
**To:** Colaccino, Joseph  
**Subject:** FW: CONSORTIUM CALL AT 2000 EDT TODAY

Hey Joe...see the first sentence in this email from Brian W.  
Does that help narrow the field?

Thanks-  
LisaG

Lisa Gibney Wright  
Liaison Team Coordinator  
US Nuclear Regulatory Commission  
Email: [lia08.hoc@nrc.gov](mailto:lia08.hoc@nrc.gov)  
Desk Ph: 301-816-5185

**From:** Wittick, Brian  
**Sent:** Monday, April 11, 2011 7:04 AM

FF/287

**To:** LIA08 Hoc; Abrams, Charlotte; Stahl, Eric  
**Cc:** Emche, Danielle  
**Subject:** Re: CONSORTIUM CALL AT 2000 EDT TODAY

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(b)(6)

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**Importance:** High

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Thanks,

LIA02

**Merzke, Daniel**

---

**From:** Merzke, Daniel  
**Sent:** Tuesday, April 12, 2011 2:46 PM  
**To:** Dudek, Michael  
**Subject:** RE: Follow up to Document Request from Commissioner Assistants Briefing on Japan Sunday April 10

Thanks, Michael.

**From:** Dudek, Michael  
**Sent:** Tuesday, April 12, 2011 2:46 PM  
**To:** Merzke, Daniel  
**Subject:** RE: Follow up to Document Request from Commissioner Assistants Briefing on Japan Sunday April 10

Dan,

You were copied on my e-mail to Brian and Trish. Neither is in their offices right now, but I will call them later today to follow up. I have to leave now for personal business so I'm hoping that this request can be fulfilled by Trish. If not, I will have to gather the info tomorrow morning and get back to you. Please call me on my cell (b)(6) you need anything else.

(b)(6)

**Michael Dudek | Technical Assistant | NSIR/Division of Preparedness & Response | U.S. NRC**  
11555 Rockville Pike, Rockville, MD 20852 | ☎ (301) 415-6500 | ✉ [Michael.Dudek@nrc.gov](mailto:Michael.Dudek@nrc.gov)

**From:** Merzke, Daniel  
**Sent:** Tuesday, April 12, 2011 2:32 PM  
**To:** Dudek, Michael  
**Subject:** FW: Follow up to Document Request from Commissioner Assistants Briefing on Japan Sunday April 10  
**Importance:** High

Michael, if you can get the latest versions of the documents requested below, that would be great. I'm fairly sure they are all still in draft form, but that's ok. The criteria for temporary re-entry and permanent re-entry may be one document. I know I saw Trish working on it this morning. If you have any trouble, let me know. Thanks a lot.

Dan

**From:** Muessle, Mary  
**Sent:** Tuesday, April 12, 2011 1:57 PM  
**To:** Merzke, Daniel  
**Cc:** Andersen, James  
**Subject:** FW: Follow up to Document Request from Commissioner Assistants Briefing on Japan Sunday April 10  
**Importance:** High

Spoke with Mike on this. We should be able to provide this information. We should also clarify that we will be prepared to brief the Secretary of State should she visit Japan and request it. We are not aware that anything is firmly scheduled.

Mary Muessle  
Assistant for Operations - Acting  
Office of the Executive Director for Operations  
U.S. Nuclear Regulatory Commission

11/1/2011

301-415-1703 office  
301-415-2700 fax

**From:** Vietti-Cook, Annette  
**Sent:** Tuesday, April 12, 2011 10:33 AM  
**To:** Muessle, Mary; ET05 Hoc  
**Cc:** Weber, Michael; Bubar, Patrice  
**Subject:** Follow up to Document Request from Commissioner Assistants Briefing on Japan Sunday April 10

I have been asked by the Commission offices to follow up on a document request from the Subject Commissioner Assistants Briefing on Japan. The Commission offices requested documents that are being shared with other agencies and were referred to on the call:

Global Assessment that will be shared with Secretary Clinton as part of her visit

Criteria for temporary reentry into the evacuation zone

Criteria for permanent reentry into the evacuation zone

Can you please assist in providing this information to the Commission offices?

**Marksberry, Don**

---

**From:** Joy L Rempe [Joy.Rempe@inl.gov]  
**Sent:** Friday, April 29, 2011 3:56 PM  
**To:** corradin@cae.wisc.edu; John Stetkar; Bill Shack; Sam Armijo; dapower@sandia.gov; (b)(6) Hackett, Edwin; Marksberry, Don; Richard B Lee  
**Subject:** Unit 4 Spent Fuel Pool Movie

Unit 4 Spent Fuel Pool Movie

<http://www.tepco.co.jp/en/news/110311/index-e.html>



Joy Rempe • Idaho National Laboratory  
Phone: (208) 526-2897 • Cell: (b)(6) Ex 6  
Email: Joy.Rempe@inl.gov • Fax: (208) 526-2930 •

FF/289

## Andersen, James

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**From:** Brock, Kathryn  
**Sent:** Tuesday, April 12, 2011 12:34 PM  
**To:** Marshall, Jane  
**Cc:** Andersen, James  
**Subject:** RE: Japan event response staffing - PMT

Hi Jane.

I talked with my management and they are willing to support my continued participation in Operations Center activities. However, if there are folks who really want to gain experience and/or do some weekend work, that would be ok with me. As I mentioned I am unavailable April 15-25 because of necessary support in OEDO, a

(b)(6) I could report back April 26<sup>th</sup> for the next few weeks, but I would really like to be on day shift. The other shifts make it difficult for me to manage my

(b)(6) Thanks very much.

**From:** Marshall, Jane  
**Sent:** Tuesday, April 12, 2011 12:06 PM  
**To:** Brock, Kathryn  
**Subject:** Japan event response staffing - PMT

The decision has been made to move to a smaller group of responders for the Operations Center, and to limit the number of folks rotating through each position to enhance continuity. The idea is that responding to the Japanese events will be your primary task for the next 3-4 weeks, at which point we can re-evaluate our staffing, change staff, or if you choose, continue to support the response. Please let me know your interest and availability. Ideally, we would like to start this staffing on April 17. If you need supervisory support let me know and our respective Office Directors can discuss.

This approach has been discussed and approved by the Chairman and EDO.

Thanks,  
Jane

-----  
Jane E. Marshall  
Chief, Coordination Branch  
Office of Nuclear Security and Incident Response  
U.S. Nuclear Regulatory Commission  
301-415-7854  
[Jane.Marshall@nrc.gov](mailto:Jane.Marshall@nrc.gov)

4/29/11