Coe, Doug

From: Coyne, Kevin
Sent: Friday, April 01, 2011 9:49 AM
To: Correia, Richard; Coe, Doug
Cc: Helton, Donald; Appignani, Peter
Subject: Re: Request for Briefing on SFP Study

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Sent from an NRC Blackberry
Kevin Coyne
(b)(6)

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To: Coyne, Kevin; Coe, Doug
Sent: Fri Apr 01 09:34:39 2011
Subject: FW: Request for Briefing on SFP Study

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Please see Commissioner Apostolakis request below Who in RES/DRA is our best person(s) to support this request?

thx

Richard Correia, PE
Director, Division of Risk Analysis
Office of Nuclear Regulatory Research
US NRC

richard.correia@nrc.gov

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Sent: Friday, April 01, 2011 9:30 AM
To: Correia, Richard; Coe, Doug
Cc: Bahadur, Sher; Ruland, William; Lee, Samson; Harrison, Donnie; Wertz, Trent
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BBB\90

ML12034A071

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Cc: Wittick, Brian; Bowman, Gregory
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B/8\91

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BBB\92

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Phone: 301-415-2241
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From: Correia, Richard
Sent: Friday, April 01, 2011 10:09 AM
To: Gibson, Kathy; Hoxie, Chris; Lee, Richard; Cheok, Michael
Cc: Coe, Doug; Coyne, Kevin
Subject: RE: Request for Briefing on SFP Study

Thanks Kathy. We should ask that the briefing be "not urgent" given our staffs' availability and work in the IRC

Mike,

Can you ask OEDO to inquire how soon the Commissioner wants the briefing?

thx

Richard Correia, PE
Director, Division of Risk Analysis
Office of Nuclear Regulatory Research
US NRC

richard.correia@nrc.gov

From: Gibson, Kathy
Sent: Friday, April 01, 2011 10:05 AM
To: Correia, Richard; Hoxie, Chris; Lee, Richard
Cc: Cheok, Michael
Subject: Re: Request for Briefing on SFP Study

Yes probably Charlie or Jason, but they are actively working Japan response issues and would have to be pulled off. We also have a request for briefing Comm Sviniki on SOARCA which they would have to do EDO is trying to delay that one if possible. I will see if someone on Richard's staff could do SFPs

---

From: Correia, Richard
To: Gibson, Kathy; Hoxie, Chris
Cc: Cheok, Michael
Sent: Fri Apr 01 09:56:18 2011
Subject: FW: Request for Briefing on SFP Study

Kathy Chris,

Commissioner Apostolakis has requested a briefing on SFP accident risk. Still learning who does what in RES I asked Kevin Coyne for advice on who would be best to support NRR for the briefing. He thought DSA/Charlie Tinkler & Jason Schaperow are the SMEs. Please let me & Mike Cheok know who would be the staff involved with the briefing.

Many thanks

Richard Correia, PE
Director, Division of Risk Analysis
Office of Nuclear Regulatory Research
US NRC

BBB 94

richard.correia@nrc.gov

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Attachments: SFP and Non Reactor PRA Scoping Study Rev Sep 1.docx

I've attached the report from the SFP and non-reactor L3 PRA scoping working group for your information, which contains references to previous risk studies

Marty

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From: Harrison, Donnie
Sent: Friday, April 01, 2011 10 16 AM
To: Cheok, Michael; Correia, Richard; Coe, Doug
Cc: Bahadur, Sher; Ruland, William; Lee, Samson; Wertz, Trent
Subject: Re: Request for Briefing on SFP Study

I recall the work being done in late 90s to early 2000s. Bob Palla worked it for DRA and maybe a couple others but I believe the DRA folks involved are all retired now.

We would need to drudge that work up and re-visit it before we could make a presentation. RES may still have the involved staff available, but I do not know
Sent from NRC blackberry
Donnie Harrison

(b)(6)

From: Cheok, Michael
To: Correia, Richard; Coe, Doug
Cc: Bahadur, Sher; Ruland, William; Lee, Samson; Harrison, Donnie; Wertz, Trent
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Let's forward to DSA for background. The document is mainly a discussion of what needs to be done to conduct a PRA of SFPs and dry casks, and was developed to support writing the SECY paper on the proposed new site Level 3 PRA project.

Marty

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I've attached the report from the SFP and non-reactor L3 PRA scoping working group for your information which contains references to previous risk studies.

Marty

From: Correia, Richard
Sent: Friday, April 01, 2011 9:57 AM
To: Coyne, Kevin; Coe, Doug
Cc: Helton, Donald; Appignani, Peter; Stutzke, Martin
Subject: RE: Request for Briefing on SFP Study

Thanks Kevin. I'll add him to the list.

Richard Correia, PE
Director, Division of Risk Analysis
Office of Nuclear Regulatory Research
US NRC

B8B\97

richard.correia@nrc.gov

From: Coyne, Kevin
Sent: Friday, April 01, 2011 9:54 AM
To: Correia, Richard; Coe, Doug
Cc: Helton, Donald; Appignani, Peter; Stutzke, Martin
Subject: RE: Request for Briefing on SFP Study

Rich -

Pondering a bit more and rereading the request from Mike Snodderly, we'd probably also want to see if Marty Stutzke (in addition to Don Helton) could support to speak to the seismic/fire aspects...

Kevin

From: Correia, Richard
Sent: Friday, April 01, 2011 9:51 AM
To: Coyne, Kevin; Coe, Doug
Cc: Helton, Donald; Appignani, Peter
Subject: RE: Request for Briefing on SFP Study

Thanks Kevin I'll forward Mike Cheok's request to Kathy Gibson et al.

Richard Correia, PE
Director, Division of Risk Analysis
Office of Nuclear Regulatory Research
US NRC

richard.correia@nrc.gov

From: Coyne, Kevin
Sent: Friday, April 01, 2011 9:49 AM
To: Correia, Richard; Coe, Doug
Cc: Helton, Donald; Appignani, Peter
Subject: Re: Request for Briefing on SFP Study

Rich-

The main folks in res who have worked with spent fuel pool issues are Don Helton in dra/prab and charlie tinkler and jason schaperow in dsa I'm not personally familiar with the work, but my understanding is that it was largely a dsa effort in the past. I've cc'ed Don so he can chime in, but my initial feeling is that this would largely be dsa lead with significant support from Don Helton

Kevin

Sent from an NRC Blackberry
Kevin Coyne
(b)(6)

From: Correia, Richard
To: Coyne, Kevin; Coe, Doug
Sent: Fri Apr 01 09:34:39 2011
Subject: FW: Request for Briefing on SFP Study

Kevin,

Please see Commissioner Apostolakis request below. Who in RES/DRA is our best person(s) to support this request?

thx

Richard Correia, PE
Director, Division of Risk Analysis
Office of Nuclear Regulatory Research
US NRC

richard.correia@nrc.gov

From: Cheok, Michael
Sent: Friday, April 01, 2011 9:30 AM
To: Correia, Richard; Coe, Doug
Cc: Bahadur, Sher; Ruland, William; Lee, Samson; Harrison, Donnie; Wertz, Trent
Subject: FW: Request for Briefing on SFP Study

Rich, Doug – Does RES want to take the lead on this and for us to support? (Or we can reverse this if you like) I kinda remember a SFP risk study back in the 90's. Not sure if there is a more recent one

Mike

From: Wertz, Trent
Sent: Friday, April 01, 2011 9:11 AM
To: Cheok, Michael
Subject: FW: Request for Briefing on SFP Study

Mike,

Here's the request. I'll see if I can pin down when they want the briefing.

Trent

From: Williams, Shawn
Sent: Thursday, March 31, 2011 8:01 PM
To: Williams, Donna; Wertz, Trent
Cc: Wittick, Brian; Bowman, Gregory
Subject: FW: Request for Briefing on SFP Study

Is this request an NRR Lead, or NRO Lead, or maybe even Research? I would think NRR.

From: Snodderly, Michael
Sent: Thursday, March 31, 2011 7:01 PM
To: Williams, Shawn
Cc: Sosa, Belkys; Davis, Roger; Castleman, Patrick; Blake, Kathleen
Subject: Request for Briefing on SFP Study

Shawn,

Commissioner Apostolakis would like to request a briefing from the staff on the generic study of spent fuel pool accident risk The Commissioner would like to have a better understanding of the risk from spent fuel pools including the risk due to fire and seismic. The Commissioner is aware of an adjudicatory issue associated with Diablo Canyon. So please avoid any discussion of SFP risk at Diablo Canyon. Commissioner Apostolakis plans to invite Commissioner Svinicki if she is interested. Please contact Kathleen Blake to schedule the briefing. Contact me if you have any questions concerning this matter.

Thanks,

Mike Snodderly
Technical Assistant for Reactors
to Commissoner Apostolakis
U. S. Nuclear Regulatory Commission

Phone: 301-415-2241
Email: michael.snodderly@nrc.gov

Coe, Doug

From: Correia, Richard
Sent: Friday, April 01, 2011 10:22 AM
To: Stutzke, Martin; Coyne, Kevin; Coe, Doug
Cc: Helton, Donald; Appignani, Peter
Subject: RE: Request for Briefing on SFP Study

Thx Marty

Richard Correia, PE
Director, Division of Risk Analysis
Office of Nuclear Regulatory Research
US NRC

richard.correia@nrc.gov

From: Stutzke, Martin
Sent: Friday, April 01, 2011 10:17 AM
To: Correia, Richard; Coyne, Kevin; Coe, Doug
Cc: Helton, Donald; Appignani, Peter
Subject: RE: Request for Briefing on SFP Study

Let's forward to DSA for background. The document is mainly a discussion of what needs to be done to conduct a PRA of SFPs and dry casks, and was developed to support writing the SECY paper on the proposed new site Level 3 PRA project.

Marty

From: Correia, Richard
Sent: Friday, April 01, 2011 10:12 AM
To: Stutzke, Martin; Coyne, Kevin; Coe, Doug
Cc: Helton, Donald; Appignani, Peter
Subject: RE: Request for Briefing on SFP Study

Thanks Marty. Should I forward this to DSA or do you think they have the same information?

Richard Correia, PE
Director, Division of Risk Analysis
Office of Nuclear Regulatory Research
US NRC

richard.correia@nrc.gov

From: Stutzke, Martin
Sent: Friday, April 01, 2011 10:11 AM
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BBB\98

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US NRC

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Office of Nuclear Regulatory Research
US NRC

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US NRC

richard.correia@nrc.gov

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Sent: Friday, April 01, 2011 9:30 AM
To: Correia, Richard; Coe, Doug
Cc: Bahadur, Sher; Ruland, William; Lee, Samson; Harrison, Donnie; Wertz, Trent
Subject: FW: Request for Briefing on SFP Study

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Mike

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To: Cheok, Michael
Subject: FW: Request for Briefing on SFP Study

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Here's the request. I'll see if I can pin down when they want the briefing

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Subject: FW: Request for Briefing on SFP Study

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Cc: Sosa, Belkys; Davis, Roger; Castleman, Patrick; Blake, Kathleen
Subject: Request for Briefing on SFP Study

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Thanks,

Mike Snodderly
Technical Assistant for Reactors
to Commissoner Apostolakis
U. S. Nuclear Regulatory Commission

Phone: 301-415-2241
Email: michael.snodderly@nrc.gov

Coe, Doug

From: Wertz, Trent
Sent: Friday, April 01, 2011 10:29 AM
To: Cheok, Michael; Correia, Richard; Coe, Doug
Cc: Bahadur, Sher; Ruland, William; Lee, Samson; Harrison, Donnie
Subject: FW: Request for Briefing on SFP Study

Importance: High

See date and time below. As soon as we know who will be doing the briefing we need to get the names to ODEO

Thanks,
Trent

From: Wittick, Brian
Sent: Friday, April 01, 2011 9:33 AM
To: Wertz, Trent; Nguyen, Quynh; Meighan, Sean
Subject: FW: Request for Briefing on SFP Study

Highlighted below is the requested briefing topic and time for Cmrs Apostolakis and Svinicki.

Please confirm acceptance and who the briefers will be.

Thanks,
Brian Wittick
Executive Technical Assistant for Reactors
Office of the Executive Director for Operations
U.S. Nuclear Regulatory Commission
301-415-2496 ([redacted] (b)(6)

From: Blake, Kathleen
Sent: Friday, April 01, 2011 9:14 AM
To: Castleman, Patrick; Snodderly, Michael; Williams, Shawn
Cc: Sosa, Belkys; Davis, Roger; Lepre, Janet; Wittick, Brian
Subject: RE: Request for Briefing on SFP Study

April 14th at 1:00 p.m. (for one hour) is confirmed for both Cmr Apostolakis and Cmr Svinicki.

Brian: Does this day/time work for you? kb

Administrative Assistant
to Commissioner Apostolakis
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, Maryland 20852
301-415-1810

From: Castleman, Patrick
Sent: Thursday, March 31, 2011 8:29 PM

BBB\99

To: Snodderly, Michael; Williams, Shawn
Cc: Sosa, Belkys; Davis, Roger; Blake, Kathleen; Lepre, Janet
Subject: RE: Request for Briefing on SFP Study

Mike and Kathleen,

Commissioner Svinicki would like to participate in this briefing. Kathleen, please coordinate with Jan on arrangements.

Thanks! Pat

From: Snodderly, Michael
Sent: Thursday, March 31, 2011 7:01 PM
To: Williams, Shawn
Cc: Sosa, Belkys; Davis, Roger; Castleman, Patrick; Blake, Kathleen
Subject: Request for Briefing on SFP Study

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Commissioner Apostolakis would like to request a briefing from the staff on the generic study of spent fuel pool accident risk. The Commissioner would like to have a better understanding of the risk from spent fuel pools including the risk due to fire and seismic. The Commissioner is aware of an adjudicatory issue associated with Diablo Canyon. So please avoid any discussion of SFP risk at Diablo Canyon. Commissioner Apostolakis plans to invite Commissioner Svinicki if she is interested. Please contact Kathleen Blake to schedule the briefing. Contact me if you have any questions concerning this matter.

Thanks,

Mike Snodderly
Technical Assistant for Reactors
to Commissoner Apostolakis
U. S. Nuclear Regulatory Commission

Phone: 301-415-2241
Email: michael.snodderly@nrc.gov

Coe, Doug

From: Wertz, Trent
Sent: Friday, April 01, 2011 10:31 AM
To: Cheok, Michael; Correia, Richard; Coe, Doug
Cc: Bahadur, Sher; Ruland, William; Lee, Samson; Harrison, Donnie
Subject: FW: Staff Briefing on the Generic Study of Spent Fuel Pool Accident Risk

FYI

From: Wittick, Brian
Sent: Friday, April 01, 2011 9:50 AM
To: Wertz, Trent; Nguyen, Quynh; Meighan, Sean
Subject: FW: Staff Briefing on the Generic Study of Spent Fuel Pool Accident Risk

FYI – looks like acceptance is OBE; please ensure the briefers are aware of the breadth of the audience.

Brian Wittick
Executive Technical Assistant for Reactors
Office of the Executive Director for Operations
U.S. Nuclear Regulatory Commission
301-415-2498 (w (b)(6)

From: Blake, Kathleen
Sent: Friday, April 01, 2011 9:47 AM
To: Hipschman, Thomas; Marshall, Michael; Castleman, Patrick; Snodderly, Michael; Orders, William; Klett, Audrey; Franovich, Mike; Sosa, Belkys; Wittick, Brian
Cc: Lepre, Janet; Savoy, Carmel; Herr, Linda; Crawford, Carrie; Harves, Carolyn; Pace, Patti; Speiser, Herald; Gibbs, Catina
Subject: Staff Briefing on the Generic Study of Spent Fuel Pool Accident Risk

Commissioner Apostolakis would like to invite you to a staff briefing on the Generic Study of Spent Fuel Pool Accident Risk. The meeting will be held in the 18th floor conference room on Thursday, April 14th at 1:00 p.m. Commissioner Svinicki will be attending as well. kb

Administrative Assistant
to Commissioner Apostolakis
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, Maryland 20852
301-415-1810

BBS\100

Coe, Doug

From: Correia, Richard
Sent: Friday, April 01, 2011 10:35 AM
To: Wertz, Trent; Cheok, Michael; Coe, Doug; Gibson, Kathy
Cc: Bahadur, Sher; Ruland, William; Lee, Samson, Harrison, Donnie; Tinkler, Charles; Coyne, Kevin
Subject: RE. Request for Briefing on SFP Study

Trent,

We are determining who in RES can support the briefing request. As you can imagine, many are supporting the IRC for the Japan event so we will need a bit more time to get back with you but we will as soon as possible.

Richard Correia, PE
Director, Division of Risk Analysis
Office of Nuclear Regulatory Research
US NRC

richard.correia@nrc.gov

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Sent: Friday, April 01, 2011 10:29 AM
To: Cheok, Michael; Correia, Richard; Coe, Doug
Cc: Bahadur, Sher; Ruland, William; Lee, Samson; Harrison, Donnie
Subject: FW: Request for Briefing on SFP Study
Importance: High

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Thanks,
Trent

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Please confirm acceptance and who the briefers will be

Thanks,
Brian Wittick
Executive Technical Assistant for Reactors
Office of the Executive Director for Operations
U.S. Nuclear Regulatory Commission
301-415-2496 (w) (b)(6)

B85\101

From: Blake, Kathleen
Sent: Friday, April 01, 2011 9:14 AM

To: Castleman, Patrick; Snodderly, Michael; Williams, Shawn
Cc: Sosa, Belkys; Davis, Roger; Lepre, Janet; Wittick, Brian
Subject: RE: Request for Briefing on SFP Study

April 14th at 1:00 p.m. (for one hour) is confirmed for both Cmr Apostolakis and Cmr Svinicki.

Brian: Does this day/time work for you? kb

[illegible]
Administrative Assistant
to Commissioner Apostolakis
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, Maryland 20852
301-415-1810

From: Castleman, Patrick
Sent: Thursday, March 31, 2011 8:29 PM
To: Snodderly, Michael; Williams, Shawn
Cc: Sosa, Belkys; Davis, Roger; Blake, Kathleen; Lepre, Janet
Subject: RE: Request for Briefing on SFP Study

Mike and Kathleen,

Commissioner Svinicki would like to participate in this briefing. Kathleen, please coordinate with Jan on arrangements.

Thanks! Pat

From: Snodderly, Michael
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Cc: Sosa, Belkys; Davis, Roger; Castleman, Patrick; Blake, Kathleen
Subject: Request for Briefing on SFP Study

Shawn,

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Thanks,

Mike Snodderly
Technical Assistant for Reactors
to Commissoner Apostolakis
U. S. Nuclear Regulatory Commission

Phone: 301-415-2241
Email: michael.snodderly@nrc.gov

Coe, Doug

From: Correia, Richard
Sent: Saturday, April 02, 2011 7:14 AM
To: Demoss, Gary
Cc: Drouin, Mary; Coe, Doug
Subject: RE: japan accident progression for cont flooding.pptx

Thanks Gary and Mary very much for your efforts to pull this information together. Please continue on Monday and I'll ask Fred how and to who he wants the information transmitted.

relax!
Rich Correia, PE
Director
Division of Risk Analysis
RES
US NRC

From: Demoss, Gary
Sent: Friday, April 01, 2011 5:50 PM
To: Correia, Richard
Cc: Drouin, Mary
Subject: Fw: japan accident progression for cont flooding.pptx

Rich,

Attached is Mary's first cut at a complete package. I worked through the diagram this afternoon and feel pretty good about it. We will all take a fresh look at it over the weekend / Monday morning. I expect we will finish up shortly after our Monday morning meeting and send it to you. Let us know if you want to transmit it to Fred Brown and the op center, or you want us to send it.

Gary
Sent from an NRC Blackberry
Gary DeMoss
(b)(6)

From: Drouin, Mary
To: John Lehner <lehner@bnl.gov>; 'Pratt, William T' <pratt@bnl.gov>; Demoss, Gary; Harrison, Donnie; Marksberry, Don; Tinkler, Charles
Sent: Fri Apr 01 16:46:23 2011
Subject: japan accident progression for cont flooding.pptx

Everyone,

Tks for all your help!

Please remember that this is a high level look, and there are ***NUMEROUS*** paths that could occur, but we were not trying to build a APET; further, I kept it strictly to the task, which was to consider the different outcomes/strategies for flooding the primary containment. On the second page, I included the path for not venting the containment as part of "flood/vent containment," so please take a careful look at that path (as you should with all the paths).

BBB\102

As you look, are there missing consequences? Are there some other caveats that need to be mentioned because of underlying assumptions? For example, where it says core quenching is questionable, should there be an explanation of why it is questionable, or is it evident by the conditions stated in the left-hand box?

We have the call/goto meeting set for 9:30 am Monday morning. Looking forward to your input

Again, tks for your hard work. Have a great weekend.

Go have a beer, wine, manhattan, margarita, whatever!

Tks, mary

Bano, Mahmooda

From: Scott, Michael
Sent: Monday, April 04, 2011 3:01 AM
To: RST06 Hoc
Cc: RST01 Hoc; Christensen, Harold; RST09 Hoc; Taylor, Robert; Giessner, John; Blamey, Alan
Subject: Re: Question about how our answer will be used

We need to focus on what they should do to optimize safety while in the condition they have for the moment chosen to remain. So not good to repeat the recommebdations if they involve major changes to current conditions. But okay to try to nudge flows up, etc. Hope that helps.

Sent from my NRC blackberry
Michael Scott
(b)(6)

From: RST06 Hoc
To: Scott, Michael
Cc: RST01 Hoc; Christensen, Harold; RST09 Hoc
Sent: Sun Apr 03 19:59:35 2011
Subject: Question about how our answer will be used

Mike,

Given our discussion of the flowrate question and the Elmo Collins questions, how do you see the NRC Japan team using the answers? Your answer to this question will help us frame the response. Naval Reactors has questioned the focus on our current document; namely, that we have included too much information that we had repeated from our original assessment. I tend to agree with them but, in my view, what the site team needs is controlling here. You could help us by providing your view of what precisely you need.

Either call or respond by e-mail.

Bill Ruland

888\103

Coe, Doug

From: Correia, Richard
Sent: Monday, April 04, 2011 6:47 AM
To: Wertz, Trent
Cc: Bahadur, Sher; Ruland, William; Lee, Samson; Harrison, Donnie; Tinkler, Charles; Coyne, Kevin; Gibson, Kathy; Coe, Doug; Cheok, Michael
Subject: RE: Request for Briefing on SFP Study

Trent,

Good morning. Brian Sheron asked Commissioner Apostolakis on Friday (during their periodic meeting) if he would be willing to have the SFP study briefing after April 14th given many of the staff involved with preparing for this are also very involved with IRC/Japan support activities. The Commissioner said he was Ok with a later day as long as it takes place in April.

So, would you please find out from Commissioner Apostolakis and Svinicki offices what other dates/times after April 14th would be acceptable and we will coordinate here in RES & NRR with the staff.

Many thanks.

Rich et al.

Richard Correia, PE
Director, Division of Risk Analysis
Office of Nuclear Regulatory Research
US NRC

richard.correia@nrc.gov

From: Wertz, Trent
Sent: Friday, April 01, 2011 10:42 AM
To: Correia, Richard; Cheok, Michael; Coe, Doug; Gibson, Kathy
Cc: Bahadur, Sher; Ruland, William; Lee, Samson; Harrison, Donnie; Tinkler, Charles; Coyne, Kevin
Subject: RE: Request for Briefing on SFP Study

Understand. I'll try to keep everyone informed of any changes or snags.

From: Correia, Richard
Sent: Friday, April 01, 2011 10:35 AM
To: Wertz, Trent; Cheok, Michael; Coe, Doug; Gibson, Kathy
Cc: Bahadur, Sher; Ruland, William; Lee, Samson; Harrison, Donnie; Tinkler, Charles; Coyne, Kevin
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Trent,

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US NRC

B/PB\104

richard.correia@nrc.gov

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To: Cheok, Michael; Correia, Richard; Coe, Doug
Cc: Bahadur, Sher; Ruland, William; Lee, Samson; Harrison, Donnie
Subject: FW: Request for Briefing on SFP Study
Importance: High

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Please confirm acceptance and who the briefers will be.

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Brian Wittick
Executive Technical Assistant for Reactors
Office of the Executive Director for Operations
U.S. Nuclear Regulatory Commission
301-415-2496 (w) (b)(6)

From: Blake, Kathleen
Sent: Friday, April 01, 2011 9:14 AM
To: Castleman, Patrick; Snodderly, Michael; Williams, Shawn
Cc: Sosa, Belkys; Davis, Roger; Lepre, Janet; Wittick, Brian
Subject: RE: Request for Briefing on SFP Study

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[illegible]
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to Commissioner Apostolakis
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, Maryland 20852
301-415-1810

From: Castleman, Patrick
Sent: Thursday, March 31, 2011 8:29 PM
To: Snodderly, Michael; Williams, Shawn

Cc: Sosa, Belkys; Davis, Roger; Blake, Kathleen; Lepre, Janet
Subject: RE: Request for Briefing on SFP Study

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Thanks,

Mike Snodderly
Technical Assistant for Reactors
to Commissoner Apostolakis
U. S. Nuclear Regulatory Commission

Phone: 301-415-2241
Email: michael.snodderly@nrc.gov

Coe, Doug

From: Correia, Richard
Sent: Monday, April 04, 2011 11:35 AM
To: Gibson, Kathy; Coe, Doug; Coyne, Kevin; Stutzke, Martin; Helton, Donald; Tinkler, Charles; Armstrong, Kenneth; Collins, Timothy
Subject: FW: Request for Briefing on SFP Study

FYI

Richard Correia, PE
Director, Division of Risk Analysis
Office of Nuclear Regulatory Research
US NRC

richard.correia@nrc.gov

From: Wertz, Trent
Sent: Monday, April 04, 2011 10:21 AM
To: Correia, Richard; Cheok, Michael
Subject: FW: Request for Briefing on SFP Study

FYI

From: Blake, Kathleen
Sent: Monday, April 04, 2011 9:42 AM
To: Wittick, Brian; Lepre, Janet
Cc: Bowman, Gregory; Williams, Shawn; Snodderly, Michael
Subject: RE: Request for Briefing on SFP Study

Great – the meeting will be held in the SECY Conference Room O16H1 since the 18th floor is booked. kb

Administrative Assistant
to Commissioner Apostolakis
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, Maryland 20852
301-415-1810

From: Wittick, Brian
Sent: Monday, April 04, 2011 9:34 AM
To: Blake, Kathleen; Lepre, Janet
Cc: Bowman, Gregory; Williams, Shawn; Snodderly, Michael
Subject: RE: Request for Briefing on SFP Study

Kathleen

This time works well for NRR and RES.

Thanks.
Brian Wittick
Executive Technical Assistant for Reactors

BBB/105

Office of the Executive Director for Operations
U.S. Nuclear Regulatory Commission
301-415-2496 (w) (b)(6)

From: Blake, Kathleen
Sent: Monday, April 04, 2011 8:45 AM
To: Wittick, Brian; Lepre, Janet
Cc: Bowman, Gregory; Williams, Shawn
Subject: RE: Request for Briefing on SFP Study

Brian: Friday, April 29 at 10:00 a.m. would work for both Commissioners. OK with you? kb

Administrative Assistant
to Commissioner Apostolakis
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, Maryland 20852
301-415-1810

From: Wittick, Brian
Sent: Monday, April 04, 2011 8:32 AM
To: Blake, Kathleen; Lepre, Janet
Cc: Bowman, Gregory; Williams, Shawn
Subject: FW: Request for Briefing on SFP Study

Kathleen,

Please see below agreement between Cmr Apostolakis and Brian Sheron to hold the subject briefing later in the month of April. Please let me know what time is mutually acceptable for your and Cmr Svinicki's office.

Thanks,

Brian Wittick
Executive Technical Assistant for Reactors
Office of the Executive Director for Operations
U.S. Nuclear Regulatory Commission
301-415-2496 (w); (b)(6)

From: Wertz, Trent
Sent: Monday, April 04, 2011 7:57 AM
To: Wittick, Brian
Cc: Nguyen, Quynh; Meighan, Sean
Subject: FW: Request for Briefing on SFP Study

Brian,

See below. Can you check with the Commissioner's offices and see when a later date can be set up?

Thanks,
Trent

From: Correia, Richard
Sent: Monday, April 04, 2011 6:47 AM
To: Wertz, Trent
Cc: Bahadur, Sher; Ruland, William; Lee, Samson; Harrison, Donnie; Tinkler, Charles; Coyne, Kevin; Gibson, Kathy; Coe, Doug; Cheok, Michael
Subject: RE: Request for Briefing on SFP Study

Trent,

Good morning. Brian Sheron asked Commissioner Apostolakis on Friday (during their periodic meeting) if he would be willing to have the SFP study briefing after April 14th given many of the staff involved with preparing for this are also very involved with IRC/Japan support activities. The Commissioner said he was Ok with a later day as long as it takes place in April.

So, would you please find out from Commissioner Apostolakis and Svinicki offices what other dates/times after April 14th would be acceptable and we will coordinate here in RES & NRR with the staff.

Many thanks.

Rich et al.

Richard Correia, PE
Director, Division of Risk Analysis
Office of Nuclear Regulatory Research
US NRC

richard.correia@nrc.gov

From: Wertz, Trent
Sent: Friday, April 01, 2011 10:42 AM
To: Correia, Richard; Cheok, Michael; Coe, Doug; Gibson, Kathy
Cc: Bahadur, Sher; Ruland, William; Lee, Samson; Harrison, Donnie; Tinkler, Charles; Coyne, Kevin
Subject: RE: Request for Briefing on SFP Study

Understand. I'll try to keep everyone informed of any changes or snags.

From: Correia, Richard
Sent: Friday, April 01, 2011 10:35 AM
To: Wertz, Trent; Cheok, Michael; Coe, Doug; Gibson, Kathy
Cc: Bahadur, Sher; Ruland, William; Lee, Samson; Harrison, Donnie; Tinkler, Charles; Coyne, Kevin
Subject: RE: Request for Briefing on SFP Study

Trent,

We are determining who in RES can support the briefing request. As you can imagine, many are supporting the IRC for the Japan event so we will need a bit more time to get back with you, but we will as soon as possible.

Richard Correia, PE
Director, Division of Risk Analysis
Office of Nuclear Regulatory Research
US NRC

richard.correia@nrc.gov

From: Wertz, Trent
Sent: Friday, April 01, 2011 10:29 AM
To: Cheok, Michael; Correia, Richard; Coe, Doug
Cc: Bahadur, Sher; Ruland, William; Lee, Samson; Harrison, Donnie
Subject: FW: Request for Briefing on SFP Study
Importance: High

See date and time below. As soon as we know who will be doing the briefing we need to get the names to ODEO.

Thanks,
Trent

From: Wittick, Brian
Sent: Friday, April 01, 2011 9:33 AM
To: Wertz, Trent; Nguyen, Quynh; Meighan, Sean
Subject: FW: Request for Briefing on SFP Study

Highlighted below is the requested briefing topic and time for Cmrs Apostolakis and Svinicki.

Please confirm acceptance and who the briefers will be.

Thanks,
Brian Wittick
Executive Technical Assistant for Reactors
Office of the Executive Director for Operations
U.S. Nuclear Regulatory Commission
301-415-2496 (w) (b)(6)

From: Blake, Kathleen
Sent: Friday, April 01, 2011 9:14 AM
To: Castleman, Patrick; Snodderly, Michael; Williams, Shawn
Cc: Sosa, Belkys; Davis, Roger; Lepre, Janet; Wittick, Brian
Subject: RE: Request for Briefing on SFP Study

April 14th at 1:00 p.m. (for one hour) is confirmed for both Cmr Apostolakis and Cmr Svinicki.

Brian: Does this day/time work for you? kb

Administrative Assistant
to Commissioner Apostolakis
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, Maryland 20852
301-415-1810

From: Castleman, Patrick
Sent: Thursday, March 31, 2011 8:29 PM
To: Snodderly, Michael; Williams, Shawn
Cc: Sosa, Belkys; Davis, Roger; Blake, Kathleen; Lepre, Janet
Subject: RE: Request for Briefing on SFP Study

Mike and Kathleen,

Commissioner Svinicki would like to participate in this briefing. Kathleen, please coordinate with Jan on arrangements.

Thanks! Pat

From: Snodderly, Michael
Sent: Thursday, March 31, 2011 7:01 PM
To: Williams, Shawn
Cc: Sosa, Belkys; Davis, Roger; Castleman, Patrick; Blake, Kathleen
Subject: Request for Briefing on SFP Study

Shawn,

Commissioner Apostolakis would like to request a briefing from the staff on the generic study of spent fuel pool accident risk. The Commissioner would like to have a better understanding of the risk from spent fuel pools including the risk due to fire and seismic. The Commissioner is aware of an adjudicatory issue associated with Diablo Canyon. So please avoid any discussion of SFP risk at Diablo Canyon. Commissioner Apostolakis plans to invite Commissioner Svinicki if she is interested. Please contact Kathleen Blake to schedule the briefing. Contact me if you have any questions concerning this matter.

Thanks,

Mike Snodderly
Technical Assistant for Reactors
to Commissoner Apostolakis
U. S. Nuclear Regulatory Commission

Phone: 301-415-2241
Email: michael.snodderly@nrc.gov

Greenwood, Carol

From: Gibson, Kathy
Sent: Monday, April 04, 2011 1:42 PM
To: Lee, Richard
Subject: RE: N2 inerting of the Fukushima drywell
Attachments: Kathy Halvey Gibson.vcf

Does the Ops Center know?

Kathy Halvey Gibson
Director
Division of Systems Analysis

Kathy.Gibson@nrc.gov
(301) 251-7499 Work
(b)(6)

From: Lee, Richard
Sent: Monday, April 04, 2011 1:04 PM
To: Esmaili, Hossein; Salay, Michael; Schaperow, Jason; Tinkler, Charles
Cc: Marksberry, Don; Helton, Donald; Gibson, Kathy; Scott, Michael
Subject: N2 inerting of the Fukushima drywell

This is to let you know that the N2 inerting system has been delivered to the Fukushima site, and that TEPCC will begin inerting the drywell of the Fukushima Unit 1 commencing Tuesday (Japanese time).

888\106

Greenwood, Carol

From: Gibson, Kathy
Sent: Monday, April 04, 2011 1:41 PM
To: Sheron, Brian; Uhle, Jennifer
Subject: FW: N2 inerting of the Fukushima drywell
Attachments: Kathy Halvey Gibson.vcf

Kathy Halvey Gibson
Director
Division of Systems Analysis

Kathy.Gibson@nrc.gov
(301) 251-7499 Work
(b)(6)
US Nuclear Regulatory Commission
Office of Nuclear Regulatory Research
Protecting People and the Environment

From: Lee, Richard
Sent: Monday, April 04, 2011 1:04 PM
To: Esmaili, Hossein; Salay, Michael; Schaperow, Jason; Tinkler, Charles
Cc: Marksberry, Don; Helton, Donald; Gibson, Kathy; Scott, Michael
Subject: N2 inerting of the Fukushima drywell

This is to let you know that the N2 inerting system has been delivered to the Fukushima site, and that TEPCO will begin inerting the drywell of the Fukushima Unit 1 commencing Tuesday (Japanese time).

Lee, Richard

From: Larzelere, Alex [alex.larzelere@nuclear.energy.gov]
Sent: Monday, April 04, 2011 5:07 PM
To: Lee, Richard
Subject: Re: handouts for today conf. call

I am heading to my computer to send it again.

Alex

Sent from my BlackBerry, which you can call (b)(6)

From: Lee, Richard (NRC)
To: Larzelere, Alex
Sent: Mon Apr 04 17:04:51 2011
Subject: handouts for today conf. call

Hi, Alex:

I have not received the handout for today conference call.

Richard

Coyne, Kevin

From: Coyne, Kevin
Sent: Tuesday, April 05, 2011 1:59 PM
To: Hudson, Daniel
Subject: Re: SOARCA likely to be referenced, questioned tomorrow

Dan -

Can you check with Rich and make sure this gets back up to Brian?

Thanks!

Kevin

Sent from an NRC Blackberry
Kevin Coyne
(b)(6)

From: Hudson, Daniel
To: Stutzke, Martin; Coyne, Kevin
Cc: Correia, Richard
Sent: Tue Apr 05 13:50:59 2011
Subject: RE: SOARCA likely to be referenced, questioned tomorrow

Kevin and Marty,

Thanks very much for developing these bullets in my absence. Everything looks great to me. I made some minor edits/additions where highlighted below.

Best,
Dan

Daniel W. Hudson
Technical Assistant
U.S. Nuclear Regulatory Commission
Office of Nuclear Regulatory Research
Division of Risk Analysis
Daniel.Hudson@nrc.gov
301-251-7919

From: Stutzke, Martin
Sent: Tuesday, April 05, 2011 1:18 PM
To: Coyne, Kevin
Cc: Hudson, Daniel; Correia, Richard
Subject: RE: SOARCA likely to be referenced, questioned tomorrow

I've added some context for the existing bullets per Kevin's request. Also added some background on Level 3 PRA per Rich's previous comments:

- A Level 3 PRA estimates the likelihood of severe accidents, models the release and transport of radioactive material in a severe accident, and estimates the health and economic impact.
  - Level 1 PRA: Estimation of the likelihood (frequency) of core-damage accidents

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- Level 2 PRA: Estimation of the likelihood (frequency) and characteristics (such as the quantity and timing) of radioactive releases to the environment
- Level 3 PRA: Estimation of the transport of radioactive material and the associated health and economic impacts
- The results of a Level 3 PRA reflect both the frequency of accidents and their associated consequences. The total accident risk is estimated by summing the product of frequency and consequences for each scenario over all accident scenarios.

- A Level 3 Probabilistic Risk Assessment (PRA) considers:
  - A range of initiating event categories (e.g., fires, flooding, seismic, and plant equipment failures)
  - Plant response to postulated scenarios
  - Core damage progression
  - Radiological release, weather, emergency response, and public health consequences
  - Goal is to quantify risk in a systematic manner

- Prior studies estimating nuclear power plant risk to public
  - WASH-740 (March 1957)
    - ❖ Provided an estimate of the upper limit consequences of severe reactor accidents to inform Congressional deliberation on the Price-Anderson Act.
    - ❖ Although this was a non-probabilistic consequence study instead of a PRA study, the probability of a severe reactor accident was considered and estimated to be 1E-5 to 1E-9 per reactor-year of operation.

  - WASH-1400 (October 1975)
    - ❖ Motivation:
      - ✓ During the late 1960s and early 1970s, the size and number of commercial NPPs rapidly increased.
      - ✓ In addition, a series of loss-of-fluid tests (LOFTs) conducted using a small-scale reactor mockup suggested that steam buildup during an accident scenario could prevent the Emergency Core Cooling System (ECCS) from injecting water into the reactor core, thereby leading to core damage.
      - ✓ Upcoming extension of the Price-Anderson Act
    - ❖ Description:
      - ✓ The AEC initiated a study in 1972 to obtain a more realistic estimate of the risk to the public from severe nuclear accidents.
      - ✓ WASH-1400 marked the first U.S. attempt to systematically evaluate a large spectrum of accidents and to use quantitative techniques to evaluate severe accident probabilities, source terms, and public consequences in an integrated manner to obtain a more realistic estimate of severe accident risk to the public
    - ❖ Criticism:
      - ✓ Although the PRA methodology used in WASH-1400 was broadly endorsed as the best available at the time, the study was widely criticized for its treatment of uncertainties in its estimates of severe accident probabilities.
      - ✓ In fact, in January 1979, the Commission withdrew its support of the WASH-1400 results stating, "In particular, in light of the [Risk Assessment] Review Group conclusions on accident probabilities, the Commission does not regard as reliable the Reactor Safety Study's estimate of the overall risk of a reactor accident."

  - NUREG-1150 (December 1990)
    - ❖ Initiated as part of the NRC's Severe Accident Closure Plan developed in response to the accident at Three Mile Island
    - ❖ Update to WASH-1400 using advanced PRA technology that could include quantitative estimates of risk uncertainty

- The NUREG-1150 study provided a set of PRA models and a snapshot-in-time assessment of the severe accident risks associated with five commercial nuclear power plants of different reactor and containment designs.
- Still viewed by many as the NRC's greatest contribution to advancing the state-of-the-art in PRA technology.

- NRC staff initiative for a comprehensive site Level 3 PRA based on:
  - PRA and technical advances since NUREG-1150
  - Interest in site accident risk versus reactor accident risk
    - Risks from spent fuel stored in:
      - ✓ Spent fuel pool
      - ✓ Dry cask storage
    - Risks from multi-unit accidents
  - Desire to use a more integrated and consistent analysis approach
  - Enhance NRC staff PRA capability by developing in-house risk expertise

- Commission tasking (SRM M100218)
  - Engage internal and external stakeholders in formulating plan and scope for future actions
  - Commission provided conditional support for Level 3 PRA related activities
  - Directed the staff to provide options for proceeding with Level 3 PRA (staff plans to provide an options SECY paper to Commission in July)

Note: The staff has been planning the proposed comprehensive site Level 3 PRA since April 2010.

- Potential uses of a Level 3 PRA
  - Inform policymaking and rulemaking
  - Focus NRC's inspection program
  - Resolution of generic safety issues
  - Prioritization of safety research programs

- Schedule
  - Staff proposal due to the Commission by July 7, 2011
  - Staff envisions a multi-year, multi-million dollar effort

Let me know if I need to revise/clarify, etc.
Marty

From: Coyne, Kevin
Sent: Tuesday, April 05, 2011 12:31 PM
To: Stutzke, Martin
Cc: Hudson, Daniel; Correia, Richard
Subject: FW: SOARCA likely to be referenced, questioned tomorrow
Importance: High

Marty -

I have attached the Level 3 RIC presentation. If you could add a bit more commentary and context to the following bullets and forward to Rich I'd very much appreciate it (e.g., is there any context to add to WASH-1400, NUREG-1150, etc...). Also feel free to revise, edit, or collapse the bullets:

- A Level 3 Probabilistic Risk Assessment (PRA) considers:
  - A range of initiating event categories (e.g., fires, flooding, seismic, and plant equipment failures)
  - Plant response to postulated
  - Core damage progression

- Radiological release, weather, evacuation, and public health consequences
- Goal is to quantify risk in a systematic manner

- Prior studies estimating nuclear power plant risk to public
  - WASH-740 (March 1957)
  - WASH-1400 (October 1975)
  - NUREG-1150 (December 1990)

- NRC staff initiative for a comprehensive site Level 3 PRA based on:
  - PRA and technical advances since NUREG-1150
  - Interest in site accident risk versus reactor accident risk
  - Desire to use a more integrated and consistent analysis approach
  - Enhance NRC staff PRA capability by developing in-house risk expertise

- Commission tasking (SRM M100218)
  - Engage internal and external stakeholders in formulating plan and scope for future actions
  - Commission provided conditional support for Level 3 PRA related activities
  - Requested the staff to provide options for proceeding with Level 3 PRA (staff plans to provide an options SECY paper to Commission in July)

- Potential uses of a Level 3 PRA
  - Inform policymaking and rulemaking
  - Focus NRC's inspection program
  - Resolution of generic safety issues
  - Prioritization of safety research programs

From: Santiago, Patricia
Sent: Tuesday, April 05, 2011 11:31 AM
To: Coyne, Kevin; Stutzke, Martin
Cc: Correia, Richard; Wagner, Katie; Lee, Richard
Subject: FW: SOARCA likely to be referenced, questioned tomorrow
Importance: High

FYI
I know Dan and Doug are out and wanted to make sure you had the request. It is related to the congressional briefings that Brian has been doing related to Japan.
thanks

From: Sheron, Brian
Sent: Tuesday, April 05, 2011 11:24 AM
To: Santiago, Patricia; Correia, Richard
Cc: Uhle, Jennifer; Gibson, Kathy
Subject: FW: SOARCA likely to be referenced, questioned tomorrow

See below. Can I get some background bullets on SOARCA and level 3 PRA within a couple of hours?

From: Rihm, Roger
Sent: Tuesday, April 05, 2011 11:17 AM
To: Sheron, Brian
Subject: FW: SOARCA likely to be referenced, questioned tomorrow

It seems this hearing is going everywhere. I know you are sending over some material on dry cask storage. Can you also provide a limited amount of background material on SOARCA and level 3 PRAs? I have the one pagers from NUREG 1925 to start with. Thx.

From: Powell, Amy
Sent: Tuesday, April 05, 2011 11:10 AM
To: Virgilio, Martin
Cc: Rihm, Roger; Shane, Raeann; Schmidt, Rebecca; Sheron, Brian
Subject: SOARCA likely to be referenced, questioned tomorrow

Marty –

OCA got a heads up from Mr. Waxman's staff that he and Rep. DeGette may reference the concept of SOARCA, work to date, and ask related questions at tomorrow's hearing. Dr. Sheron did a briefing for a number of House Energy and Commerce staffers that referenced ongoing work on this; staff was impressed so encouraged their bosses to ask about it (understanding that it is evolving, draft, preliminary, etc.).

Amy

Amy Powell
Associate Director
U. S. Nuclear Regulatory Commission
Office of Congressional Affairs
Phone: 301-415-1673

Lee, Richard

From: Douglas.Burns@inl.gov
Sent: Tuesday, April 05, 2011 5:34 PM
To: Lee, Richard
Subject: Fw: 4/5 Science Expert Call Briefing
Attachments: graycol.gif; 0405 S-1 Briefing.pptx

Fyi.

Douglas E Burns

----- Original Message -----
From: Douglas E Burns
Sent: 04/05/2011 02:16 PM MDT
To: 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)

BBB\110

From: Sheron, Brian
To: Borchardt, Bill; Weber, Michael; Virgilio, Martin; Leeds, Eric; Johnson, Michael; Wiggins, Jim; Miller, Charles; Holahan, Gary; Grobe, Jack; Haney, Catherine; Moore, Scott; Dean, Bill; McCree, Victor; Satorius, Mark; Collins, Elmo; Casto, Chuck
Subject: FW: E-mail response
Date: Wednesday, April 06, 2011 2:15:00 PM
Attachments: Statement April 4, 2011.pdf
2011_04_06_12_53_14.pdf

FYI.

From: Hayden, Elizabeth
Sent: Wednesday, April 06, 2011 1:05 PM
To: Vietti-Cook, Annette; Muessle, Mary
Cc: Sheron, Brian; Brenner, Eliot
Subject: FW: E-mail response

I'm sending you this e-mail from Harold Denton in case you want to make additional distribution of the multi-national statement and recommendations re severe accidents that is being provided to IAEA.

Beth Hayden
Senior Advisor
Office of Public Affairs
U.S. Nuclear Regulatory Commission
--- Protecting People and the Environment
301-415-8202
elizabeth.hayden@nrc.gov

From: Harold Denton (b)(6)
Sent: Wednesday, April 06, 2011 12:51 PM
To: Hayden, Elizabeth
Subject: Re: E-mail response

Roger Mattson found the email addresses for a number of NRCers and has sent them the same attachments as here in.

Feel free to distribute.
Harold

From: Hayden, Elizabeth
To: (b)(6)
Sent: Wednesday, April 06, 2011 10:20 AM
Subject: E-mail response

Hi Harold -- thanks for calling this morning. I look forward to seeing your e-mail on Chernobyl that I will make sure goes to the Commission.

Beth Hayden
Senior Advisor
Office of Public Affairs
U.S. Nuclear Regulatory Commission

--- *Protecting People and the Environment*
301-415-8202
elizabeth.hayden@nrc.gov

STATEMENT

NEVER AGAIN: An Essential Goal for Nuclear Safety

The people listed below are nuclear safety experts from various countries that for many years have been engaged in research and development, design, construction, operation, management and safety regulation of nuclear power plants (NPPs). We express here our deep concern about the future of nuclear power in view of the consequences of the earthquake and tsunami at the Fukushima-Daiichi NPP in Japan. We are confident that only nuclear power that avoids being a threat to the health and safety of the population and to the environment is acceptable to society. Although comprehensive analysis of this tragic event is not feasible at the moment due to lack of complete data on the events that occurred, we wish to voice our opinion about severe accidents at civilian nuclear power plants and suggest additional measures to avoid them in light of the experience so far gained at Fukushima. First, we review the improvements made in safety due to earlier severe accidents.

The accident at Three Mile Island (TMI) Unit 2 (USA, 1979) did not cause injuries of the plant personnel or the population. There was no significant radioactive contamination outside the plant. Even so, the accident caused a reduction of investments in new NPPs due to a decreased interest from private investors. Studies of the accident confirmed the robustness of safety principles employed in the design of that type of NPP. At the same time, the accident revealed significant weaknesses in the implementation of those principles, including design of instrumentation and controls, operating procedures and the realism of the analyses supporting them, personnel training, and feedback of operating experience. Lessons learned from the accident allowed improvements with regard to human factors (how people and NPPs relate), design-specific probabilistic safety assessments, emergency preparedness, and safety systems. This accident also led the nuclear industry to design new NPPs that include passive safety features not dependent on the availability of electrical or mechanical equipment.

The accident at Chernobyl Unit 4 (USSR, 1986) was the largest in history. The spread of the accident to the other reactors at the plant was prevented but cost the lives of thirty-one members of plant personnel and firemen. There was widespread radioactive contamination over large parts of Europe. Many thousand people had to be relocated from their homes near the plant. Regionally, the accident produced excess thyroid cancers and other negative effects on human health and had a large psychological impact on the public. The accident also had significant political resonance. The design of the reactor at Chernobyl was very different from the light-water reactors at TMI and Fukushima. Studies of the Chernobyl accident highlighted significant design deficiencies (core instability, inadequate design of control rods, unsatisfactory characteristics of confinement) as well as deficiencies in safety culture in the former Soviet Union. In harmony with international guidance and in compliance with upgraded national safety standards, significant modernization was achieved in NPPs in the former Soviet Union. Moreover, the IAEA International Nuclear Safety Advisory Group (INSAG) issued reports on the accident and developed Guidance on General Safety Principles and Safety Culture for improving NPP safety worldwide. The nuclear industry created the World Association of Nuclear Operators (WANO) for a continuous review and feedback of nuclear power plant operating experience.

On learning the lessons from these accidents, the approaches to safety regulation and NPP design were upgraded, and an international nuclear safety regime based on the Nuclear Safety Convention and other international accords was established. The fundamental principle of safety culture has become a daily routine.

International cooperation was strengthened to improve the fundamental requirements and criteria to ensure safety of nuclear power and to incorporate them into the design basis of NPPs of the next generations. The Nuclear Safety Convention also called for reviewing the safety of existing NPPs to identify and implement reasonably practical improvements.

The importance of nuclear education and training was acknowledged, which led to the establishment of the World Nuclear University (WNU) and the creation of regional nuclear education networks in different parts of the world.

Severe nuclear accidents seemed to have gone to history. Nevertheless, another one has happened. Why?

A detailed analysis based on more data is needed to give a full answer, but some preliminary observations deserve to be made now. On one hand, the Tohoku-Taiheiyou-Oki Earthquake on March 11, 2011 shows that nuclear power plants are capable of withstanding some catastrophic natural events better than many other manmade objects. On the other hand, it appears that, in the siting and design of the Fukushima-Daiichi nuclear plants, an unlikely combination of low-probability events (historic earthquake plus historic tsunami leading to loss of all electrical power) was not taken sufficiently into account.

In fact, complex combinations of initiating events unforeseen in plant designs resulted in all the severe accidents described above. In addition, these accidents took emergency responders outside the range of circumstances for which they were trained and equipped. Moreover, hindsight shows that relatively inexpensive improvements, detectable by more extensive analysis beforehand, may have avoided these accidents altogether.

These observations lead us to conclude that more can be done to prevent severe accidents and to limit their consequences should they nevertheless occur. We know that due to a natural tendency of human beings for complacency, the nuclear safety regime can erode; i.e., if we do not continuously pursue safety, we can loose safety. There are occasional signs that national and international safety assessments and peer review missions are becoming more focused on demonstrating that safety is satisfactory and in compliance with national and international standards than on finding and correcting deficiencies, be they in design, operation, or the standards themselves. Therefore, we need to reinforce our dedication, not only in words but also in actions towards a questioning attitude, thereby assuring continuous improvement in the safety of NPPs.

Thus, there is a need to continue to audit and improve the safety culture at all levels of nuclear power management and regulation, achieve due attention to detail, implement effective programs to identify, analyze and correct safety deficiencies, and effectively manage nuclear knowledge.

Special attention should be paid to the quality of personnel training for nuclear power. To achieve this goal, NPP vendor countries should establish centers to train specialists for nuclear technology in recipient countries. Top professionals involved in nuclear power generation should not only "know what" and "know how" but also "know why" in order to deliver difficult and critical decisions in time to deal with unforeseen circumstances. In

addition, regulatory organizations should improve the effectiveness of expert missions and inspections, and guarantee openness and honesty in reporting the findings of such inspections to the public. Routine inspections are important; however, even more important is the capability to recognize early indications of low probability incidents or circumstances.

In addition to further measures to prevent severe accidents, more must be done to limit the consequences of such accidents if they occur. It is important to finalize the in-depth safety assessments of severe accident vulnerabilities for each NPP plant design and to develop severe accident management provisions for all operating nuclear reactors. Measures for accident management should be supported with robust technical capabilities, backup equipment, and procedures for restoration of core heat removal before the onset of fuel melting. Plant staff should be well trained in flexible severe accident management.

Renewed attention should be given to general safety requirements for plants built to earlier safety standards in view of the considerable remaining operating time envisaged for many such plants. A more internationally harmonized approach in this area should be sought. In light of the common mode failure of redundant safety systems (electric power) caused by the tsunami at Fukushima, authorities should ask to what extent this failure and other common mode failure vulnerabilities in operating plants might be revealed by current technology.

The safety requirements for future NPPs should be refined to assure that their backup cooling systems are able to operate for a long enough time following a complete loss of on-site and off-site power. These future NPPs should be able to promptly restore or compensate for lost power. Passive systems and advanced technologies for system engineering, materials, information management and communications should be applied to new NPPs. New plants should be sited away from areas of extreme natural and manmade hazards. Risk assessments and risk governance should be used for optimization of plant design and operation but not substitute for deterministic safety justifications. The next-generation NPPs should ensure safety even if operating personnel are not able to provide immediate response in an emergency.

The responsibility and qualifications of government and corporate officials involved in nuclear safety-related decision-making should be reviewed and enhanced by national authorities where needed. National nuclear institutions in all countries, including nuclear safety regulators, should be accountable for their actions and transparent in nuclear safety communications so that they receive and deserve the trust of the public. It is necessary to ensure that national nuclear safety regulators in all countries are fully independent in their decision-making on nuclear safety and to assure their competence, resources and enforcement authorities. Insurance premiums for all NPP owners should be tied to plant safety performance.

The safety of nuclear power goes beyond national boundaries. Appropriate measures to further strengthen the international nuclear safety regime should be identified and implemented after proper discussions, whether it will be within the framework of the Nuclear Safety Convention, the IAEA, regional bodies like the EU or industry organizations like WANO. A critical question should be what measures would be most effective in further promoting a high level of nuclear safety worldwide. Would it be to create new international frameworks, for example in the shape of an international regulatory agency entrusted with

issuing binding international safety standards and performing compulsory inspections, or would it be to further develop and strengthen existing frameworks, emphasizing national responsibilities in combination with rigorous international peer reviews? It is to be expected that the international conference to be convened at the IAEA in Vienna in June of this year will provide a starting point for discussions of such measures.

Requirements for new countries wishing to start using nuclear power should be developed and incorporated into the international nuclear safety regime. Such countries must demonstrate their ability to uphold high international standards with regard to safety, security and non-proliferation over the lifetime of their nuclear power programs.

We hope that our recommendations will be accepted for consideration by national authorities and international organizations and that concerted measures will be developed. We are always ready to share our experience and expertise to assist in developing and implementing these and other recommendations to reach our common goal - to "Never Again" experience severe accidents in the future and, as defense in depth, to effectively respond to them should they nevertheless occur.

The following people assisted in the formulation of this Statement and concur in its issuance.

Adolf Birkhofer	Germany	Professor Emeritus, Technical University of Munich; former member and chair, INSAG; former chair, German Reactor Safety Commission; former chair, Committee on Safety of Nuclear Installations of OECD
Agustin Alonso	Spain	Former member, INSAG; former member, director and commissioner of Spanish Regulatory Institution; vice chair, Committee on Safety of Nuclear Installations of OECD
KunMo Chung	Republic of Korea	Former member, INSAG; former minister, Science & Technology, Republic of Korea; former president, Korean Academy of Science & Technology; former president, General Conference, IAEA; former vice chair, World Energy Council
Harold Denton	USA	Former director, office of nuclear reactor regulation, US Nuclear Regulatory Commission and President Carter's representative at TMI during the accident
Lars Högberg	Sweden	Former member, INSAG; former director general, Swedish Nuclear Power Inspectorate; former chair, steering committee, OECD Nuclear Energy Agency
Anil Kakodkar	India	Former member, INSAG, former chairman, Atomic Energy Commission of India
Georgy Kopchinsky	Ukraine	Former head, nuclear power and industry department, USSR Council of Ministers; former vice chair, Ukrainian nuclear regulatory authority
Jukka Laaksonen	Finland	Vice-chair, INSAG; director general, Finnish Radiation & Nuclear Safety Authority; chair, Western European Nuclear Regulatory Association (WENRA); former chair, NEA Committee on Nuclear Regulatory Activities (CNRA)
Salomon Levy	USA	Former member, INSAG; former design and manufacturing manager, General Electric Atomic Power Equipment Division; honorary member, ASME

Roger Mattson	USA	Former director of reactor systems safety division and leader, TMI Lessons Learned Task Force, US Nuclear Regulatory Commission; working group co-chair, INSAG-3
Victor Murogov	Russia	Professor, National Nuclear Research University (MEPHI); director, Russian Association Nuclear Science and Education; former director, Institute of Physics and Power Engineering (IPPE); former deputy director general for nuclear power, IAEA
Nikolai Ponomarev-Stepnoy	Russia	Member, Russian Academy of Science; former deputy director, Kurchatov Institute
Victor Sidorenko	Russia	Correspondent member of Russian Academy of Science; former member; INSAG; former deputy director, Kurchatov Institute; former deputy Chairman of the USSR nuclear regulatory authority; former deputy minister of nuclear power of the USSR and Russia
Nikolai Steinberg	Ukraine	Former member, IAEA Standing Advisory Group on Nuclear Energy; former chief engineer, Chernobyl NPP; former deputy chairman of USSR nuclear regulatory authority; former chairman of Ukrainian nuclear regulatory authority; former deputy minister of fuel & power of Ukraine
Pierre Tanguy	France	Former member, INSAG; former inspector general of nuclear safety, Electricité de France
Jurgis Vilemas	Lithuania	Member of Lithuanian Academy of Science; former director, Lithuanian Energy Institute

April 6, 2011

Director General
International Atomic Energy Agency
Vienna International Centre
A-1400 Vienna, Austria

Dear Mr. Amano:

I am writing to you on behalf of an ad hoc group of nuclear safety experts from various countries that for many years have been engaged in research and development, design, construction, operation, management and safety regulation of nuclear power plants. We have prepared a Statement, "NEVER AGAIN: An Essential Goal for Nuclear Safety" to express our deep concern about the future of nuclear power in view of the consequences of the earthquake and tsunami at the Fukushima-Daiichi NPP in Japan. A copy of the Statement is attached.

Although comprehensive analysis of this tragic event is not feasible at the moment due to lack of complete data on the events that occurred, we wish to voice our opinion about severe accidents at civilian nuclear power plants and suggest additional measures to avoid them in light of the experience so far gained at Fukushima. In our Statement, we review the many advances in nuclear safety that were realized after the accidents at Three Mile Island and Chernobyl. We hoped these advances would relegate severe nuclear accidents to history. Nevertheless, another one has happened. Why?

A detailed analysis based on more data is needed to give a full answer to this question, but some preliminary observations deserve to be made now. Accordingly, our Statement describes measures that should be considered, for both operating and new nuclear power plants, by the organizations that own and operate these plants and those that oversee their safety.

We hope that our recommendations will be accepted for consideration by national authorities, the nuclear industry, the conferees at the Chernobyl-25 Conference in Kiev this month, and the conferees at the IAEA Ministerial Conference in Vienna in June.

We are always ready to share our experience and expertise to assist in developing and implementing these and other recommendations to reach our common goal - to "Never Again" experience severe accidents and, as defense in depth, to effectively respond to them should they nevertheless occur.

Sincerely, on behalf of the ad hoc group,

Jukka Laaksonen

Jukka Laaksonen

Coe, Doug

From: Correia, Richard
Sent: Wednesday, April 06, 2011 4:42 PM
To: Coe, Doug
Subject: Fw:

Fyi
Rich Correia, Director
Division of Risk Analysis
RES

From: Uhle, Jennifer
To: Sheron, Brian; Gibson, Kathy
Cc: Correia, Richard
Sent: Wed Apr 06 15:53:19 2011
Subject: RE:

An issue to consider is that MELCOR modeling would be involved and Sandia is stretched thin for SOARCA. Plus, we are considering Level 3 work so we are running out of MELCOR types fast and my vote would be to keep SOARCA focused on completion.

From: Sheron, Brian
Sent: Wednesday, April 06, 2011 3:29 PM
To: Gibson, Kathy
Cc: Uhle, Jennifer; Correia, Richard
Subject: RE:

Yes, this is roughly what I had in mind.

From: Gibson, Kathy
Sent: Wednesday, April 06, 2011 2:45 PM
To: Sheron, Brian
Cc: Uhle, Jennifer; Correia, Richard
Subject: FW:

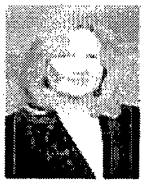
Brian,
Apparently the question of SFP comparative risk was raised previously (about 3 years ago) and Charlie put together the attached plan which was not implemented at that time. This is where the $2M over 2 years estimate came from.

If you have time, could you take a look and see if this is what you have in mind? I haven't read it in detail, but I am anticipating that some of the work has already been done with the security assessments and the ORNL analysis recently done could be factored in and would reduce the cost and time from this previous proposal.

This document seems to be a good place for us to start regarding a SOW. DSA and DRA are meeting Tues or Wed next week, so if you have comments on this document it would be great if we had them by then so we could be that much further ahead.

Thanks,
Kathy

B88\112



Kathy Halvey Gibson
Director
Division of Systems Analysis

(b)(6)

From: Tinkler, Charles
Sent: Wednesday, April 06, 2011 1:52 PM
To: Gibson, Kathy
Subject:

Attached is a plan which I developed about 3 yrs ago in response to Brian's request for a study on risk reduction associated with removing older fuel from pools.. (He has requested such a study before)

While the plan was developed it was subsequently shelved – lack of resources – available staff and money

I understand DRA has recently(?) developed a new version of such a plan (Don Helton has a copy of the attached plan – he worked with me back in that timeframe). I have not seen the DRA plan but I guess it is more heavily inclined towards level 1 PRA stuff.

Charles Tinkler
Charles.Tinkler@nrc.gov

Greenwood, Carol

From: Gibson, Kathy
Sent: Wednesday, April 06, 2011 3:25 PM
To: Huffert, Anthony; Bush-Goddard, Stephanie; Lee, Richard; Bajorek, Stephen
Subject: FW: ACTION: Identify 4th wave of NRC staff to Japan
Attachments: Kathy Halvey Gibson.vcf

Importance: High

Tony, see below, are you interested/willing to be offered up for a free trip to Japan?

Steph, Richard,
Anybody else you would suggest? If so, check with them first and then let me know.

Steve, you expressed interest, do you fit any of the skills sets they list below?

Thanks all.

Kathy Halvey Gibson
Director
Division of Systems Analysis

Kathy.Gibson@nrc.gov
(301) 251-7499 Work
(b)(6)

From: Sheron, Brian
Sent: Wednesday, April 06, 2011 3:09 PM
To: Case, Michael; Coe, Doug; Correia, Richard; Gibson, Kathy; Richards, Stuart; Scott, Michael; Uhle, Jennifer; Valentin, Andrea
Subject: FW: ACTION: Identify 4th wave of NRC staff to Japan

See below. Please let me know if you have anyone that meets the technical and interpersonal skill sets needed. Due date is this Friday.

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:

888\113

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

Greenwood, Carol

From: Gibson, Kathy
Sent: Wednesday, April 06, 2011 3:37 PM
To: Bajorek, Stephen
Subject: RE: ACTION: Identify 4th wave of NRC staff to Japan
Attachments: Kathy Halvey Gibson2.vcf

Ok thanks

Kathy Halvey Gibson
Director
Division of Systems Analysis

Kathy.Gibson@nrc.gov
(301) 251-7499 Work

(b)(6)

From: Bajorek, Stephen
Sent: Wednesday, April 06, 2011 3:37 PM
To: Gibson, Kathy
Subject: RE: ACTION: Identify 4th wave of NRC staff to Japan

Kathy,

Interested, but the skill set they are looking for isn't mine.

Steve

From: Gibson, Kathy
Sent: Wednesday, April 06, 2011 3:25 PM
To: Huffert, Anthony; Bush-Goddard, Stephanie; Lee, Richard; Bajorek, Stephen
Subject: FW: ACTION: Identify 4th wave of NRC staff to Japan
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BBB\114

Kathy Halvey Gibson
Director
Division of Systems Analysis

Kathy.Gibson@nrc.gov
(301) 251-7499 Work
(b)(6)
US Nuclear Regulatory Commission
Office of Nuclear Regulatory Research
Protecting People and the Environment

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Sent: Wednesday, April 06, 2011 3:09 PM
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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

Lee, Richard

From: Larzelere, Alex [alex.larzelere@nuclear.energy.gov]
Sent: Thursday, April 07, 2011 5:24 PM
To: Lee, Richard
Subject: Emailing Presentations

Richard,

Please let me now if you get this. The only email address I have for you is richard.lee@nrc.gov.

I sent the presentation to this address at about 4:30. I also sent it to the NITSolutions distribution list and I have checked to make sure you address was correct on the list.

I am very sorry but, I really do not understand why you are not getting the slides.

Please let me know if you get this.

Alex

Sent from my BlackBerry, which you can call @ (b)(6)

B88\115

Bano, Mahmooda

From: Scott, Michael
Sent: Friday, April 08, 2011 8.10 AM
To: Taylor, Robert
Subject: RE: Notification of your arrival in the U.S.

Can you please send me the group photo(s) by Monday? My dog-and-pony show on Japan is scheduled for Wednesday.

Thanks!

From: Taylor, Robert
Sent: Thursday, April 07, 2011 3:59 PM
To: Scott, Michael
Subject: Re: Notification of your arrival in the U.S.

Even better than the ride over. This was the deluxe business class.

Sent from an NRC BlackBerry
Robert Taylor
(b)(6)

From: Scott, Michael
To: Taylor, Robert
Sent: Thu Apr 07 15:57:37 2011
Subject: RE: Notification of your arrival in the U.S.

Good to be the (business class) king, yes?

From: Taylor, Robert
Sent: Thursday, April 07, 2011 3:57 PM
To: Scott, Michael; LIA03 Hoc; Liaison Japan
Cc: LIA02 Hoc
Subject: Re: Notification of your arrival in the U.S.

I'm back.

Sent from an NRC BlackBerry
Robert Taylor
(b)(6)

From: Scott, Michael
To: LIA03 Hoc; Liaison Japan
Cc: LIA02 Hoc
Sent: Wed Apr 06 20:10:10 2011
Subject: RE: Notification of your arrival in the U.S.

I arrived U.S. 3:37 pm EDT 4/6/11.

BBB\116

From: LIA03 Hoc
Sent: Thursday, March 31, 2011 7:10 PM
To: Liaison Japan
Cc: LIA02 Hoc
Subject: Notification of your arrival in the U.S.

Dear NRC Japan Team - Upon your return, please "reply All" to this email and let the International Liaison Team know that you're back in the U.S.

Thank you in advance.
Mugeh
On behalf of the International Liaison Team

Coe, Doug

From:	Helton, Donald
Sent:	Friday, April 08, 2011 1:02 PM
To:	Coyne, Kevin
Subject:	DSA SF dRisk Study - Comments
Attachments:	Comments on DSA dRisk Study - 040811.docx

Kevin,

My comments on the SF delta risk study are attached. Please let me know how, or if, you want to proceed in engaging Rich or others prior to next Tuesday's meeting with DSA.

Best,
Don

From: Helton, Donald
Sent: Thursday, April 07, 2011 2:15 PM
To: Coyne, Kevin
Subject: FW:

Kevin,

Regarding Rich's direction on reviewing DSA's 2008 SFP dRisk study to "meet amongst ourselves before we re-engage DSA," what form should that take...i.e., me funneling my thoughts to you for consideration vs actually meeting with Doug/Rich?

For what it is worth, my hope is to re-review the plan tomorrow and compile my current thoughts and those I had 3 years ago. I should be prepared to discuss by mid-day Monday (if not earlier)...

Best,
Don

From: Correia, Richard
Sent: Wednesday, April 06, 2011 4:58 PM
To: Coyne, Kevin; Helton, Donald
Cc: Coe, Doug
Subject: FW:

Gents,

Please review and provide comment/recommended changes to the attached plan in preparation for a meeting next week as a follow on to Monday's discussion on Brian's tasking. Let us meet amongst ourselves before we re-engage DSA.

thx

Richard Correia, PE
Director, Division of Risk Analysis
Office of Nuclear Regulatory Research
US NRC

BBB\117

richard.correia@nrc.gov

From: Gibson, Kathy
Sent: Wednesday, April 06, 2011 3:45 PM
To: Correia, Richard; Lee, Richard; Armstrong, Kenneth
Cc: Uhle, Jennifer; Sheron, Brian; Tinkler, Charles; Santiago, Patricia
Subject: RE:

Great! Rich, would you have your staff take a look and come to the meeting prepared with any changes they think need made for discussion including any parts that may have already been done that we can build upon?

Ken and Richard, would you review the attached and determine whether and what parts of this may have already been done and come to the meeting prepared to discuss?

I propose we walk through the document in the meeting, make appropriate changes and work toward finalizing it.

Kathy Halvey Gibson
Director
Division of Systems Analysis

(b)(6)

From: Sheron, Brian
Sent: Wednesday, April 06, 2011 3:29 PM
To: Gibson, Kathy
Cc: Uhle, Jennifer; Correia, Richard
Subject: RE:

Yes, this is roughly what I had in mind.

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This document seems to be a good place for us to start regarding a SOW. DSA and DRA are meeting Tues or Wed next week, so if you have comments on this document it would be great if we had them by then so we could be that much further ahead.

Thanks,
Kathy

Kathy Halvey Gibson
Director
Division of Systems Analysis
Kathy.Gibson@nrc.gov
(b)(6)

From: Tinkler, Charles
Sent: Wednesday, April 06, 2011 1:52 PM
To: Gibson, Kathy
Subject:

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I understand DRA has recently(?) developed a new version of such a plan (Don Helton has a copy of the attached plan – he worked with me back in that timeframe). I have not seen the DRA plan but I guess it is more heavily inclined towards level 1 PRA stuff.

Charles Tinkler
Charles.Tinkler@nrc.gov

April 8th, 2011

RES/DRA/PRAB Comments on the 2008 RES/DSA Spent Fuel Storage Differential Risk Study Plan Documented in ML081790081

General:

- The study appears to be a worthwhile endeavor in that it will permit a more realistic estimate of: the risks associated with storage of spent fuel in pools, the benefits of mitigation measures implemented as part of B.5.b, and the potential differences in risks posed by alternative spent fuel storage approaches. However, **it seems questionable to expedite a study of this kind at this time**, from two perspectives: (i) events related to the Japanese earthquake are still evolving and could change our perspective on how such a study should be conducted and (ii) this study has not been coordinated with a very similar activity that constitutes one piece of the SECY paper for the new site Level 3 PRA and risks significant re-direction when Commission direction on that study is issued.
- The writeup should emphasize the benefit of such a study for external risk communications. The vast majority of the work performed since 9/11 is unavailable to the public due to its relationship to the NRC security assessments. Any study of this type would enhance public access to state-of-the-art analyses.
- **Rather than launching in to a full-blown study, it might be prudent to take a phased approach.** An example is provided as an attachment to these comments.

Objectives:

- The stated objective is somewhere between a cost/benefit analysis on moving fuel and an absolute risk quantification study. **It is very important that the decision makers agree that this is the objective, as it will affect the preferred approach.**
    - For instance, a study to compare SFP risk to reactor risk might be more advantageous from an overall regulatory perspective, and might prompt a different approach.
- The plan acknowledges the need to consider the risk associated with fuel movement and storage of older fuel that is offloaded to achieve low density racking. However, the plan does not seem to include any recommended approach or resources for doing this.
- It is stated that seismic events and cask drop events are sufficiently risk dominant such that other initiating events (e.g., human errors) can be neglected. **Is there sufficient basis for this, and does this fundamentally affect whether the proposed study is a risk study or a consequence study?**
- Given current events, the plan should be updated to at least consider reactor-event-initiated SFP accidents (e.g., loss of pool integrity due to hydrogen explosions associated with reactor containment venting).

Technical Approach:

- The study intends to evaluate only a single SFP design -- Peach Bottom, with Mark I containment and elevated pool. This does not appear to be sufficient to draw general conclusions regarding the risk and cost/benefit differential for various storage options since variations in pool structural capabilities and failure modes/locations (e.g., among the elevated pools in Mark I and II plants), pool location (e.g., elevated versus below grade pools), and other SFP features can significantly impact the likelihood and consequences of SFP damage. **We recommend that the project plan include a task**

to evaluate extending the methods or results to cover other sites, and that the <u>models/methods</u> developed through this effort (but not the specific boundary conditions/assessments) be as generalized as practical to facilitate future application to other SFP and reactor building designs

- We agree that phenomenological modeling and human reliability analysis are important components of the quantification, as stated. We also agree that probabilistically weighted structural damage conditions are needed. We further agree that structural assessments of the fuel, pool, and building are necessary.
- The issue of spray system scrubbing of fission products is raised. This is an important issue from the perspective of the state-of-the-art in phenomenological modeling.

Risk Assessment:

- **We agree with the argument that knowing absolute risk is important, and do not recommend proceeding with any variation of the proposed study that would not be able to compute it.** Doing so would be inconsistent with the notion of the Safety Goal, the Backfit Rule, etc.
- **The project plan is silent regarding security-related events.** Evaluating the benefits of the B.5.b mitigation measures, while omitting treatment of the security events themselves (for which these measures were implemented) provides an incomplete picture of risk and could be problematic from a public perception point of view. We recommend that dialogue on this issue be continued.
- **Given that the initiating event frequencies in NUREG-1738 are over a decade old and the accompanying structural assessments have been cited as being conservative, it isn't clear why they should be the primary basis for this component of the study.** Some of the initiating event frequencies (particularly SBO and seismic) would be better taken from existing agency or licensee reactor PRA models. Admittedly, some others (e.g., cask drop) might be more difficult to obtain if operating experience events and/or processes do not provide sufficient data. In both cases, updated structural assessments are called for elsewhere in the plan.

Analyses:

- Terms like "idealized" and "optimal" connote non-conservatism, even when that isn't the intent. Suggest removing these words, or replacing with "stylized" or the like.
- Whether the circa 2004 fuel loading information will be used and extrapolated, or new information will be obtained from the licensee, is an important point for consideration
- **It is imperative that the grace period for a non-dispersed configuration following an outage be included.** Not considering this period while taking credit for re-configuration would render the results misleading.
- **The writeup should be updated to reflect the current SOARCA practices with regard to reporting dose effects based on different dose response models, as well as to include how the ongoing economics model update for MACCS2 would or would not feed in to this study.** [Note that prior NRR comment on the plan proposed the need to systematically update economic modeling inputs.]
- **We agree that capturing economic effects is important, and that if it is not included this should be justified up front.**

Task Summaries:

- See previous comment on initiating event frequency - **In addition, the plan minimizes the amount of risk modeling that actually exists in this risk study. Doing so will likely lead to similar concerns over sequence selection as have been raised during the SOARCA project.**
- It is suggested that MELCOR model development be phased such that it corresponds to the end of the structural analysis task, given that the assessments of fuel, pool, and building damage may influence model development.
- **There is no discussion of human reliability analysis in the task breakdown, or even the broader need of identifying timing for mitigative actions.** The plan needs to be further developed in this area.

Resource Requirements & Impacts:

- **The roughly 5 staff-months (12%) associated with the risk analysis portion of the overall plan seems insufficient for meaningfully influencing the course of the project.**
- As time permits, a more detailed cost/FTE breakdown needs to be developed to identify which pieces are in-house versus which are contracted. Further the FTE and responsibilities of the various offices needs to be identified and budgeted.
- The contractor availability piece obviously needs to be updated, though ironically, SOARCA may still be the biggest conflict. During this update, **a broader look needs to be taken at the impacts on non-DSA projects**, particularly those that support other offices.
- The departure of key personnel involved in prior SFP analysis from Sandia, and their availability as a contractor or subcontractor, should be discussed.
- **The plan estimates 1.75 FTE over 28 months, or less than 1 FTE/year. Understanding that the intent is to have much of the work done by contractor staff, this estimate seems unreasonable given the scope and complexity of the project.**

Coordination:

- I agree with the assertions that good coordination is key. **NMSS should be added to the list of internal stakeholders, as they "own" any part of the study that involves dry cask loading and storage risk.** In particular, NMSS' willingness to have results of this study compared to NUREG-1864 (2007 Pilot Dry Cask PRA) is an important aspect to discuss early, given past concerns over some of the limitations associated with NUREG-1864.
- The plan should also acknowledge that work is ongoing internationally in the area of SFP modeling and risk analysis (particularly in Switzerland and France). A side-task to coordinate with these entities should be considered, potentially through existing channels such as the OECD SFP experimental testing project or WGRisk.

Attachment – Example of a Phased Approach to the Study

Phase 1 – Framework Demonstration (~ 6 months)

- In-house development of accident scenarios (e.g., development of event trees)
  - Utilize IEF, success criteria, etc. from previous studies (NUREG-1738, Sandia studies, etc.)
  - Input placeholders for HRA pre-initiators, conditional structural damage probabilities, recovery probabilities, etc.
  - Include frequency uncertainty, albeit using placeholders
  - Document above
- Initiate planning/resourcing discussions with other divisions, other offices
- Socialize project with senior management
- Product: draft SECY

Phase 2 – Initial review and preparation for detailed study (~ 6 months)

- Brief ACRS
- Form steering committee
- Hold public meeting
- Issue SECY
- Site visit
- Formulate and award necessary contracts

Phase 3 – Detailed study (~ 12 months)

- Continued interaction with site
- Contractor and in-house work to replace placeholders, strengthen uncertain aspects
  - DRA – IEFs, HRA, develop reactor-accident initiators / multi-unit considerations, etc.
  - DSA – accident progression modeling, source term modeling, consequence analysis
  - DE – seismic fragility analysis, structural response analysis, fuel damage analysis
  - NSIR – EP modeling

Phase 4 – Documentation and outreach

- Licensee factual review
- Brief ACRS
- Hold public meeting(s)
- Issue NUREG(s)

Greenwood, Carol

From: Gibson, Kathy
Sent: Monday, April 11, 2011 4:12 PM
To: Huffert, Anthony
Subject: Re: THuffert travel info (Japan)

Godspeed, Tony!

From: Huffert, Anthony
To: Greenwood, Carol
Cc: Bano, Mahmooda; Scott, Michael; Gibson, Kathy; Schaffer, Steven
Sent: Mon Apr 11 12:50:13 2011
Subject: THuffert travel info (Japan)

Carol,

Below is contact information while I'm on assignment in Tokyo this month.

NRC site team in Japan (general phone number): 9-011-81-3-3224-5066
Hotel Okura Tokyo (2-10-4 Toranomon in Minatu-ku, Tokyo): 9-011-81-3-3582-0111
My blackberry number (b)(6)

(b)(6)

Flight information is expected later today from USAID.

Tony

888\118

From: Beasley, Benjamin
To: Correia, Richard; Coe, Doug
Subject: FW: Press Release: Power Grid Reliability and Nuclear Power Plants
Date: Monday, April 11, 2011 8:46:58 AM
Attachments: Petition For Rulemaking Submitted 2 8 2011.pdf
PreparedStatementofThomasPopik 2 8 2011.pdf
3CPositionStatementonSolarMagneticDisturbanceForecasting.pdf

From: Beasley, Benjamin
Sent: Thursday, February 10, 2011 7:36 AM
To: Lui, Christiana; Coe, Doug
Subject: FW: Press Release: Power Grid Reliability and Nuclear Power Plants

FYI...

(This would not be a generic issue because it is being handled by another regulatory process.)

From (b)(6)
Sent: Wednesday, February 09, 2011 6:41 PM
To: Beasley, Benjamin; GWM2@nrc.gov; Foster, Jack; Kauffman, John
Subject: Fwd: Press Release: Power Grid Reliability and Nuclear Power Plants

Greetings;
I am passing on some information I have just received, I recall having made several visits with NRC staff over the past 3 years to discuss findings on concern for long term outages to the US power grid and issues this may raise regarding NRC coping strategies.

A new group has just this week formally filed a draft petition on this issue with the NRC. See below for more details.
Best Regards,

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From: thomasp@resilientsocieties.org
To (b)(6)

BB/119

Sent: 2/9/2011 1:20:19 P.M. Central Standard Time
Subj: Press Release: Power Grid Reliability and Nuclear Power Plants

FOR IMMEDIATE RELEASE

February 9, 2011

GROUP FILES FORMAL PETITION TO NUCLEAR REGULATORY COMMISSION TO REQUIRE INSTALLATION OF NEW BACK-UP SAFETY SYSTEMS

CONGRESSMAN TRENT FRANKS ADDRESSES FEDERAL ENERGY REGULATORY COMMISSION ON RISKS TO U.S. POWER GRIDS

NASHUA NH—At a press conference in front of the Federal Energy Regulatory Commission on February 8, the Foundation for Resilient Societies announced the filing of a Petition for Rulemaking before the Nuclear Regulatory Commission (NRC). Experts on hand to answer media questions included George Baker, professor at James Madison University and former staff to Electromagnetic Pulse (EMP) Commission; Bronius Cikotas, founder of the Asymmetrical Threat Analysis Response Center; Michael Del Rosso, research fellow of the Claremont Institute and former Chairman of the IEEE-USA Critical Infrastructure Protection Committee; Henry Kluepfel, former EMP commissioner; Charles Manto, president of Instant Access Networks ; and Michael Mariotte, executive director of Nuclear Information and Resource Service. The petition, submitted to the NRC on February 6, proposes requirements for unattended spent fuel pool cooling at nuclear power plants to protect against long-term power grid collapse. The full text of the petition is available at www.resilientsocieties.org.

Immediately after the press conference, Congressman Trent Franks (R-AZ) addressed attendees to an electric reliability technical conference held at the Federal Energy Regulatory Commission. Congressman Franks gave the 1859 Carrington Event as an example of severe space weather that could cause long-term collapse of the North American power grids. As part of later testimony, Avi Schnurr of the Electric Infrastructure Security Council stated that long-term grid collapse is an "existential" threat to the United States.

The rolling blackouts in Texas this past week demonstrated the fragility of the North American power grids and their vulnerability to extreme weather and other natural disasters. The safety of nuclear power plants depends on reliable grid power. Nuclear Regulatory Commissioner Jeffery Merrifield stated in 2006, "A big part of our risk-informed regulatory strategy depends on plants having access to reliable offsite power. We assume that there will be very few times when a plant will be subjected to a total loss of offsite power, and when such condition exists it will be for a relatively short period of time (hours or days rather than weeks)."

According to a recent report released by the Oak Ridge National Laboratory, the North American power grids are vulnerable to severe space weather and could experience widespread and long-term outages persisting 1-2 years. Most nuclear power plants in the eastern United States, as well the Columbia Generating Station in Washington State, are in the area of probable power system collapse as disclosed by Oak Ridge.

Spent fuel pools are currently used at all operating nuclear power plants. Fuel rods continue to generate substantial heat after removal from the reactor core, necessitating active cooling in water pools. There are 104 nuclear power reactors operating in the United States at 65 sites in 31 states. Each site has one or more spent fuel pools. Spent fuel contains a number of radioactive elements resulting from fission within the reactor core, the most significant being Ruthenium-106 with a half-life of one year and Cesium-137 with a half-life of 30 years. Should spent fuel rods become uncovered by water, the zirconium cladding of the rods would likely catch fire.

While there are multiple scenarios that could cause uncovering of spent fuel rods and result in zirconium fire, for the purposes of the Petition, the most significant scenario is long-term loss of outside power supplied by the commercial electric grid. Current design criteria for nuclear power plants and associated spent fuel pools assume reliable and quickly restored commercial grid power. In the event of a long-term loss of commercial grid power, extending beyond a month, it is likely that water in spent fuel pools would heat up and boil-off, fuel rods would become uncovered by water, zirconium cladding would catch fire, and large amounts of fatal radiation would be released into the atmosphere.

In October 2010, Oak Ridge National Laboratory released Electromagnetic Pulse: Effects on the U.S. Power Grid, a series of comprehensive technical reports for the Federal Energy Regulatory Commission (FERC) in joint sponsorship with the Department of Energy and the Department of Homeland Security. These reports disclose that the commercial power grids in two large areas of the continental United States are vulnerable to severe space weather. The reports conclude that solar activity and resulting large earthbound Coronal Mass Ejection (CME), occurring on average once every one hundred years, would induce a geomagnetic disturbance and cause probable collapse of the commercial grid in these vulnerable areas. Excess heat from induced currents in transmission lines would permanently damage approximately 350 extra high voltage transformers. The replacement lead time for extra high voltage transformers is approximately 1-2 years. As a result, about two-thirds of nuclear power plants and their associated spent fuel pools would likely be without commercial grid power for a period of 1-2 years.

Commercial grid outage of 1-2 years far exceeds the current design criteria for nuclear power plants and associated spent fuel pools. Accordingly, the NRC should adjust design criteria for nuclear power plants and associated spent fuel pools to minimize risk and avoid radiation fatalities.

For more information contact Thomas Popik, Foundation for Resilient Societies.

email thomasp@resilientsocieties.org, phone 603-321-1090.

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Before the
UNITED STATES NUCLEAR REGULATORY COMMISSION
Rockville, Maryland

**In the Matter of a Proposed Rulemaking
Regarding Amendment of 10 CFR Part 50,
"DOMESTIC LICENSING OF PRODUCTION
AND UTILIZATION FACILITIES"**

Docket No.____________________

PETITION FOR RULEMAKING

This Petition for Rulemaking is submitted pursuant to 10 CFR 2.802, "Petition for Rulemaking," by the Foundation for Resilient Societies. The Petitioner requests that the U.S. Nuclear Regulatory Commission (NRC), following public notice and opportunity for comment, adopt regulations that would require facilities licensed by the NRC under 10 CFR Part 50 to assure long-term cooling and automated water makeup of spent fuel pools.

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STATEMENT OF PETITIONER'S INTEREST

Petitioner is an association within the United States, has an interest in the health and safety of its citizens, and has a further interest in large land areas of the United States not becoming contaminated with nuclear radiation and therefore being uninhabitable for hundreds of years.

SUMMARY OF CURRENT SITUATION

Spent fuel pools are currently used at all operating nuclear power plants. Fuel rods continue to generate substantial heat after removal from the reactor core, necessitating active cooling in water pools. There are 104 nuclear power reactors operating in the United States at 65 sites in 31 states. Each site has one or more spent fuel pools. Spent fuel contains a number of radioactive elements resulting from fission within the reactor core, the most significant being Ruthenium-106 with a half-life of one year and Cesium-137 with a half-life of 30 years. Should spent fuel rods become uncovered by water, the zirconium cladding of the rods would likely catch fire.

While there are multiple scenarios that could cause uncovering of spent fuel rods and result in zirconium fire, for the purposes of this Petition, the most significant scenario is long-term loss of outside power supplied by the commercial electric grid. Current design criteria for nuclear power plants and associated spent fuel pools assume reliable and quickly restored commercial grid power. In the event of a long-term loss of commercial grid power, extending beyond a month, it is likely that water in spent fuel pools would heat up and boil-off, fuel rods would become uncovered by water, zirconium cladding would catch fire, and large amounts of fatal radiation would be released into the atmosphere.

In October 2010, Oak Ridge National Laboratory released "Electromagnetic Pulse: Effects on the U.S. Power Grid," a series of comprehensive technical reports for the Federal Energy Regulatory Commission (FERC) in joint sponsorship with the Department of Energy and the Department of Homeland Security. These reports disclose that the commercial power grids in two large areas of the continental United States are vulnerable to severe space weather. The reports conclude that solar activity and resulting large earthbound Coronal Mass Ejection (CME), occurring on average once every one hundred years, would induce a geomagnetic disturbance and cause probable collapse of the commercial grid in these vulnerable areas. Excess heat from induced currents in transmission lines would permanently damage approximately 350 extra high voltage transformers. The replacement lead time for extra high voltage transformers is approximately 1-2 years. As a result, about two-thirds of nuclear power plants and their associated spent fuel pools would likely be without commercial grid power for a period of 1-2 years.

Commercial grid outage of 1-2 years far exceeds the current design criteria for nuclear power plants and associated spent fuel pools. Accordingly, the NRC should adjust design criteria for nuclear power plants and associated spent fuel pools to minimize risk and avoid radiation fatalities. This Petition proposes requirements for unattended spent fuel pool cooling at nuclear power plants.

SPECIFIC ISSUES FOR SPENT FUEL POOLS

Risk of Spent Fuel Pools

Spent fuel pools have long been recognized by the NRC as a risk. In order to prevent overheating and boil-off of water in spent fuel pools, active cooling and/or continual replenishment of water is required. Nuclear power plants have been operated for many years without off-site repositories for spent fuel. With each reactor refueling, spent fuel has been added to water pools with limited capacity. Originally, these pools were designed for temporary storage until spent fuel had cooled sufficiently for transport off-site. The typical spent fuel pool now contains 10-30 years of fuel stored in high density racks that were not part of the original pool design. Spent fuel pools are in industrial-design buildings that vent to the atmosphere and do not provide radiation containment.

NUREG-0933, "Resolution of Generic Safety Issues: Issue 82: Beyond Design Basis Accidents in Spent Fuel Pools (Rev. 3) (NUREG-0933, Main Report with Supplements 1–33)" summarizes current spent fuel storage practices and the risk of radiation release to the atmosphere:

> A typical spent fuel storage pool with high density storage racks can hold roughly five times the fuel in the core. However, since reloads typically discharge one third of a core, much of the spent fuel stored in the pool will have had considerable decay time. This reduces the radioactive inventory somewhat. More importantly, after roughly three years of storage, spent fuel can be air-cooled, i.e., such fuel need not be submerged to prevent melting. (Submersion is still desirable for shielding and to reduce airborne activity, however.)
>
> If the pool were to be drained of water, the discharged fuel from the previous two refuelings would still be "fresh" enough to melt under decay heat. However, the zircaloy cladding of this fuel could be ignited during the heatup.[543] The resulting fire, in a pool equipped with high density storage racks, would probably spread to most or all of the fuel in the pool. The heat of combustion, in combination with decay heat, would certainly release considerable gap activity from the fuel and would probably drive "borderline aged" fuel into a molten condition. Moreover, if the fire becomes oxygen-starved (quite probable for a fire located in the bottom of a pit such as this), the hot zirconium would rob oxygen from the uranium dioxide fuel, forming a liquid mixture of metallic uranium, zirconium, oxidized zirconium, and dissolved uranium dioxide. This would cause a release of fission products from the fuel matrix quite comparable to that of molten fuel.[545] In addition, although confined, spent fuel pools are almost always located outside of the primary containment. Thus, release to the atmosphere is more likely than for comparable accidents involving the reactor core.

NRC also examined the risk of spent fuel pools in NUREG-1738, "Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants," February 2001. This study calculated the length of time between cessation of active cooling and water uncovering of spent fuel rods. This time varies from 4 to 22 days, depending on reactor design and age of fuel.

> Analyses were performed to evaluate the thermal-hydraulic characteristics of spent fuel stored in the spent fuel pools (SFPs) of decommissioning plants and determine the time available for plant operators to take actions to prevent a zirconium fire. These are discussed in Appendix 1A. The focus was the time available before fuel uncovery and the time available before the zirconium ignites after fuel uncovery. These times were utilized in performing the risk assessment discussed in Section 3.
>
> To establish the times available before fuel uncovery, calculations were performed to determine the time to heat the SFP coolant to a point of boiling and then boil the coolant down to 3 feet above the top of the fuel. As can be seen in Table 2.1 below, the time available to take actions

before any fuel uncovery is 100 hours or more for an SFP in which pressurized-water reactor (PWR) fuel has decayed at least 60 days.

Table 2.1 Time to Heatup and Boiloff SFP Inventory Down to 3 Feet Above Top of Fuel (60 GWD/MTU)

DECAY TIME	PWR	BWR
60 days	100 hours (>4 days)	145 hours (>6 days)
1 year	195 hours (>8 days)	253 hours (>10 days)
2 years	272 hours (>11 days)	337 hours (>14 days)
5 years	400 hours (>16 days)	459 hours (>19 days)
10 years	476 hours (>19 days)	532 hours (>22 days)

NUREG-1738 identified nine events that could cause uncovering of spent fuel and resulting zirconium cladding fires:

> The staff identified nine initiating event categories to investigate as part of the quantitative assessment on SFP risk:
>
> 1. Loss of offsite power from plant centered and grid-related events
> 2. ***Loss of offsite power from events initiated by severe*** **weather**
> 3. Internal fire
> 4. Loss of pool cooling
> 5. Loss of coolant inventory
> 6. Seismic event
> 7. Cask drop
> 8. Aircraft impact
> 9. Tornado missile
>
> (Emphasis added)

The National Research Council of the National Academies of Science also authored a report on spent fuel pools. "Safety and Security of Commercial Spent Nuclear Fuel Storage" was developed at the request of the U.S. Congress with sponsorship from the NRC and Department of Homeland Security and released in 2005. While the National Research Council report focused on the risk of uncovered spent fuel due to terrorist attack, many of its findings are also applicable to other events that would result in a "loss-of-pool-coolant" scenario. The National Research Council report confirmed the loss-of-pool-coolant scenario as described in the Nuclear Regulatory Commission report, "Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants."

> A terrorist attack that either disrupted the cooling system for the spent fuel pool or damaged or collapsed the pool itself could potentially lead to a loss-of-pool-coolant event. The cooling system could be disrupted by disabling or damaging the system that circulates water from the pool to heat exchangers to remove decay heat. This system would not likely be a primary target of a terrorist attack, but it could be damaged as the result of an attack on the spent fuel pool or other targets at the plant (e.g., the power for the pumps could be interrupted). The loss of cooling

capacity would be of much greater concern were it to occur during or shortly after a reactor offloading operation, because the pool would contain a large amount of high decay-heat fuel.

The consequences of a damaged cooling system would be quite predictable: The temperature of the pool water would rise until the pool began to boil. Steam produced by boiling would carry away heat, and the steam would cool as it expanded into the open space above the pool.[13] Boiling would slowly consume the water in the pool, and if no additional water were added the pool level would drop. It would likely take several days of continuous boiling to uncover the fuel. Unless physical access to the pool were completely restricted (e.g., by high radiation fields or debris), there would likely be sufficient time to bring in auxiliary water supplies to keep the water level in the pool at safe levels until the cooling system could be repaired. This conclusion presumes, of course, that technical means, trained workers, and a sufficient water supply were available to implement such measures. The Nuclear Regulatory Commission requires that alternative sources of water be identified and available as an element of each plant's operating license.

Cooling Systems for Spent Fuel Pools

NUREG-1738, "Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants," contains a diagram and description of a typical spent fuel cooling system.

Figure 2.1 Simplified Diagram of Spent Fuel Pool Cooling and Inventory Makeup Systems

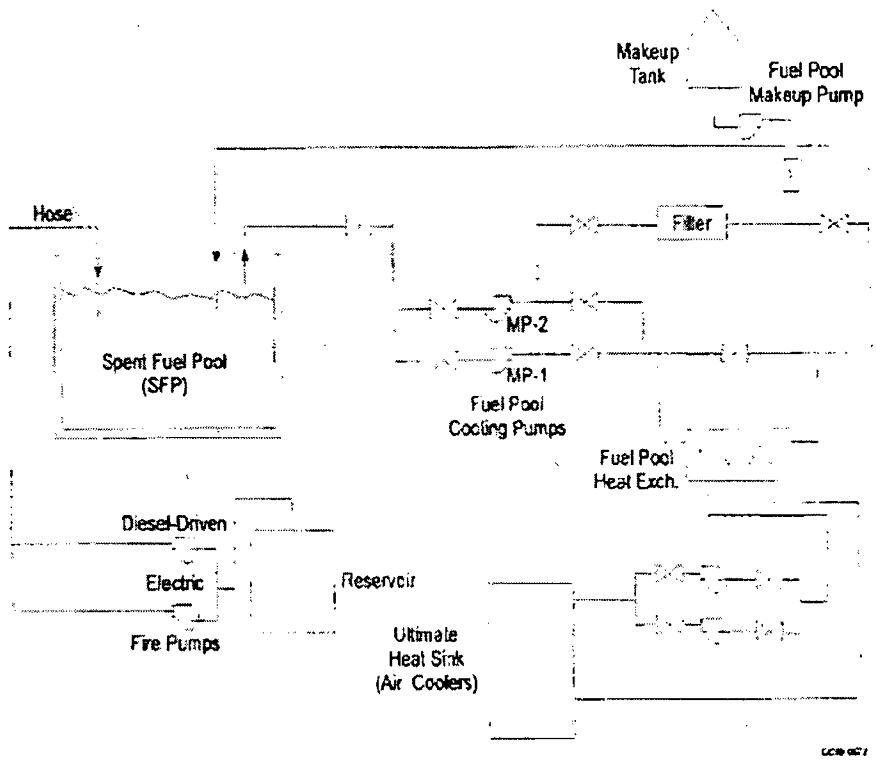


Figure 2.1 is a simplified drawing of the system assumed for the development of the model. The spent fuel pool cooling (SFPC) system is located in the SFP area and consists of motor-driven pumps, a heat exchanger, an ultimate heat sink, a makeup tank, filtration system and isolation valves. Suction is taken via one of the two pumps on the primary side from the SFP and is passed through the heat exchanger and returned back to the pool. One of the two pumps on the secondary side rejects the heat to the ultimate heat sink. A small amount of water is diverted to the filtration process and is returned to the discharge line. A regular makeup system supplements the small losses because of evaporation. In the case of prolonged loss of SFPC system or loss of inventory events, the inventory in the pool can be made up using the firewater system. There are two firewater pumps, one motor-driven (electric) and the other diesel-driven, which provide firewater throughout the plant. A firewater hose station is provided in the SFP area. The firewater pumps are assumed to be located in a separate structure.

As described in the NUREG-1738, pumps to provide active cooling of the spent fuel pool are powered by electric motors. Without a continual source of alternating electric current, the motors would stop powering the circulation pumps and active cooling would cease.

As shown in Figure 2.1 of NUREG-1738, alternate systems exist to provide makeup water should active cooling by water circulation cease—specifically, electrically-driven and diesel-driven pumps. In theory, as long as electricity or diesel fuel is available, and makeup water pumps do not mechanically break down, and operators are on-site to monitor the water level and start up the pumps, and the makeup water reservoir contains water, water could be added to the spent fuel pools. Adding makeup water would keep the temperature of the spent fuel rods at or below the boiling point of water (100 degrees Celsius), which is substantially below the ignition point for zirconium (900 degrees Celsius).

To summarize, active cooling systems for spent fuel pools are primarily dependent on a continual supply of electric power. While diesel-driven pumps for makeup water can be used as a stopgap measure when electric power is not available, their continuing use would require diesel fuel and human operator attention.

Alternating Current Power Sources for Nuclear Power Plants and Spent Fuel Pools

Design criteria for nuclear power plants and associated spent fuel pools specify three levels of alternating current power sources:

1. Offsite power, also known as the "commercial grid"
2. Onsite power, also known as emergency backup generation
3. Alternate ac sources

10 CFR Part 50.63, "Loss of all alternating current power," specifies the critical role of reliable and quickly restored offsite power, also commonly referred to as "commercial grid," in nuclear power plant design criteria:

§ 50.63 Loss of all alternating current power.

(a) *Requirements*. (1) Each light-water-cooled nuclear power plant licensed to operate under this part, each light-water-cooled nuclear power plant licensed under subpart C of 10 CFR part 52 after the Commission makes the finding under § 52.103(g) of this chapter, and each design for a light-water-cooled nuclear power plant approved under a standard design approval, standard design certification, and manufacturing license under part 52 of this chapter must be able to withstand for a specified duration and recover from a station blackout as defined in § 50.2. The specified station blackout duration shall be based on the following factors:

(i) The redundancy of the onsite emergency ac power sources;

(ii) The reliability of the onsite emergency ac power sources;

(iii) The expected frequency of loss of offsite power; and

(iv) The probable time needed to restore offsite power.

Because offsite electric power is the default design criteria power source for nuclear power plants, it is required to be supplied in a high-reliability, dual-circuit configuration. Appendix A to Part 50--General Design Criteria for Nuclear Power Plants, describes the importance of reliable offsite power for the maintenance of vital safety functions:

> Electric power from the transmission network to the onsite electric distribution system shall be supplied by two physically independent circuits (not necessarily on separate rights of way) designed and located so as to minimize to the extent practical the likelihood of their simultaneous failure under operating and postulated accident and environmental conditions. A switchyard common to both circuits is acceptable. Each of these circuits shall be designed to be available in sufficient time following a loss of all onsite alternating current power supplies and the other offsite electric power circuit, to assure that specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded. One of these circuits shall be designed to be available within a few seconds following a loss-of-coolant accident to assure that core cooling, containment integrity, and other vital safety functions are maintained.

In the event of failure of electric power from the redundant transmission network circuits, also commonly referred to as "grid power," the first level of backup is onsite alternating current power. Onsite alternating current power is commonly supplied by emergency diesel generators as described in Regulatory Guide 1.9, "Application and Testing of Safety-Related Diesel Generators in Nuclear Power Plants":

> 10 CFR 50.63, "Loss of All Alternating Current Power," requires that each light-water-cooled nuclear power plant must be able to withstand and recover from a station blackout (i.e., loss of offsite and onsite emergency alternating current (ac) power systems) for a specified duration. The reliability of onsite ac power sources is one of the main factors contributing to the risk of core melt as a result of a station blackout...Most onsite electric power systems use diesel generators as the chosen onsite emergency power source.
>
> (Ellipses not in original document.)

The typical onsite storage of diesel fuel for emergency generators is sufficient for only seven days of continuous operation as described in NRC Regulatory Guide 1.137, "Fuel-Oil Systems for Standby Diesel Generators":

> c. Section 5.4, "Calculation of Fuel Oil Storage Requirements," of the standard sets forth two methods for the calculation of fuel-oil storage requirements. These two methods are (1) calculations based on the ***assumption that the diesel generator operates continuously for 7 days at its rated capacity***, and (2) calculations based on the time-dependent loads of the diesel generator. For the time-dependent load method, the minimum required capacity should include the capacity to power the engineered safety features.
>
> (Emphasis added.)

Should both offsite grid power and onsite emergency power from diesel generators be lost, the nuclear power plant would enter a station blackout condition. NRC Regulatory Guide 1.155, "Station Blackout" describes the expected duration of station blackouts in current design criteria. Required capability to withstand station blackouts is limited to only 16 hours:

> The term "station blackout" refers to the complete loss of alternating current electric power to the essential and nonessential switchgear buses in a nuclear power plant. Station blackout therefore involves the loss of offsite power concurrent with turbine trip and failure of the onsite emergency ac power system, but not the loss of available ac power to buses fed by station batteries through inverters or the loss of power from "alternate ac sources." Station blackout and alternate ac source are defined in § 50.2. Because many safety systems required for reactor core decay heat removal and containment heat removal are dependent on ac power, the consequences of a station blackout could be severe. In the event of a station blackout, the capability to cool the reactor core would be dependent on the availability of systems that do not require ac power from

the essential and nonessential switchgear buses and on the ability to restore ac power in a timely manner.

The concern about station blackout arose because of the accumulated experience regarding the reliability of ac power supplies. Many operating plants have experienced a total loss of offsite electric power, and more occurrences are expected in the future. In almost every one of these loss-of-offsite-power events, the onsite emergency ac power supplies have been available immediately to supply the power needed by vital safety equipment. However, in some instances, one of the redundant emergency ac power supplies has been unavailable. In a few cases there has been a complete loss of ac power, but during these events ac power was restored in a short time without any serious consequences. In addition, there have been numerous instances when emergency diesel generators have failed to start and run in response to tests conducted at operating plants.

Based on § 50.63, all licensees and applicants are required to assess the capability of their plants to maintain adequate core cooling and appropriate containment integrity during a station blackout and to have procedures to cope with such an event. This guide presents a method acceptable to the NRC staff for determining the specified duration for which a plant should be able to withstand a station blackout in accordance with these requirements. ***The application of this method results in selecting a minimum acceptable station blackout duration capability from 2 to 16 hours***, depending on a comparison of the plant's characteristics with those factors that have been identified as significantly affecting the risk from station blackout. These factors include redundancy of the onsite emergency ac power system (ie., the number of diesel generators available for decay heat removal minus the number needed for decay heat removal), the reliability of onsite emergency ac power sources (e.g., diesel generators), the frequency of loss of offsite power, and the probable time to restore offsite power.

(Emphasis added.)

Time between Commercial Grid Outage and Zirconium Ignition

Should commercial grid power fail, backup diesel generators can provide power for 7 days without resupply of diesel fuel under typical emergency plans. Should emergency diesel generators cease functioning, current design criteria specify "alternate ac sources" to be available for a period of only 2 to 16 hours. Once electric power is no longer supplied to circulation pumps, the spent fuel pool would begin to heat up and boil; total time from cessation of active cooling to water uncovering of zirconium cladding would be 4 to 22 days, depending on reactor design and average decay years of spent fuel. Again depending on fuel decay years, from water uncovering to ignition of the zirconium cladding could be an additional 2 to 24 hours. Absent any addition of makeup water to the spent fuel pool, the total time from commercial grid outage to spontaneous zirconium ignition would likely be 12-31 days.

PROPOSED AMENDMENT TO 10 CFR PART 50

Petitioner requests that 10 CFR Part 50 be amended because the North American commercial grids are vulnerable to outage caused by severe space weather such as Coronal Mass Ejection and resulting geomagnetic disturbance and therefore cannot be relied on to provide continual power for active cooling and/or water makeup of spent fuel pools. Moreover, existing means of onsite backup power are designed to operate for only a few days, while spent fuel requires active cooling for several years after removal from the reactor core.

NRC should require all Part 50 licensees as of January 1, 2013 to meet these new requirements:

> Emergency systems to provide long-term cooling and water makeup for spent fuel pools shall be able to rely exclusively on on-site resources for a period of two years without human operator intervention and fuel resupply. Automated means of power sufficient to assure safety may include, but are not limited to: solar power, wind turbine, hydroelectric power, and other on-site means of generating electricity. This additional backup power must be dedicated to cooling and water makeup of spent fuel pools. If weather-dependent power sources such as solar or wind turbine are to be used, sufficient battery storage must be provided to maintain continual power during weather conditions which may temporarily constrict generation. Two independent cooling and water makeup systems shall be provided with a combined Mean Time Between Failure (MTBF) of 100,000 hours and an availability of 99% during normal operations (before loss of outside power).

RATIONALE FOR PROPOSED AMENDMENT

At the time of drafting of the current text of 10 CFR 50, vulnerability of the North American commercial grids to severe space weather had not been comprehensively studied, nor had probabilities and consequences for widespread and long-term power grid outage been determined. A primary rationale for this proposed amendment is a recently documented vulnerability of the North American power grids to severe space weather which could cause multiple-year power outages. In addition, a government-sponsored study of second-order effects of commercial grid failure on petrochemical fuel and food supplies shows that any assumption of outside assistance to nuclear power plants, including resupply of diesel fuel and food, may not be valid.

Risks from Severe Space Weather

In a previous Denial of Petition for Rulemaking (PRM-50-67), NRC recognized North American Electric Reliability Corporation (NERC) as the nation's authority on reliability of the electric power grid. At the time of the denial, NRC referenced data from NERC to argue that long-term onsite backup power for nuclear power plants was not necessary. In recent years, the authority of NERC on electric reliability has been further codified in law. The Federal Energy Regulatory Commission (FERC), pursuant to the Energy Policy Act of 2005, has certified NERC as the nation's Electric Reliability Organization and charged it with developing procedures for the establishment, approval and enforcement of mandatory electric reliability standards.

In a June 2010 report titled, "High-Impact, Low-Frequency Event Risk to the North American Bulk Power System," jointly sponsored by NERC and the Department of Energy, NERC now concedes that the North American power grids have significant reliability issues in regard to High-Impact, Low-Frequency (HILF) events such as severe space weather. The NERC HILF report explains commercial grid vulnerability to space weather:

> Intense solar activity, particularly large solar flares and associated coronal mass ejections can create disturbances in the near-Earth space environment when this activity is directed towards the Earth. The coronal mass ejection's solar wind plasma can then connect with the magnetosphere causing rapid changes in the configuration of Earth's magnetic field, a form of space weather called a geomagnetic storm. Geomagnetic storms produce impulsive disturbance of the geomagnetic field over wide geographic regions which, in turn, induce currents (called geomagnetically-induced currents or GIC) in the complex topology of the North American bulk power system and other high-voltage power systems across the globe. For many years it has been known that these storms have the potential to pose operational threats to bulk power systems; both contemporary experience and analytical work support these general conclusions. The electric sector has taken some meaningful steps to mitigate this risk as outlined in the January 2009 Report by National Academy of Sciences "Severe Space Weather Events—Understanding Societal and Economic Impacts Workshop Report," but more work is needed.
>
> More recently, a number of investigations have been carried out under the auspices of the EMP Commission and also for FEMA under Executive Order 13407 and FERC in partnership with the Departments of Energy, Homeland Security, and Defense. These investigations have been undertaken to examine the potential impacts on the U.S. electric power grid for severe geomagnetic storm events and EMP threats. In addition, this analysis was formative in the National Academy of Sciences "Severe Space Weather Events—Understanding Societal and

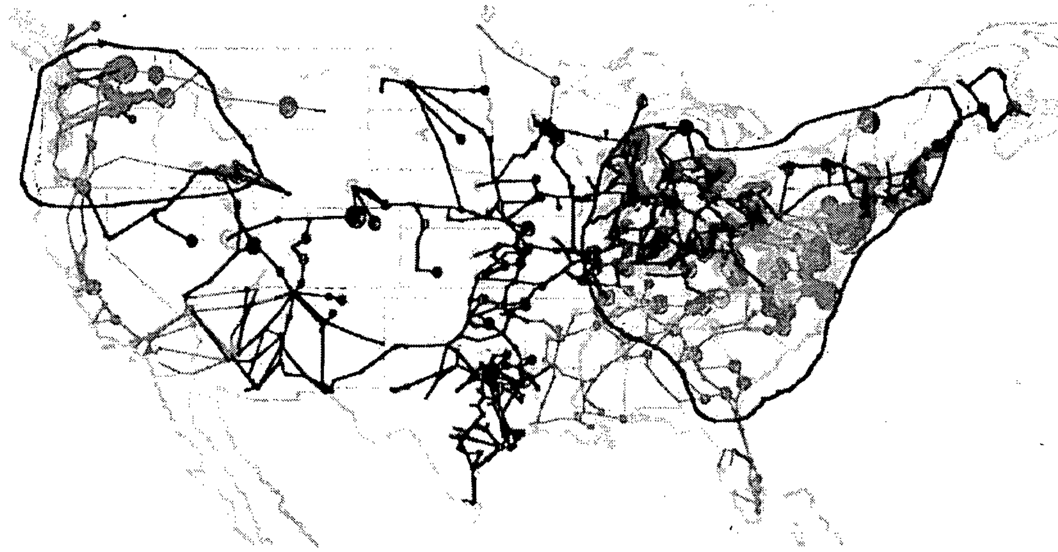
> Economic Impacts Workshop Report." ***These assessments indicate that severe geomagnetic storms have the potential to cause long-duration outages to widespread areas of the North American grid.***
>
> (Emphasis added.)

The HILF report further concludes that damage from space weather could not be quickly repaired:

> The design of transformers also acts to further compound the impacts of GIC flows in the high voltage portion of the power grid... ***These transformers generally cannot be repaired in the field, and if damaged in this manner, need to be replaced with new units, which have manufacture lead times of 12–24 months or more in the world market.***
>
> (Emphasis added.)

NERC and technical consultants conducted detailed analysis in preparation of the HILF report:

> Metatech conducted a simulation based on a 4800 nT/min disturbance, shown in Figure 11 which calculated the pattern of GIC flows in the U.S. power grid and the boundaries of regions of power grid that could be subject to progressive collapse, such as what occurred to the Québec Interconnection in March 1989. The simulation results indicate that more than a thousand EHV transformers will have sufficient GIC levels to simultaneously be driven into saturation. Further, this would suddenly impose an increase of over 100,000 MVARs of reactive demand on the system, a scenario that could trigger a widespread voltage collapse, resulting in system instability and, likely, a short-duration blackout. The analysis also indicates that the GIC in over 350 transformers will exceed levels where the transformer is at risk of irreparable damage. Figure 12 provides an estimate of "Percent Loss" of EHV transformation capacity by state for the same 4800 nT/min threat environment. ***Such large-scale damage could lead to prolonged restoration and long-term chronic shortages of electricity supply capability to the impacted regions, arguably for multiple years.***
>
> (Emphasis added.)



100 Year Geomagnetic Storm Ğ50 Degree Geomagnetic Disturbance Scenario

Figure 11: The simulation results showing the pattern of GIC flows in the U.S. grid for a 4800 nT/min geomagnetic field disturbance at 50 degrees geomagnetic latitude. The above regions outlined are susceptible to system collapse due to the effects of the GIC.

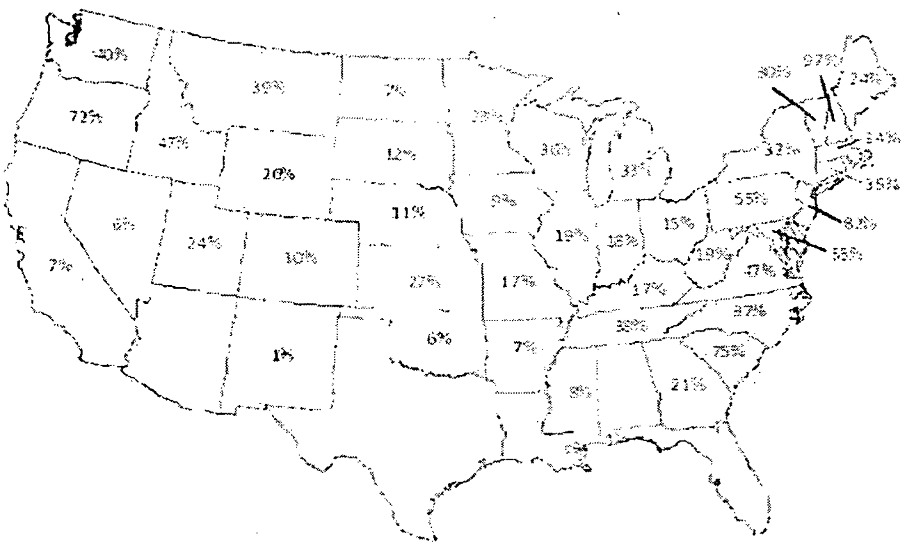


Figure 12: A map showing the At-Risk EHV Transformer Capacity by State for this disturbance scenario, regions with high percentages could experience long duration outages that could extend multiple years.[63]

Extra High Voltage (EHV) transformer damage would not be evenly distributed. For example, in New Hampshire, location of the Seabrook nuclear power plant, 97% of transformer capacity is at-risk to severe space weather.

In 2008, a National Research Council formed a Committee on the Societal and Economic Impacts of Severe Space Weather Events and published a report, "Severe Space Weather Events—Understanding Societal and Economic Impacts." The report described several severe space weather events over the past one-hundred and fifty years. The report reads in part:

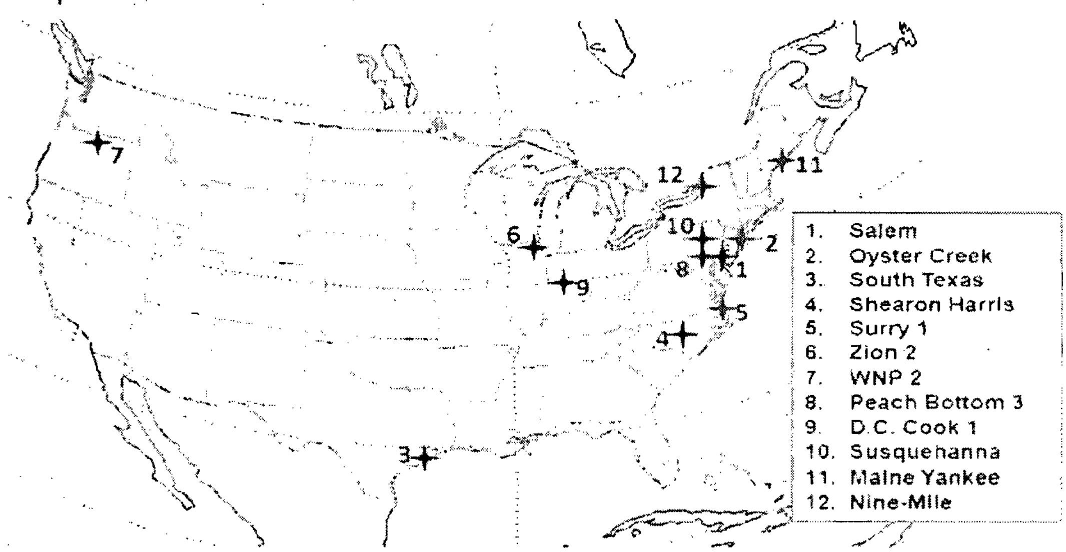
> Our knowledge and understanding of the vulnerabilities of modem technological infrastructure to severe space weather and the measures developed to mitigate those vulnerabilities are based largely on experience and knowledge gained during the past 20 or 30 years, during such episodes of severe space weather as the geomagnetic superstorms of March 1989 and October-November 2003. As severe as some of these recent events have been, the historical record reveals that space weather of even greater severity has occurred in the past—e.g., the Carrington event of 1859 and the great geomagnetic storm of May 1921—and suggests that such extreme events, though rare, are likely to occur again some time (sic) in the future. While the socioeconomic impacts of a future Carrington event are difficult to predict, it is not unreasonable to assume that an event of such magnitude would lead to much deeper and more widespread socioeconomic disruptions than occurred in 1859, when modern electricity-based technology was still in its infancy.

The Executive Director of Systems Operations at PJM Interconnection provided a specific example of space weather impact on power grid operations as part of the above referenced National Research Council report. (PJM is a regional transmission organization with 164,905 MW of generating capacity that coordinates the movement of wholesale electricity over 56,250 miles of transmission lines in all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and the District of Columbia.)

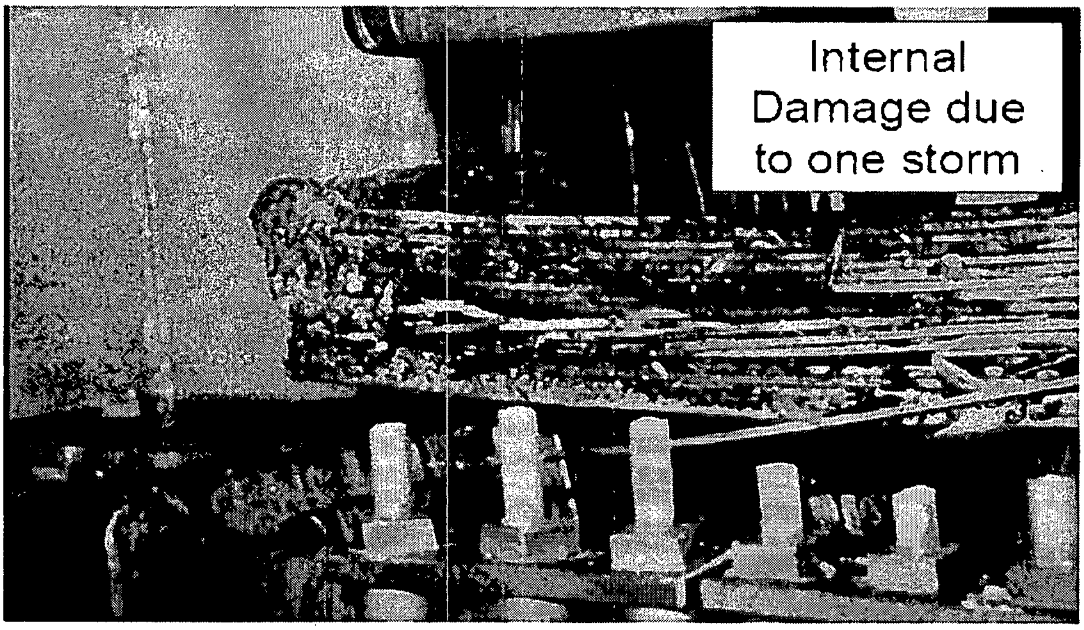
One example of a space weather event that had a major impact was the March 1989 superstorm. During this storm, a large solar magnetic impulse caused a voltage depression on the Hydro-Quebec power system in Canada that could not be mitigated by automatic voltage compensation equipment. The failure of the equipment resulted in a voltage collapse. Specifically, five transmission lines from James Bay were tripped, which caused a generation loss of 9,450 MW. With a load of about 21,350 MW, the system was unable to withstand the generation loss and collapsed within seconds. The province of Quebec was blacked out for approximately 9 hours.

Also during this storm, a large step-up transformer failed at the Salem Nuclear Power Plant in New Jersey. That failure was the most severe of approximately 200 separate events that were reported during the storm on the North American power system. Other events ranged from generators tripping out of service, to voltage swings at major substations, to other lesser equipment failures.

A presentation by John Kappenman titled "Impact of Severe Solar Flares, Nuclear EMP and Intentional EMI on Electric Grids," at the Electric Infrastructure Security (EIS) Summit in London, England on September 20, 2010, described the effects of solar storms on high voltage transformers. A long duration solar storm in October 2003 damaged 15 high voltage transformers in South Africa. After the March 1989 storm, 12 large Generator Step Up (GSU) transformers at United States nuclear power plants failed within 25 months; geomagnetically-induced current is the suspected cause of these failures:



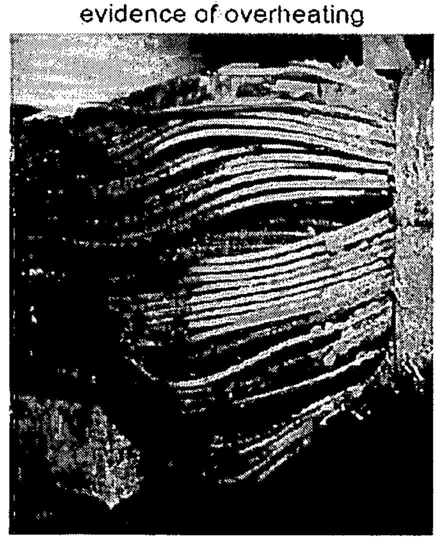
GSU Transformer Failures at Nuclear Power Plants within 25 Months of 1989 Solar Storm
Source: Impact of Severe Solar Flares, Nuclear EMP and Intentional EMI on Electric Grids



Damaged Core on Salem Nuclear Power Plant Transformer

Station 3 Gen Transformer 4
HV winding failure

Station 3 Gen. Transformer 5
evidence of overheating



Courtesy Eskom, Makhosi, T. G. Coetzee

Damaged Winding and Core on Eskom Transformers in South Africa

Source: Impact of Severe Solar Flares, Nuclear EMP and Intentional EMI on Electric Grids

In October 2010, Oak Ridge National Laboratory released "Electromagnetic Pulse: Effects on the U.S. Power Grid," a series of comprehensive technical reports for the Federal Energy Regulatory Commission (FERC) in joint sponsorship with the Department of Energy and the Department of Homeland Security. The executive summary of this report series reads in part:

> In 1989, an unexpected geomagnetic storm triggered an event on the Hydro-Québec power system that resulted in its complete collapse within 92 seconds, leaving six million customers without power. This same storm triggered hundreds of incidents across the United States including destroying a major transformer at an east coast nuclear generating station. ***Major geomagnetic storms, such as those that occurred in 1859 and 1921, are rare and occur approximately once every one hundred years.*** Storms of this type are global events that can last for days and will likely have an effect on electrical networks world wide. Should a storm of this magnitude strike today, it could interrupt power to as many as 130 million people in the United States alone, requiring several years to recover.

The Oak Ridge National Laboratory report further describes the effects of a geomagnetic storm expected to occur, on average, every 100 years:

> By simulating the effects of a 1 in 100 year geomagnetic storm centered over southern Canada, the computer models estimated the sections of the power grid expected to collapse during a major EMP event. This simulation predicts that over 300 EHV transformers would be at-risk for failure or permanent damage from the event. With a loss of this many transformers, the power system would not remain intact, leading to probable power system collapse in the Northeast, Mid-Atlantic and Pacific Northwest, affecting a population in excess of 130 million (Figure 1). Further simulation demonstrates that a storm centered over the northern region of the United States could result in extending the blackout through Southern California, Florida and parts of Texas.
>
> In addition to causing the immediate damage and failure of transformers, there is also evidence that GIC may be responsible for the onset of long-term damage to transformers and other key power grid assets. Damaged transformers require repair or replacement with new units. ***Currently most large transformers are manufactured in foreign countries and replacements would likely involve long production lead times in excess of a year.***
>
> (Emphasis added.)

Notably, the "Areas of Probable Power System Collapse" as illustrated in Figure 1 of the Oak Ridge National Laboratory report largely coincide with many locations of United States nuclear power plants and associated spent fuel pools. Seventy-one out of 104 spent fuel pools are within areas of probable power system collapse that would result from a severe geomagnetic storm expected to occur, on average, every 100 years.

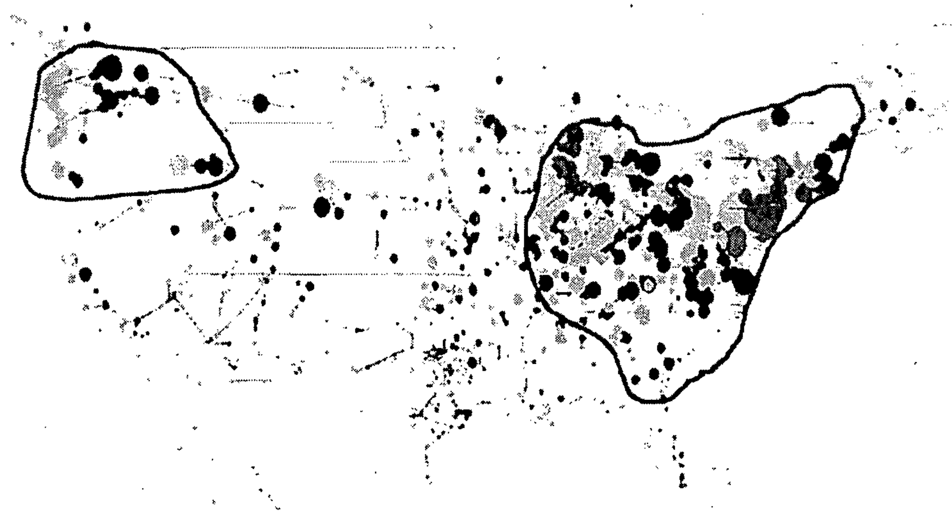
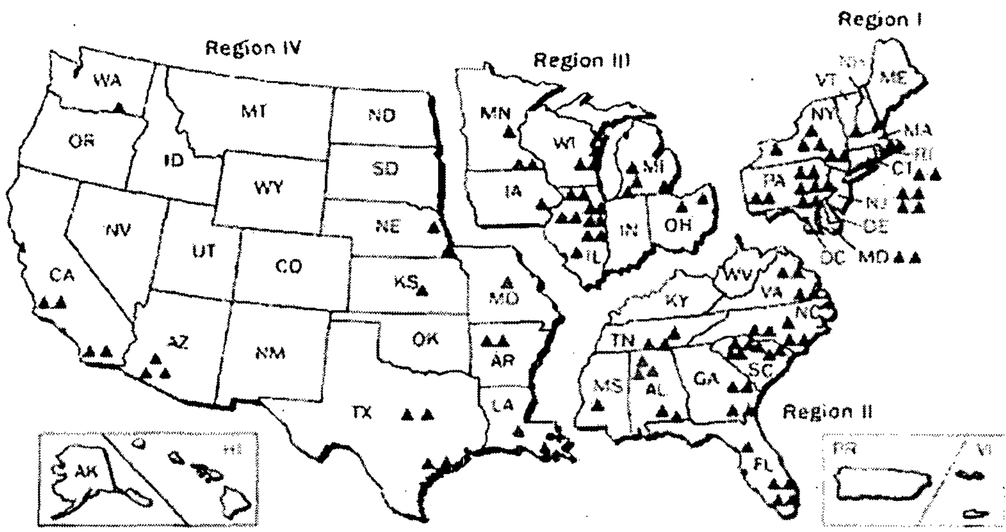


Figure 1 Areas of Probable Power System Collapse



▲ Licensed to Operate (104)

Locations of United States Nuclear Power Plants

Source: Nuclear Regulatory Commission, as of October 20, 2010

Disruption of Petrochemical Fuel Resupply

In 2008, the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack published a report on Critical National Infrastructures. An EMP can be caused by detonation of a nuclear weapon at high altitude. Significantly, the so-called "E3" pulse resulting from a nuclear detonation would cause an effect in long-haul power transmission lines nearly identical to the geomagnetically-induced current (GIC) of severe space weather. The Commission's report reads in part:

> There are a wide variety of potential threats besides EMP that must be addressed, which can have serious to potentially catastrophic impacts on the electrical system. Common solutions must be found that resolve these multiple vulnerabilities as much as possible. For example, in the course of its work, the Commission analyzed the impact of a 100-year solar storm (similar to E3 from EMP) and discovered a very high consequence vulnerability of the power grid. Steps taken to mitigate the E3 threat also would simultaneously mitigate this threat from the natural environment.

The study of the EMP Commission is illustrative of second-order effects of commercial grid outage on petrochemical infrastructure. The EMP Commission concluded:

> The petroleum and natural gas infrastructures are critically dependent on the availability of assured electric power from the national grid, as well as all the other critical national infrastructures, including food and emergency services that sustain the personnel manning these infrastructures. In turn, all these infrastructures rely on the availability of fuels provided by the petroleum and natural gas sector. Petroleum and natural gas systems are heavily dependent on commercial electricity during the entire cycle of production, refining, processing, transport, and delivery to the ultimate consumer. ***The availability of commercial power is the most important dependency for the domestic oil sector.***
>
> (Emphasis added.)

According to the work of the EMP commission, in the aftermath of a large induced current in the bulk power transmission system—whether this current is induced by a nuclear EMP or severe space weather—continued regular delivery of petrochemical fuels would be in doubt. In the event of widespread commercial grid power outage, nuclear plant operators cannot depend on resupply of diesel fuel for emergency backup generators once initial fuel stored on-site is exhausted.

Disruption of Food and Water Supply

The above-referenced Critical National Infrastructures report authored by the EMP commission also examined the potential effect of long-term power failure on food and water supplies. The report reads in part:

> Should the electrical power system be lost for any substantial period of time, the Commission believes that the consequences are likely to be catastrophic to civilian society. Machines will stop; transportation and communication will be severely restricted; heating, cooling, and lighting will cease; ***food and water supplies will be interrupted***; and many people may die. "Substantial period" is not quantifiable but generally outages that last for a week or more and affect a very large geographic region without sufficient support from outside the outage area would qualify. (Emphasis added.)

Under current emergency plans, on-site nuclear power plant personnel would be required to maintain systems for active cooling and/or water makeup of spent fuel pools. It is probable that these personnel might go an extended period of time without resupply of food and potable water. In addition, any stored supplies of food and potable water for critical personnel would be subject to theft and pilferage during an extended commercial grid outage. As a result, active cooling, water makeup systems should be able to operate in unattended mode for a period of at least two years.

Lack of DHS Plan for a Scenario of North American Power Grid Collapse

The Department of Homeland Security does not currently have a plan to prevent or recover from a regional or national scenario of North American power grid collapse. The Department of Homeland Security publishes an extensive document disclosing disaster planning, the National Preparedness Guidelines. These Guidelines can be accessed at:

http://www.dhs.gov/xlibrary/assets/National_Preparedness_Guidelines.pdf

The Guidelines read in part:

> Homeland Security Presidential Directive-8 (HSPD-8) of December 17, 2003 ("*National Preparedness*") directed the Secretary of Homeland Security to develop a national domestic ***all-hazards*** preparedness goal. As part of that effort, in March 2005 the Department of Homeland Security (DHS) released the Interim National Preparedness Goal. Publication of the *National Preparedness Guidelines* (*Guidelines*) finalizes development of the national goal and its related preparedness tools.
>
> The *Guidelines*, including the supporting *Target Capabilities List*, simultaneously published online, supersedes the Interim National Preparedness Goal and defines what it means for the Nation ***to be prepared for all hazards***. There are four critical elements of the *Guidelines*:
>
> > (1) The ***National Preparedness Vision***, which provides a concise statement of the core preparedness goal for the Nation.
> >
> > (2) The ***National Planning Scenarios***, which depict a diverse set of high-consequence threat scenarios of ***both potential terrorist attacks and natural disasters***. Collectively, the 15 scenarios are designed to focus contingency planning for homeland security preparedness work at all levels of government and with the private sector. The scenarios form the basis for coordinated Federal planning, training, exercises, and grant investments needed to prepare for ***emergencies of all types***.
>
> (Emphasis added.)

The Guidelines purport to include all consequential hazards, both from both potential terrorist attacks and natural disasters. The Guidelines continue:

> While preparedness applies across the all-hazards spectrum, the 2002 National Strategy for Homeland Security attaches special emphasis to preparing for catastrophic threats with "the greatest risk of mass casualties, massive property loss, and immense social disruption." To illustrate the potential scope, magnitude, and complexity of a range of major events, the Homeland Security Council—in partnership with the Department of Homeland Security (DHS), other Federal departments and agencies, and State, local, tribal, and territorial governments—developed the National Planning Scenarios. The 15 Scenarios include terrorist attacks, major disasters, and other emergencies. They are listed in Figure B-1.

Figure B-1: National Planning Scenarios	
Improvised Nuclear Device	Major Earthquake
Aerosol Anthrax	Major Hurricane
Pandemic Influenza	Radiological Dispersal Device
Plague	Improvised Explosive Device
Blister Agent	Food Contamination
Toxic Industrial Chemicals	Foreign Animal Disease
Nerve Agent	Cyber Attack
Chlorine Tank Explosion	

Notably, none of the fifteen purportedly all-inclusive National Planning Scenarios include a scenario for severe space weather/geomagnetic disturbance and associated long-term and widespread commercial grid outage. Lack of DHS inclusion of a geomagnetic disturbance scenario is not inadvertent. Metatech, a firm consulting to the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack, suggested inclusion of a such a scenario and DHS staff declined to do so. Because current DHS scenarios do not include geomagnetic disturbance and resulting commercial grid outage, replacement of high-voltage transformers and resupply of diesel fuel, food, and potable water to nuclear power plants could be substantially delayed or never occur.

Persistent NRC Concerns Regarding Reliability of Commercial Grid Power

For over thirty years, the NRC has had persistent concerns about the reliability of commercial grid power and its effect on nuclear power plant risk. In August 1988, Oak Ridge National Laboratory and the NRC published ORNL/NRC/LTR-98/12, "Evaluation of the Reliability for the Offsite Power Supply as a Contributor to the Risk of Nuclear Plants." The abstract for ORNL/NRC/LTR-98/12 reads in full:

> The objective of this project (job code number J2528) is to provide technical expertise from the Oak Ridge National Laboratory (ORNL) to assist the Nuclear Regulatory Commission (NRC) staff assessing the nature of any changes in the reliability of the national electric power grid to supply offsite power to nuclear power plants due to electric industry restructuring. Specifically, the task is to determine the potential for increases in the frequency of loss-of-offsite power (LOOP) events associated with grid related offsite power events.
>
> NRC is responsible for the evaluation of issues related to the design and operation of offsite power grid systems with regard to interrelationships between the nuclear unit, the utility grid and interconnecting grids, the functional performance, design and operation of on-site power systems, and the interface between the offsite and on-site power systems to include performance related issues for electrical components.
>
> Safe nuclear plant operation requires a source of power capable of maintaining acceptable static and dynamic voltage and frequency limits while supplying minimum amounts of auxiliary power. The preferred power source for safe plant operation is the offsite electric power system or power grid.
>
> Accident sequences initiated by LOOP are important contributors to risk for most nuclear plants. In 1979, the NRC identified the loss of all alternating current (AC) electrical power to the nuclear plant, called station blackout (SBO), as an unresolved safety issue. SBO was shown to be an important contributor to the total risk from nuclear power plant accidents. A task action plan A-44 was issued in July 1980 to address this issue and the results were published in a final report

issued in June 1988 as NUREG-1032, *Evaluation Station Blackout Accidents at Nuclear Power Plants*. In essence, the findings were that the grid was assumed to be stable and reliable.

At this time, the electric power industry in the United States is dominated by vertically integrated utilities. These were interconnected initially to primarily increase reliability, but now utilities use the interconnections for commercial transactions as well. Each utility or a small group of utilities form a control area containing customers for which they are jurisdictionally responsible. The control areas are divided into reliability councils. In addition, there are power pools which are associations of utilities that have joined for the purpose of reducing the cost of producing and delivering power through coordinated operation. However, there are reliability constraints on the individual systems as indicated in North American Electric Reliability Council (NERC) reports submitted to the U.S. Department of Energy (DOE). These constraints include, but are not limited to, low reserve margins, a shortage of transmission facilities, and technical problems in transmitting power over long distance lines.

Two relatively new factors are emerging: nonutility generation and industry restructuring. It is anticipated that, in the not too distant future, power suppliers, whether utilities, independent power producers (IPPs), or power marketers will actively compete for sales to customers who may be located anywhere on the power grid. Regional grid control will be the responsibility of centralized Independent System Operators (ISOs) in many regions. The locations, membership, responsibilities, and authority of all ISOs have yet to be defined. It is expected that these ISOs will be charged with maintaining grid reliability to facilitate the marketing of power. It is also uncertain how the current method of reliability standard maintenance through voluntary compliance with guidelines established by consensus associations will transition to the new utility structure. These uncertainties raise questions with respect to the continued supply of reliable offsite power to nuclear power plants.

Any reliability study of offsite power sources needs to consider both the quality of the voltage and frequency as needed by the nuclear generating station, the probability of the frequency and duration of a LOOP event to the subject station, and potential impacts which can occur during events (i.e., transients, low voltage, and frequency degradation). The industry structure is shifting from one with vertically integrated control by corporate entities that both own nuclear plants and have essentially autonomous authority over reliability rules and procedures. The new structure may have many commercially independent entities. There will be an as-yet undefined standards setting and enforcement process responding to commercial pressure as well as a desire to maintain reliability. These factors raise the concern, will nuclear plant offsite power requirements always be fulfilled? Also, what guarantees by the transmission provider interconnected with the nuclear plant need to be in place so that reliable power in accordance with voltage and frequency requirements can be assured for safe operation?

The answers to these and other potentially complicated questions as tasked to the NRC staff by the Commission can be provided through the performance of engineering studies, such as this by ORNL, to assess potential changes in the reliability of the grid to supply offsite power. The results of this project show that some nuclear plants are more vulnerable to grid-centered loss-of offsite power than others. Vulnerability from the grid is discussed in detail in this report.

The Oak Ridge National Laboratory/NRC study was prescient in its list of concerns resulting from electric industry deregulation:

1.2 Overview of Concerns

Restructuring of the electric power industry is resulting in the increasing number of financially independent entities whose operations can influence a nuclear plant's offsite power supply. Historically, the nuclear plant owner also owned and operated the transmission system, the control area, and the other generators in the immediate area and was fully responsible for the reliability of the power system. Now, each of these can be owned and operated by separate commercial entities, and there is also a NERC regional security coordinator with authority to

coordinate system operator actions when reliability is threatened. This arrangement presents the following concerns:

- A key factor in providing the required offsite power quality is a determination of the offsite power design basis.
- Requirements for the nuclear plant. Some of the utilities which were visited do not appear to be addressing this important analysis in a thorough manner.
- Each entity must be aware of the nuclear plant's power requirements and must have procedures to provide that the correct action is taken under varying conditions.
- There must be contractual arrangements between these entities that assure the nuclear plant owners/operators and the NRC that required actions will be taken.
- National standards do not exist yet to guide these entities in structuring their reliability activities. Regional and local standards often lack the rigor required to function in a commercially contentious environment.
- There may be significant costs associated with both the analysis and the system operation constraints required to provide the adequacy and reliability of the offsite power supply.
- In the event of a regional or control area grid blackout, there is concern that key black start units (see Appendix D for definitions) may be under the control of a new, independent financial entity. The reliability of these units is unknown unless blackout simulation testing is also covered under contract and regularly performed.

In December 2005, Idaho National Laboratory and NRC published NUREG/CR-6890, Vol. 2, "Reevaluation of Station Blackout Risk at Nuclear Power Plants--Analysis of Station Blackout Risk." The executive summary from this report reads in part:

> The availability of alternating current (ac) power is essential for safe operations and accident recovery at commercial nuclear power plants. This ac power is normally supplied by offsite power sources via the electrical grid but can be supplied by onsite sources such as emergency diesel generators (EDGs). A subset of LOOP scenarios involves the total loss of ac power as a result of complete failure of both offsite and onsite ac power sources. This is termed station blackout (SBO). In SBO scenarios, safe shutdown relies on components that do not require ac power, such as turbine-driven pumps or diesel driven pumps. The reliability of such components, along with direct current battery depletion times and the characteristics of offsite power restoration, are important contributors to SBO risk. Historically, risk models have indicated that SBO is an important contributor to overall plant risk, contributing as much as 70 percent or more. Therefore, LOOP, restoration of offsite power, and reliability of onsite power sources are important inputs to plant probabilistic risk assessments (PRAs).
>
> Based on concerns about SBO risk and associated emergency diesel generator reliability, the U.S. Nuclear Regulatory Commission (NRC) established Task Action Plan (TAP) A-44 in 1980. The NRC report NUREG-1032, *Evaluation of Station Blackout Accidents at Nuclear Power Plants*, issued in 1988, integrated many of the efforts performed as part of TAP A-44. In 1988 NRC also issued the SBO rule, 10 CFR 50.63, and the accompanying regulatory guide, RG 1.155. That rule required plants to be able to withstand an SBO for a specified duration and maintain core cooling during that duration. As a result of the SBO rule, plants were required to enhance procedures and training for restoring offsite and onsite ac power sources. In addition, to meet the rule's requirements, some plants chose to make modifications such as adding additional emergency ac power sources. Emphasis was also placed on establishing and maintaining high reliability of the emergency power sources.
>
> Finally, a widespread grid-related LOOP occurred on August 14, 2003. That event resulted in LOOPs at nine U.S commercial nuclear power plants. As a result of that event, the NRC initiated a comprehensive program that included updating and reevaluating LOOP frequencies and durations as well as SBO risk.

Regulatory Actions after the 2003 Northeast Blackout

On August 14, 2003, a grid blackout spread over the northeastern United States and parts of Canada. An article published in Scientific American, "The 2003 Northeast Blackout--Five Years Later," (August 13, 2008) described the event:

> On August 14, 2003, shortly after 2 P.M. Eastern Daylight Time, a high-voltage power line in northern Ohio brushed against some overgrown trees and shut down—a fault, as it's known in the power industry. The line had softened under the heat of the high current coursing through it. Normally, the problem would have tripped an alarm in the control room of FirstEnergy Corporation, an Ohio-based utility company, but the alarm system failed.
>
> Over the next hour and a half, as system operators tried to understand what was happening, three other lines sagged into trees and switched off, forcing other power lines to shoulder an extra burden. Overtaxed, they cut out by 4:05 P.M., tripping a cascade of failures throughout southeastern Canada and eight northeastern states.
>
> All told, 50 million people lost power for up to two days in the biggest blackout in North American history. The event contributed to at least 11 deaths and cost an estimated $6 billion.

The Scientific American article describes new regulatory standards after the 2003 Northeast Blackout:

> In February 2004, after a three-month investigation, the U.S.–Canada Power System Outage Task Force concluded that a combination of human error and equipment failures had caused the blackout. The group's final report made a sweeping set of 46 recommendations to reduce the risk of future widespread blackouts. First on the list was making industry reliability standards mandatory and legally enforceable.
>
> Prior to the blackout, the North American Electricity Reliability Council (NERC) set voluntary standards. In the wake of the blackout report, Congress passed the Energy Policy Act of 2005, which expanded the role of the Federal Energy Regulatory Commission (FERC) by requiring it to solicit, approve and enforce new reliability standards from NERC, now the North American Electricity Reliability Corporation.
>
> FERC has so far approved 96 new reliability standards…Standard PER-003, for example, requires that operating personnel have at least the minimum training needed to recognize and deal with critical events in the grid; standard FAC-003 makes it mandatory to keep trees clear of transmission lines; standard TOP-002-1 requires that that grid operating systems be able to survive a power line fault or any other single failure, no matter how severe. FERC can impose fines of up to a million dollars a day for an infraction, depending on its flagrancy and the risk incurred.
>
> If the standards have reduced the number of blackouts, the evidence has yet to bear it out. A study of NERC blackout data by researchers at Carnegie Mellon University in Pittsburgh found that the frequency of blackouts affecting more than 50,000 people has held fairly constant at about 12 per year from 1984 to 2006. Co-author Paul Hines, now assistant professor of engineering at the University of Vermont in Burlington, says current statistics indicate that a 2003-level blackout will occur every 25 years.
>
> (Ellipsis not in original.)

A speech by Jeffery Merrifield, Commissioner of the NRC, at the American Nuclear Society Executive Conference on Grid Reliability, Stability and Off-Site Power (July 24, 2006) describes the effect of the 2003 Northeast Blackout on nuclear power plants:

> **(Slide 2)** On August 14, 2003, I was the Acting Chairman on what I thought was going to be just another routine day at the NRC. I had a series of scheduled meetings that day, including a briefing on grid reliability, where the staff discussed the trends in loss of offsite power events at nuclear power plants. The staff informed me that the number of these events was decreasing, which was encouraging. They also mentioned, however, that the duration of individual events was tending to be longer.
>
> Around 4:00 p.m. that afternoon, Bill Travers, the EDO at that time, came into my office and informed me that the staff was assembling in our Operations Center in response to the automatic shutdown of several nuclear plants in the Northeast and Midwest. At that time, we did not know whether it was caused by multiple operational events or, perhaps by a coordinated act of terrorism.
>
> **(Slide 3)** As information continued to pour in the rest of the afternoon and into the evening hours, we came to learn that nine nuclear power plants in the U.S., as well as 11 in Canada, and a host of coal-fired power plants had been disconnected from the grid because of electrical instabilities, resulting in the blackout of major portions of the Northeast and Midwest in the U.S. and parts of Canada.
>
> **(Slide 4)** In fact, virtually every power plant east of the Mississippi experienced voltage swings of variable amplitude, though plants further from the Northeast corridor saw only minor voltage perturbations.
>
> **(Slide 5)** By the next morning, after a long night at the Ops Center, we were only beginning to understand the magnitude of the blackout. ***I participated in several conference calls, including calls with the White House Situation Room, to discuss the causes of the event with the staff of the National Security Council as well as various Cabinet members.***
>
> (Emphasis not in original.)

Notably, the gravity of the 2003 situation for nuclear power plants necessitated coordination with the National Security Council, a high-level group that includes the President, Vice President, Secretary of State, Secretary of the Treasury, Secretary of Defense, and Assistant to the President for National Security Affairs and which is advised by the Chairman of the Joint Chiefs of Staff and the Director of National Intelligence.

In his speech, Commissioner Merrifield described current design philosophy for nuclear power plants regarding commercial grid power:

> **(Slide 6) WHY DOES NRC CARE ABOUT GRID STABILITY?**
>
> Nuclear power reactors must be cooled continuously, even when shut down. The numerous pumps and valves in the reactor cooling systems therefore must have access to electrical power at all times, even if the normal power supply from the grid is degraded or completely lost.
> As a regulator, we want to minimize the time a nuclear power plant is subjected to a complete loss of offsite power, otherwise known as Station Blackout. Even though plants are designed with emergency diesel generators to supply power to pumps and valves that keep the reactor cool when normal power is lost, we do not like to challenge those diesel generators any more than is absolutely necessary.

The NRC was concerned about grid reliability long before the 2003 blackout event. On August 12, 1999, while the Callaway plant (in Missouri) was offline in a maintenance outage, the plant saw the offsite power supply voltage fall below minimum requirements for a 12-hour period. The voltage drop they observed was caused by peak levels of electrical loading and the transport of large amounts of power on the grid adjacent to Callaway. The licensee noted that the deregulated wholesale power market contributed to conditions where higher grid power flows were likely to occur in the area near Callaway. Alliant Energy had to spend ten's of millions of dollars to install new transformers with automatic tap changers to keep voltage above minimum requirements, and capacitor banks to improve the reactive power (volt-amps reactive, or VARs) factor in the Callaway switchyard.

As a result of deregulation, many electric utilities were split into electric generating companies and transmission and distribution companies. Thus, nuclear power plants now must rely on outside entities to maintain the switchyard voltage within acceptable limits. Over time, some transmission companies have become less sensitive to the potential impacts that grid voltage can have on nuclear plant operations.

A big part of our risk-informed regulatory strategy depends on plants having access to reliable offsite power. We assume that there will be very few times when a plant will be subjected to a total loss of offsite power, and when such condition exists it will be for a relatively short period of time (hours or days rather than weeks). Our strategy of allowing more on-line maintenance to be performed on certain important safety equipment such as the emergency diesel generators makes sense as long as the risk of a plant trip remains very low during the period of time that equipment is out of service. This philosophy relies on the fact that a total loss of offsite power is a rare occurrence that will be corrected in a short period of time.

(Emphasis not in original.)

After the 2003 Northeast Blackout, an extensive series of meetings between NRC, NERC, FERC, and the electric power and nuclear generation industries ensued. These meetings resulted in an NRC Generic Letter and new NERC reliability standard for nuclear power plants and their commercial grid suppliers.

The background section of NRC Generic Letter 2006-2, "Grid Reliability and the Impact on Plant Risk and the Operability of Offsite Power" (February 2006), reads in full:

BACKGROUND

Based on information obtained from inspections and risk insights developed by an internal NRC expert panel (further described below), the staff is concerned that several conditions associated with assurance of grid reliability may impact public health and safety and/or compliance with applicable regulations. These conditions include use of long-term periodic grid studies and informal communication arrangements to monitor real-time grid operability, potential shortcomings in grid reliability evaluations performed as part of maintenance risk assessments, lack of preestablished arrangements identifying local grid power sources and transmission paths, and potential elimination of grid events from operating experience and training. The staff identified these issues as a result of considering the August 14, 2003, blackout event.

On August 14, 2003, the largest power outage in U.S. history occurred in the Northeastern United States and parts of Canada. Nine U.S. NPPs tripped. Eight of these lost offsite power, along with one NPP that was already shut down. The length of time until power was available to the switchyard ranged from approximately one hour to six and one half hours. Although the onsite emergency diesel generators (EDGs) functioned to maintain safe shutdown conditions,

this event was significant in terms of the number of plants affected and the duration of the power outage.

The loss of all alternating current (AC) power to the essential and nonessential switchgear buses at a NPP involves the simultaneous loss of offsite power (LOOP), turbine trip, and the loss of the onsite emergency power supplies (typically EDGs). Such an event is referred to as a station blackout (SBO). Risk analyses performed for NPPs indicate that the SBO can be a significant contributor to the core damage frequency. Although NPPs are designed to cope with a LOOP event through the use of onsite power supplies, LOOP events are considered precursors to SBO. An increase in the frequency or duration of LOOP events increases the probability of core damage.

The NRC issued a regulatory issue summary ((RIS) 2004-5, "Grid Operability and the Impact on Plant Risk and the Operability of Offsite Power," dated April 15, 2004) to advise NPP addressees of the requirements in Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants;" 10 CFR 50.63, "Loss of all alternating current power;" 10 CFR Part 50, Appendix A, General Design Criterion (GDC) 17, "Electric power systems;" and plant technical specifications on operability of offsite power. In addition, the NRC issued Temporary Instruction (TI) 2515/156, "Offsite Power System Operational Readiness," dated April 29, 2004, and TI 2515/163, "Operational Readiness of Offsite Power," dated May 05, 2005, which instructed the regional offices to perform followup inspections at plant sites on the issues identified in the RIS.

The NRC needs additional information from its licensees in the four areas identified above in order to determine if regulatory compliance is being maintained.

On April 26, 2005, the Commission was briefed on grid stability and offsite power issues by a stakeholder panel that included representatives of the Federal Energy Regulatory Commission, the North American Electric Reliability Council (NERC), the National Association of Regulatory Utilities Commissioners, PJM Interconnection (one of the country's largest transmission system operators), a FirstEnergy Corporation executive representing the Nuclear Energy Institute (NEI), and the NRC staff. In light of this briefing, the Commission issued a staff requirements memorandum (SRM) dated May 19, 2005, in which the Commission directed the staff to review NRC programs related to operator examination and training and ensure that these programs adequately capture the importance of grid conditions and offsite power issues to the design, assessment, and safe operation of the plant, including appropriate interactions with grid operators. The SRM further directed the staff to determine whether the operator licensing program needs to be revised to incorporate additional guidance on grid reliability.

(Emphasis added.)

In January 2010, FERC and NERC established a reliability standard for coordination between commercial grid suppliers and nuclear power plant operators. This standard recognizes the urgency for restoration of commercial grid power for safety considerations. The standard reads in part:

<u>Standard NUC-001-2 — Nuclear Plant Interface Coordination</u>

3. Purpose: This standard requires coordination between Nuclear Plant Generator Operators and Transmission Entities for the purpose of ensuring nuclear plant safe operation and shutdown.

R9. The Nuclear Plant Generator Operator and the applicable Transmission Entities shall include, as a minimum, the following elements within the agreement(s) identified in R2: [Risk Factor: Medium]

> R9.3.5. Provision for considering, within the restoration process, the requirements and urgency of a nuclear plant that has lost all off-site and on-site AC power.

NERC Standard NUC-001-2 requires urgent restoration of commercial grid power for nuclear power plants. However, without actual planning and financial investment for a condition of geomagnetic disturbance, this paper standard provides ineffectual protection.

Lack of NERC Reliability Standard for Geomagnetic Disturbance

While NUC-001-02 recognizes the urgency of providing reliable off-site power to nuclear power plants, NUC-001-02 does not specifically require electric utilities to protect against severe space weather. In particular, NERC has not published a reliability standard for protection against geomagnetic disturbance. Were such a standard to exist, it could specify a system for forecasting geomagnetic disturbance and require operational plans to shut down high voltage transmission equipment when such this condition is predicted. Moreover, standards for protective devices, such as blocking devices for high voltage transformers, could be specified.

The NERC Board of Trustees recognized the need for action on geomagnetic disturbance twenty years ago, in the aftermath of the 1989 Quebec blackout caused by space weather. A NERC report, "March 13, 1989 Geomagnetic Disturbance," recommends the use of blocking devices to protect high voltage transformers:

> **Neutral-Blocking Capacitor**
>
> Capacitors installed between transformer neutrals and grounds can be very effective in blocking ground-induced currents. Ideally, the capacitor should be very simple, should not increase voltage stress on transformer insulation, should not have to be bypassed during faults (eliminating the necessity for a complex bypass device) and should have a low 60 Hz impedance (to avoid any impact on the system grounding coefficient). The cost of such a device, will of course, have to be weighed against its simplicity, robustness, and reliability. Hydro-Québec is currently studying a capacitor of this sort and if findings are promising, a prototype will be installed for field testing and evaluation of long-term reliability and performance.

Below is the full text of the 1990 Board of Trustees position statement on solar magnetic (geomagnetic) disturbance forecasting and the need for protective measures:

NERC Position Statement on
Solar Magnetic Disturbance Forecasting
Approved by the Board of Trustees
July 9, 1990

The North American Electric Reliability Council (NERC) strongly urges that improvements be made to the SMD forecasting accuracy of the National Oceanic & Atmospheric Administration. With the current activity on the sun projected to continue well into the 1990s, NERC believes that a forecasting procedure to provide at least one hour notice and an accuracy of at least 90% is required. This security margin will allow sufficient time to implement special operating procedures.

The geomagnetic induced currents (GIC) that are imposed on electric systems as a result of severe solar magnetic disturbances (SMD) pose a threat to the reliability of the interconnected electric networks in the U.S. and Canada. The GICs cause transformers to saturate and overheat. This results in depressed system voltages, failure or misoperation of critical system voltage control devices, and damage to the transformers themselves. On March 13, 1989, a severe SMD caused the total shutdown of the Hydro-Québec system in Canada. Electric utilities across the northern latitudes of the U.S also experienced transformer damage, depressed voltages, and the forced tripping of several voltage control devices. While no widespread blackouts have yet occurred, the incident demonstrated the potential damage to equipment and risk to system reliability. As a result, several control areas have established SMD operating guidelines and study groups.

The nature of the sudden onset of SMD requires that an effective SMD forecasting mechanism be in place to provide system operators with sufficient time to take preventive measures to protect the reliability of the network. Current forecasting technology has not proved to be sufficiently accurate or timely.

In 2005, NERC prepared a draft reliability guideline for geomagnetic disturbances. This draft can be found at:

http://www.nerc.com/files/GMD_Guideline_v2_clean.pdf)

Since 2005 there have been numerous meetings and updates on the subject of geomagnetic disturbance but no reliability guideline or standard has been published.

Due to the complexity of protecting the commercial grid, it is exceedingly unlikely that grid reliability will be improved in the near future. The HILF report explains the magnitude of effort required:

> The interconnected and interdependent nature of the bulk power system requires that risk management actions be consistently and systematically applied across the entire system to be effective. The magnitude of such an effort should not be underestimated. The North American bulk power system is comprised of more than 200,000 miles of high-voltage transmission lines, thousands of generation plants, and millions of digital controls. More than 1,800 entities own and operate portions of the system, with thousands more involved in the operation of distribution networks across North America. These entities range in size from large investor-owned utilities with over 20,000 employees to small cooperatives with only ten. The systems and facilities

> comprising the larger system have differing configurations, design schemes, and operational concerns. Referring to any mitigation on such a system as "easily-deployed," "inexpensive," or "simple" is an inaccurate characterization of the work required to implement these changes.

The HILF report also describes the likely timeframe of any protective measures:

> The Proposals for Action outlined in this report are intended to provide input into a formal action plan to address these issues. They do not, in and of themselves, constitute this plan. The effort needed to address these risks will require intense coordination and a significant resource commitment from all entities involved. ***The time needed to address these issues and complete the work contemplated herein will be measured in years.*** NERC and the U.S. DOE will work together with the electric sector, manufacturers, and other government authorities to support the development and execution of a clear and concise action plan to ensure accountability and coordinated action on these issues going forward.
>
> (Emphasis added.)

In summary, after many years of consideration, no regulatory standards or laws require electric utilities to protect against severe space weather and resulting geomagnetic disturbance. Any eventual measures to improve commercial grid reliability will extend far into the operational life of nuclear power plants and associated spent fuel pools. In the absence of such legal standards, and actual measures taken to implement standards, the NRC has an immediate regulatory obligation to act independently to protect spent fuel pools from the effect of long-term commercial grid outage.

Previous NRC Analysis of Probability of Zirconium Cladding Fires

The NRC staff calculated the probability of an accident resulting in a zirconium cladding fire and associated radiation release in NUREG-1738, "Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants," February 2001. On the basis of probabilistic risk assessment, NUREG-1738 concluded that the risk of a zirconium cladding fire is low, principally because human operators would have several days to react to a loss of active cooling and because offsite assistance would be available. The study summarized the risk from zirconium fires:

> This study documents an evaluation of spent fuel pool (SFP) accident risk at decommissioning plants. The study was undertaken to develop a risk-informed technical basis for reviewing exemption requests and a regulatory framework for integrated rulemaking...The staff based its sensitivity assessment on the guidance in Regulatory Guide (RG) 1.174, An Approach for Using Probabilistic Risk Assessment In Risk-Informed Decisions On Plant-Specific Changes to the Licensing Basis."...The results of the study indicate that the risk at SFPs is low and well within the Commission's Quantitative Health Objectives (QHOs). The risk is low because of the very low likelihood of a zirconium fire even though the consequences from a zirconium fire could be serious.
>
> (Ellipses not in original document.)

NUREG-1738 examined a number of accident scenarios, including one that involved loss of offsite power in the aftermath of severe weather:

Table 3.1 Spent Fuel Pool Cooling Risk Analysis — Frequency of Fuel Uncovery (per year)

INITIATING EVENT	Frequency of Fuel Uncovery (EPRI hazard)	Frequency of Fuel Uncovery (LLNL hazard)
Seismic event [5]	2×10^{-07}	2×10^{-06}
Cask drop [6]	2.0×10^{-07}	same
Loss of offsite power[7] initiated by severe weather	1.1×10^{-07}	same
Loss of offsite power from plant centered and grid-related events	2.9×10^{-08}	same
Internal fire	2.3×10^{-08}	same
Loss of pool cooling	1.4×10^{-08}	same
Loss of coolant inventory	3.0×10^{-09}	same
Aircraft impact	2.9×10^{-09}	same
Tornado Missile	$<1.0 \times 10^{-09}$	same
Total[5]	5.8×10^{-07}	2.4×10^{-06}

For the purposes of a departure point for the analysis of this Petition, "Loss of offsite power initiated by severe weather" is the scenario closest to a severe space weather scenario. This scenario assumes that it might be difficult for offsite help to reach the spent fuel pool site. When all factors are considered, NRC probabilistic risk assessment shows a chance of zirconium fire of 1.1 in 10 million per year. This extremely low probability relies heavily on the assumed intervention of human operators at the spent fuel pool site, as described in Industry Decommissioning Commitments (IDC). (While these commitments are for decommissioned plants, similar licensure obligations exist at operating nuclear power plants with spent fuel pools.)

NUREG-1738 explains the conditions of loss of offsite power from severe weather events:

3.4.4 Loss of Offsite Power from Severe Weather Events

This event represents the loss of SFP cooling because of a loss of offsite power from severe weather-related events (hurricanes, snow and wind, ice, wind and salt, wind, and one tornado event). Because of the potential for severe localized damage, tornadoes are analyzed separately in Appendix 2E. The analysis is summarized in Section 3.5.3 of this study.

Until offsite power is recovered, the electrical pumps are unavailable and the diesel-driven fire pump is available only for makeup. Recovery of offsite power after severe weather events is assumed to be less probable than after grid-related and plant-centered events. In addition, it is more difficult for offsite help to reach the site.

The calculated fuel uncovery frequency for this event is 1.1×10^{-7} per year. As in the previous cases, this estimate was based on IDCs #2, #5, #8, #10 and on assumptions documented in SDA #2 and SDA #3. In addition, IDC #3, the commitment to have procedures in place for communications between onsite and offsite organizations during severe weather, is also important in the analysis for increasing the likelihood that offsite organization can respond effectively.

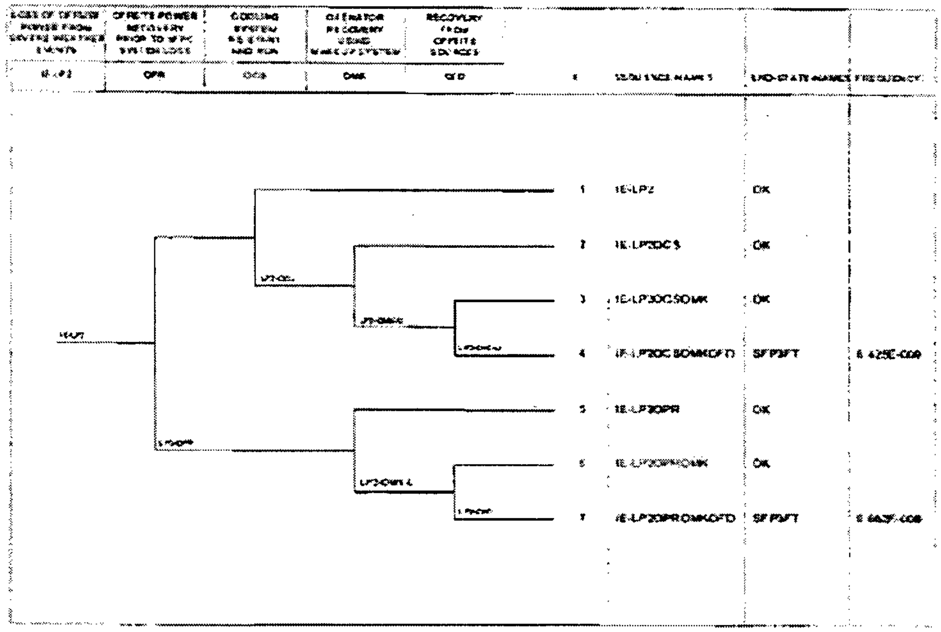
Table 4.1-1 delineates commitments which assume that both onsite and offsite personnel will be available in the aftermath of a severe weather event and associated widespread commercial grid outage.

Table 4.1-1 Industry Decommissioning Commitments (IDCs)

IDC No.	Industry commitments
1	Cask drop analyses will be performed or single failure-proof cranes will be in use for handling of heavy loads (i.e., phase II of NUREG-0612 will be implemented).
2	Procedures and training of personnel will be in place to ensure that onsite and offsite resources can be brought to bear during an event.
3	Procedures will be in place to establish communication between onsite and offsite organizations during severe weather and seismic events.
4	An offsite resource plan will be developed which will include access to portable pumps and emergency power to supplement onsite resources. The plan would principally identify organizations or suppliers where offsite resources could be obtained in a timely manner.
5	SFP instrumentation will include readouts and alarms in the control room (or where personnel are stationed) for SFP temperature, water level, and area radiation levels.
6	SFP seals that could cause leakage leading to fuel uncovery in the event of seal failure shall be self limiting to leakage or otherwise engineered so that drainage cannot occur.
7	Procedures or administrative controls to reduce the likelihood of rapid draindown events will include (1) prohibitions on the use of pumps that lack adequate siphon protection or (2) controls for pump suction and discharge points. The functionality of anti-siphon devices will be periodically verified.
8	An onsite restoration plan will be in place to provide repair of the SFP cooling systems or to provide access for makeup water to the SFP. The plan will provide for remote alignment of the makeup source to the SFP without requiring entry to the refuel floor.
9	Procedures will be in place to control SFP operations that have the potential to rapidly decrease SFP inventory. These administrative controls may require additional operations or management review, management physical presence for designated operations or administrative limitations such as restrictions on heavy load movements
10	Routine testing of the alternative fuel pool makeup system components will be performed and administrative controls for equipment out of service will be implemented to provide added assurance that the components would be available, if needed.

The analysis in NUREG-1738 uses a probabilistic risk assessment that assumes both onsite and offsite resources:

Figure 4.4 Severe weather related loss of offsite power event tree



4.4.6 Summary

Table 4.4 presents a summary of basic events used in the event tree for Loss of Offsite Power from severe weather events.

As in the case of the loss of offsite power from plant centered and grid related events, based on the assumptions made, the frequency of fuel uncovery can be seen to be very low. Again, a careful and thorough adherence to NEI commitments 2, 5, 8 and 10, the assumption that walkdowns are performed on a regular, (once per shift) basis is important to compensate for potential failures to the instrumentation monitoring the status of the pool, the assumption that the procedures and/or training are explicit in giving guidance on the capability of the fuel pool makeup system, and when it becomes essential to supplement with alternate higher volume sources, the assumption that the procedures and training are sufficiently clear in giving guidance on early preparation for using the alternate makeup sources, are crucial to establishing the low frequency. NEI commitment 3, related to establishing communication between onsite and offsite organizations during severe weather, is also important, though its importance is somewhat obscured by the assumption of dependence between the events OMK and OFD. However, if no such provision were made, the availability of offsite resources could become more limiting.

Table 4.4 Basic Event Summary for Severe Weather Loss of Offsite Power Event Tree

Basic Event Name	Description	Basic Event Probability
IE-LP2	LOSP event because of severe-weather-related causes	1.1E-02
HEP-DIAG-SFPLP2	Operators fail to diagnose loss of SFP cooling because of loss of offsite power	1.0E-5
HEP-RECG-DEPEN	Failure to recognize need to cool pool given prior failure	5.0E-2
HEP-SFP-STR-LP2	Operators fail to restart and align the SFP cooling system once power is recovered	5.0E-4
HEP-RECG-FWST-SW	Operators fail to diagnose need to start the firewater system	1.0E-4
HEP-FW-START-SW	Operators fail to start firewater pump and provide alignment	1.0E-3
HEP-FW-REP-DEPSW	Repair crew fails to repair firewater system	7.0E-2
HEP-FW-REP-NODSW	Repair crew fails to repair firewater system	1.8E-2
HEP-INV-OFFST-SW	Operators fail to provide alternate sources of cooling from offsite	8.0E-2
REC-OSP-SW	Recovery of offsite power within 24 hours	2.0E-2
SPC-CKV-CCF-H	Heat exchanger discharge check valves - CCF	1.9E-5
SPC-CKV-CCF-M	SFP cooling pump discharge check valves - CCF	3.2E-5
SPC-HTX-CCF	SFP heat exchangers - CCF	1.9E-5
SPC-HTX-FTR	SFP heat exchanger cooling system fails	2.4E-4
SPC-HTX-PLG	Heat exchanger plugs	2.2E-5
SPC-PMP-CCF	SFP cooling pumps - common cause failure	5.9E-4
SPC-PMP-FTF-1	SFP cooling pump 1 fails to start and run	3.9E-3

Table 4.4 Continued. Basic Event Summary for Severe Weather Loss of Outside Power Event Tree

Basic Event Name	Description	Basic Event Probability
SPC-PMP-FTF-2	SFP cooling pump 2 fails to start and run	3.9E-3
FP-2PUMPS-FTF	Failure of firewater pump system	6.7E-4
FP-DGPUMP-FTF	Failure of the diesel-driven firewater pump	1.8E-1

Close examination of the "Loss of offsite power initiated by severe weather" scenario shows that the NRC's calculated low probability of a zirconium fire is heavily dependent on a number of assumptions: quick restoration of offsite power, availability of diesel fuel, intervention of onsite human operators, and availability of offsite assistance. But as previously outlined in this Petition, these assumptions are in doubt in a scenario of long-term and widespread commercial grid outage. Most significantly, the NRC probability calculation assumes a 98% chance of offsite power recovery within 24 hours; however, as previously discussed, it is likely to take 1-2 years to replace transformers damaged by severe space weather. As a result, previous NRC analysis of the probability of zirconium fires in spent fuel pools is not applicable to a scenario of long-term and widespread commercial grid outage caused by severe space weather.

Probability of Zirconium Fires Due to Severe Space Weather

Under current design criteria and licensure requirements, and assuming no long-term human operator intervention, and also assuming that zirconium-cladded fuel rods uncovered by water would spontaneously ignite, the probability of a zirconium fire in a spent fuel pool could be roughly approximated by the probability of a long-duration commercial grid outage to the associated nuclear power plant. As previously described in this Petition, for the 71 nuclear power reactors and associated spent fuel pools in an "Area of Probable Power System Collapse," the chance of a long-term commercial grid outage in any given year is 1.0E-2, or one in one hundred. If one were to assume no outside assistance for any nuclear power plant and spontaneous ignition of zirconium cladding regardless of time elapsed since removal of fuel rods from the reactor core, the probability of zirconium fire would be the same as the probability of long-term commercial grid outage.

While many might consider the above assumptions to be reasonable and realistic, for the purposes of this Petition, we propose that the probability of zirconium fires at spent fuel pools due to severe space weather and resulting long-term commercial grid outage would be more precisely determined by the individual probabilities of three events:

1. Severe space weather of sufficient intensity to cause long-term and widespread commercial grid outage.
2. Outside assistance becoming unavailable to nuclear power plants and associated spent fuel pools.
3. Spontaneous ignition of zirconium fire should fuel rods become uncovered by water.

We examine the probability of each of these events below and then calculate estimates for the overall probability of zirconium fires at multiple nuclear power plants and associated spent fuel pools.

Probability of Severe Space Weather and Resulting Commercial Grid Outage

Severe space weather caused by solar activity is a rare event that occurs much less frequently than other natural phenomena such as earthquakes, hurricanes, volcanic eruptions, wildfires, etc. Unlike other natural phenomena which are localized in their effects, severe space weather has the potential to affect large areas of the planet nearly simultaneously. The sun has a regular 11-year cycle of sunspot activity and throughout each cycle significant flares and Coronal Mass Ejections (CMEs) occur. Fortunately, the resulting Coronal Mass Ejections (CME) are not always pointed at earth, but those relatively small CMEs that do arrive at earth allow astronomers to observe and judge their statistical frequency while most activity on earth goes on unaffected.

A significant body of knowledge indicates large CMEs caused by solar activity hit the earth roughly every 100 years on average, implying a 1E-2 (1%) yearly probability. Two incidences of severe space weather have occurred in recently recorded history—the 1859 Carrington Event and an event of comparable magnitude in 1921. However, it should be noted that only these two storms have received recent scientific forensic analysis; there are a number of other significant storms that may be similarly large but have not as of yet received any detailed analysis in a modern forensic basis. Smaller CMEs hit the earth on a more regular basis, allowing researchers to imply the frequency and magnitude of more severe CMEs.

The effect of space weather on power grids is not theoretical or speculative—space weather has already caused widespread blackouts such as the 1989 Quebec blackout. Because nuclear power plants typically have large high voltage transformers under high base load, these plants and surrounding grid infrastructure are most likely to experience long-term commercial grid outage. For example, the same CME that caused the 1989 Quebec blackout permanently damaged a transformer at the Salem nuclear power plant in New Jersey.

Research on the effect of CMEs and resulting geomagnetic disturbance on power grids has been conducted for many years by multiple researchers. Below is the list of citations from the NERC and Department of Energy-sponsored report on High Impact Low Frequency events:

Additional References on Geomagnetic Disturbance Events:

1. P. R. Barnes and J. W. Van Dyke, "Potential Economic Costs From Geomagnetic Storms," Geomagnetic Storm Cycle 22: Power System Problems on the Horizon, Special Panel Session Report, IEEE PES Summer Meeting, IEEE Publication 90TH0357-4-PWR,1990.
2. V. D. Albertson, "Geomagnetic Disturbance Causes and Power System Effects," Effects of Solar-Geomagnetic Disturbances on Power Systems, Special Panel Session Report, IEEE PES Meeting, 90TH0291-5 PWR, , July 12, 1989.
3. Dan Nordell et al., "Solar Effects on Communications," Geomagnetic Storm Cycle 22:Power System Problems on the Horizon, Special Panel Session Report, IEEE PES Summer Meeting, IEEE Publication 90TH0357-4-PWR,1990.
4. Robert J. Ringlee and James R. Stewart, "Geomagnetic Effects on Power Systems," IEEE . Power Eng. Rev. 9(7), (July 1989).
5. P. R. Gattens et al., "Investigation of Transformer Overheating Due to Solar Magnetic Disturbances," Effects of Solar-Geomagnetic Disturbances on Power Systems, Special

Panel Session Report. IEEE PES Summer Meeting, IEEE Publication 90TH0291-5 PWR,1989.
6. J. D. Aspnes and R. P. Merritt, "Effect of DC Excitation on Instrument Transformers, Geomagnetically Induced Currents," IEEE Trans. Power Apparatus and Syst. PAS-102 (1 I), 3706-3712 (November 1983).
7. D. H. Boteler et al., "Effects of Geomagnetically Induced Currents in the B. C. Hydro 500 kV System," IEEE Trans. Power Delivery 4(I), (January 1989).
8. IEEE Power System Relaying Committee, Working Group Kl 1, "The Effects of Solar Magnetic Disturbances on Protective Relaying, " Geomagnetic Storm Cycle 22: Power System Problems on the Horizon, Special Panel Session Report, IEEE PES Summer Meeting, IEEE Publication 90TH0357-4-PWR, 1990.
9. D. Larose, "The Hydro-Québec System Blackout of March 13, 1989," Effects of Solar Geomagnetic Disturbances on Power Systems, Special Panel Session Report, IEEE PES Summer Meeting, IEEE Publication 90TH0291-5 PWR, 1989.
10. D. A. Fagnan, P. R. Gattens, and R. D. Johnson, "Measuring GIC in Power Systems," Geomagnetic Storm Cycle 22: Power System Problems on the Horizon, Special Panel Session Report, IEEE PES Summer Meeting, IEEE Publication 90TH0357-4-PWR,1990.
11. V. D. Albertson, "Measurements and Instrumentation for Disturbance Monitoring of Geomagnetic Storm Effects," Effects of Solar-Geomagnetic Disturbances on Power Systems, Special Panel Session Report, IEEE PES Summer Meeting, IEEE Publication 9OTHO291-5 PWR, 1989.
12. L. Bolduc et al., "Currents and Harmonics Generated in Power Transformers By DC Polarization," presented at the meeting of the IEEE T&D Working Group on Geomagnetic Disturbances and Power System Effects, IEEE PES Summer Meeting, Minneapolis, Minn., July 18, 1990.

Other published research on the effect of space weather on electric grids includes:

1. J.G. Kappenman, L.J. Zanetti, W.A. Radasky, "Space Weather From a User's Perspective: Geomagnetic Storm Forecasts and the Power Industry", EOS Transactions of the American Geophysics Union, Vol 78, No. 4, January 28, 1997, pg 37-45.
2. J.G. Kappenman, W.A. Radasky, J.L. Gilbert, I.A. Erinmez, "Advanced Geomagnetic Storm Forecasting: A Risk Management Tool for Electric Power Operations", IEEE Plasma Society Special Issue on Space Plasmas, December 2000, Vol 28, No. 6, pages 2114-2121.
3. I.A. Erinmez, J.G. Kappenman, W.A. Radasky, "Management of the Geomagnetically Induced Current Risks on the National Grid Company's Electric Power Transmission System," Journal of Atmospheric and Solar Terrestrial Physics (JASTP) Special Edition for NATO Space Weather Hazards Conference, June 2000, Vol 64, (2002) pp. 743-756.
4. W.A. Radasky, J.G. Kappenman, R. Pfeffer, "Nuclear and Space Weather Effects on the Electric Power Infrastructure," NBC Report, Fall/Winter 2001, pages 37-42.
5. Kappenman, J. G., "Storm sudden commencement events and the associated geomagnetically induced current risks to ground-based systems at low-latitude and midlatitude locations," Space Weather, 1(3), 1016, doi:10.1029/2003SW000009, 2003.
6. Kappenman, J., "The Evolving Vulnerability of Electric Power Grids," Space Weather, 2, S01004, doi:10.1029/2003SW000028, 2004.
7. John G Kappenman, William A. Radasky, James L. Gilbert, "Electric Power Grid Vulnerability to Natural and Intentional Geomagnetic Disturbances," 2005 Zurich EMC Conference Paper, February 2005.
8. Kappenman, J. and W. Radasky, "Too Important to Fail, Space Weather," Space Weather, 3, S05001, doi:10.1029/2005SW000152, 2005.
9. John G. Kappenman, "Great Geomagnetic Storms and Extreme Impulsive Geomagnetic Field Disturbance Events – An Analysis of Observational Evidence including the Great Storm of May 1921," 35th COSPAR Assembly publication in Advances in Space Research, August 2005.
10. Kappenman, J. G., "An overview of the impulsive geomagnetic field disturbances and power grid impacts associated with the violent Sun-Earth connection events of 29–31

October 2003 and a comparative evaluation with other contemporary storms," Space Weather, 3, S08C01, doi:10.1029/2004SW000128, 2005.

Direct observations and extensive research clearly shows that the probability of long-term commercial grid outage caused by space weather falls well within the range that NRC considers reasonably foreseeable. Moreover, unless and until a better estimate is developed, the Oak Ridge National Laboratory probability estimate of 1E-2 (one in one hundred) per year for severe space weather sufficient to collapse two large portions of the North American power grid should be accepted.

Probability of Outside Assistance

Should electric power for active cooling of spent fuel pools cease, the probability preventing of a zirconium fire then becomes is largely dependent on the willingness and ability of human operators to remain onsite to operate and maintain the pump and firewater system. The use of ad-hoc systems to provide makeup water could be operationally challenging and risky to workers. NUREG-0933, "Resolution of Generic Safety Issues: Issue 82: Beyond Design Basis Accidents in Spent Fuel Pools," makes this clear:

> Ultimately, makeup to the pool could be supplied by bringing in a fire hose (60 gpm would suffice). Although one would expect that the failure probability associated with bringing in a hose (over a period of four or more days) would be very low, it must also be remembered that working next to 385,000 gallons of potentially contaminated boiling water on top of a 10-story building is not a trivial problem.

"Safety and Security of Commercial Spent Nuclear Fuel Storage" also examined the difficulty of supplying makeup water once active cooling has ceased and water has boiled off:

> Most immediately, ionizing radiation levels in the spent fuel building rise as the water level in the pool falls. Once the water level drops to within a few feet (a meter or so) of the tops of the fuel racks, elevated radiation fields could prevent direct access to the immediate areas around the lip of the spent fuel pool building by workers. This might hamper but would not necessarily prevent the application of mitigative measures, such as deployment of fire hoses to replenish the water in the pool.

Despite the human dangers of maintaining spent fuel pools under a condition of long-term loss of outside power, we assume for the purposes of this Petition that all necessary personnel are willing to remain on-site. Continued maintenance of spent fuel pools then is conditional on explicit and implicit provision of outside assistance. Explicit outside assistance could include fire trucks to pump makeup water and resupply of diesel fuel for backup generators. Implicit outside assistance would include supply of food and water for site personnel. Other implicit outside assistance would include ongoing security assistance by local authorities and provision of spare parts for cooling and makeup water systems.

In the event of long-term power loss affecting approximately one-third of the US population, including major east coast metropolitan areas, any long-term provision of outside assistance would be in doubt. In particular, when the power grid is down, it is dubious that one could call up the local fire department, order up a fire truck, have the fire truck and firefighter operators stay at the spent fuel site for a period of months or years, and obtain resupply of diesel fuel for the fire truck all the while.

The most pessimistic probability assumption would be for no long-term outside assistance. The lack of any Department of Homeland Security plan for long-term and widespread commercial grid outage buttresses this pessimistic assumption. Classified plans may exist for military assistance for nuclear power plants; however, even these plans would fall apart if military personnel have no long-term supplies of food and water. And if several dozen nuclear power plants were to be without outside power for an extended period, any available government resources would be stretched thin. Nonetheless, for the purposes of this Petition, we assume a 5E-1 (50%) chance of continuing outside assistance to nuclear power plants over a two year period, an assumption that many would find optimistic.

Probability of Zirconium Ignition after Becoming Uncovered by Water

As a bounding assumption, NUREG-1738 assumed that zirconium fire would occur if the tops of fuel rods became uncovered by water, regardless of complicating factors such as the length of time since the most recent refueling, density of fuel rods in the pool, and circulation of air within the spent fuel pool. Subsequent classified analysis of the probability of zirconium fires was performed by Sandia National Laboratories. "Mitigation of Spent Fuel Pool Loss-of-Coolant Inventory Accidents and Extension of Reference Plant Analyses to Other Spent Fuel Pools," Sandia Letter Report, Revision 2 (November 2006), incorporates and summarizes the Sandia Studies. This document is designated "Official Use Only—Security Related Information."

In response to a Freedom of Information Act request, a redacted version of a Sandia report, "MELCOR 1.8.5 Separate Effect Analyses of Spent Fuel Pool Assembly Accident Response," June 2003, was released. The original report consisted of 95 pages, but the redacted version consists of little more than a portion of the executive summary, principal headings in the table of contents, and a partial list of tables and figures. In total, the redacted version runs 12 pages, with nearly 5 pages of white space redactions. The report covered two scenarios: "Complete Loss-of-Coolant Inventory Accident" and "Partial Loss-of-Coolant Accident." The executive summary of this report reads in part:

> In 2001, United State Nuclear Regulatory Commission (NRC) staff performed an evaluation of the potential accident risk in a spent fuel pool (SFP) at decommissioning plants in the United States [NUREG-173 8]. The study was prepared to provide a technical basis for decommissioning rulemaking for permanently shutdown nuclear power plants. The study described a modeling approach of a typical decommissioning plant with design assumptions and industry commitments; the thermal-hydraulic analyses performed to evaluate spent fuel stored in the spent fuel pool at decommissioning plants; the risk assessment of spent fuel pool accidents; the consequence calculations; and the implications for decommissioning regulatory requirements. It was known that some of the assumptions in the accident progression in NUREG-1738 were necessarily conservative, especially the estimation of the fuel damage. Furthermore, the NRC desired to expand the study to include accidents in the spent fuel pools of operating power plants. Consequently, the NRC has continued spent fuel pool accident research by applying best-estimate computer codes to predict the severe accident progression following various postulated accident initiators. This report presents the results of separate effect calculations used to better understand the postulated accident behavior in SFPs.
>
> The MELCOR 1.8.5 severe accident computer code [Gauntt] was used to simulate the SFP accident response. MELCOR includes fuel degradation models for BWR and PWR fuel, radiation, convection, and conduction heat transfer models, air and steam oxidation models, hydrogen burn models, two-phase thermal-hydraulic models, and fission product release and transport models. Hence, it contains the basic models to address questions and phenomena expected during a spent fuel pool accident.

> Table E-1 summarizes the types of calculations that were performed. The types of calculations are divided into four parts; Part 1 - Decay heat evaluations, Part 2 - Separate Effect Air Cases, Part 3 - Separate Effect Water Cases, and Part 4 - Separate Effect Propagation Cases.

The body of the Sandia report reads in part:

> **Background**
>
> In 2001, the NRC staff performed an evaluation of the potential accident risk in a SFP at decommissioning plants in the United States (NUREG-1738). The study was prepared to provide a technical basis for decommissioning rulemaking for permanently shutdown nuclear power plants. The study described a modeling approach of a typical decommissioning plant with design assumptions and industry commitments; the thermal-hydraulic analyses performed to evaluate spent fuel stored in the spent fuel pool at decommissioning plants; the risk assessment of spent fuel pool accidents; the consequence calculations; and the implications for decommissioning regulatory requirements. It was known that some of the assumptions in the accident progression in NUREG-1738 were necessarily conservative, especially the estimation of the fuel damage. Furthermore, the NRC desired to expand the study to include accidents in the spent fuel pools of operating power plants. Consequently, the NRC has continued spent fuel pool accident research by applying best-estimate computer codes to predict the severe accident progression following various postulated accident initiators. The present report documents the use of separate effect models to develop a methodology to perform SFP accident analyses as well as to assess the importance of uncertain and variable parameters. In Section 1.1, a description of the key phenomena expected in a SFP accident is presented. Two types of SFP accidents will be described, air cases and partial water cases. The present report examines the coolability of various assembly configurations to both complete and partial loss-of-coolant inventory accident (i.e., air and water cases, respectively). Next, Section 2 discusses the SFP geometry, the analysis methodology, and the MELCOR separate effects input model. Section 3 gives the results from the simulations. Finally, Section 4 gives the conclusions and Section 5 gives the references.

Petitioner does not know the complete contents of the classified Sandia studies. However, any reasonable person would conclude that there are certainly some circumstances under which zirconium cladding will spontaneously heat up and catch fire. If this was not true, the reports would not be classified.

Nearly all spent fuel pools store fuel rods in high density racks surrounded by boron partitions to prevent criticality. Under a gradual boil-off scenario, the water at the bottom of the partitions would prevent natural air convection cooling from occurring. Gradual boil-off would be the least favorable convection cooling case and as a result, the chance of spontaneous zirconium ignition is greatly increased. The National Academies of Science report, "Safety and Security of Commercial Spent Nuclear Fuel Storage," describes the risk of spontaneous zirconium ignition in the case of gradual boil-off, here referred to as a "partial-loss-of-pool-coolant" scenario:

> The global analysis modeled the actual design and fuel loading pattern of the reference BWR spent fuel pool. The pool was divided into seven regions based on fuel age. Within each of those seven regions, the model for the fuel racks was subdivided into 16 zones. The grouping of assemblies into zones reduced the computational requirements compared to modeling every assembly.[18] Two scenarios were examined: (1) a complete loss-of-pool-coolant scenario in which the pool is drained to a level below the bottom of spent fuel assemblies; and (2) a partial-loss-of-pool-coolant scenario in which water levels in the pool drain to a level somewhere between the top and bottom of the fuel assemblies. In the former case, a convective air circulation path can be established along the entire length of the fuel assemblies, which promotes convective air cooling of the fuel, in the latter case, an effective air circulation path cannot form because the bottom of

the assembly is blocked by water. Steam is generated by boiling of the pool water, and the zirconium cladding oxidation reaction produces hydrogen gas. This analysis suggests that circulation blockage has a significant impact on thermal behavior of the fuel assemblies. The specific impact depends on the depth to which the pool is drained.

The global analysis examined the thermal behavior of fuel assemblies in the pool at 1, 3, and 12 months after the offloading of one-third of a core of spent fuel from the reactor. Sensitivity studies were carried out to assess the importance of radiation heat transfer between different regions of the pool, the effects of building damage on releases of radioactive material to the environment, and the effects of varying the assumed location and size of the hole in the pool wall.

The results of these analyses are provided in the committee's classified report. For some scenarios, the fuel could be air cooled within a relatively short time after its removal from the reactor. If a loss-of-coolant event took place before the fuel could be air cooled, however, a zirconium cladding fire could be initiated if no mitigative actions were taken. Such fires could release some of the fuel's radioactive material inventory to the environment in the form of aerosols.

For a partial-loss-of-pool-coolant event, the analysis indicates that the potential for zirconium cladding fires would exist for an even greater time (compared to the complete-loss-of-pool-coolant event) after the spent fuel was discharged from the reactor because air circulation can be blocked by water at the bottom of the pool. Thermal coupling between adjacent assemblies will be due primarily to radiative rather than convective heat transfer. However, this heat transfer mode has been modeled simplistically in the MELCOR runs performed by Sandia.

(Emphasis not in original.)

A key finding of the National Academy of Sciences "Safety and Security of Commercial Spent Nuclear Fuel Storage" report confirms that spent fuel stored in water pools needs an active heat removal system for at least one year after removal from the reactor core:

FINDING 3A: Pool storage is required at all operating commercial nuclear power plants to cool newly discharged spent fuel. Freshly discharged spent fuel generates too much decay heat to be passively air cooled. This fuel must be stored in a pool that has an active heat removal system (i.e., water pumps and heat exchangers) for at least one year before being moved to dry storage. Most dry storage systems are licensed to store fuel that has been out of the reactor for at least five years. Although spent fuel younger than five years could be stored in dry casks, the changes required for shielding and heat-removal could be substantial, especially for fuel that has been discharged for less than about three years.

For the purposes of this Petition, we assume that if spent fuel rods that have been outside the reactor core for one year or less, they will spontaneously ignite if gradual water boil-off and uncovering of fuel rods occurs. Nuclear power plants have a typical refueling cycle of 18-24 months. Here we make the optimistic assumption that refueling takes place every 24 months. As a result, at any random point in time, there would be 50% chance of spontaneous zirconium cladding ignition, because half of the time between refueling the rods would have been out of the core one year or less (12 months/24 months = 50%).

Plant-Specific Probability of Zirconium Cladding Fires

To calculate the plant-specific probability of zirconium cladding fires at spent fuel pools, one must multiply the individual probabilities of three factors:

- Probability of long-term Loss of Outside Power (LOOP)
- Probability of outside aassistance
- Probability of spontaneous zirconium ignition

The probability of long-term LOOP at a specific nuclear power plant is dependent on the probability of severe space weather and resulting power system collapse in any given year and also dependent on the number of years remaining in reactor licensure period. The probability of LOOP can be calculated using the probability formula:

$$Pt = 1 - (1\text{-}Py)^{Yt}$$

Where:

Pt = Total Probability
Py = Individual Year Probability
Yt = Number of Years

Notably, under this formula, there is never a 100% probability of an event occurring, even over a specific period of 100 years if the yearly probability is one-in-one-hundred, or 1%. In fact, the probability for a specific one-hundred year period is 63%. For a specific 150 year period the probability is 78%. (Although over a long period, events would occur every one hundred years, *on average*.) With understanding of this formula, one can see why although 150 years has passed since the 1859 Carrington Event, the passage of time without another space weather event of comparable magnitude is not proof that another event will not likely occur. (It does show, however, that the United States has been extraordinarily lucky that a severe space weather event has not occurred since the post-World War II build-out of the modern high voltage electric grid.)

As previously described in this Petition, we assume the probability of no outside assistance to be 50% and the probability of spontaneous ignition of zirconium cladding to be 50%. When calculations are done on a plant-specific basis, zirconium fire probabilities range from 0.3% at Vermont Yankee to 7.9% at Vogtle 2 in Georgia.

Probability of Zirconium Fire at Spent Fuel Pools

Preliminary Estimates Over Remaining Reactor Operation

Page 1 of 4

Probability of No Outside Assistance	50%
Probability of Spontaneous Zirconium Ignition	50%

Within Area of Probable Power System Collapse	State	Plant	Years Remaining in Reactor Operation	Long-Term LOOP Probability	Probability of Water Boil-Off	Zirconium Fire Probability
yes	Alabama	Browns Ferry 1	22	19.8%	9 9%	5.0%
yes	Alabama	Browns Ferry 2	23	20.6%	10.3%	5.2%
yes	Alabama	Browns Ferry 3	25	22.2%	11.1%	5.6%
no	Alabama	Farley 1	26	0.0%	0.0%	0.0%
no	Alabama	Farley 2	30	0.0%	0.0%	0.0%
no	Arizona	Palo Verde 1	14	0.0%	0 0%	0.0%
no	Arizona	Palo Verde 2	15	0.0%	0.0%	0.0%
no	Arizona	Palo Verde 3	16	0.0%	0 0%	0.0%
no	Arkansas	Arkansas Nuclear 1	23	0.0%	0.0%	0.0%
no	Arkansas	Arkansas Nuclear 2	27	0.0%	0.0%	0.0%
no	California	Diablo Canyon 1	13	0.0%	0.0%	0.0%
no	California	Diablo Canyon 2	14	0.0%	0.0%	0.0%
no	California	San Onofre 2	11	0.0%	0.0%	0.0%
no	California	San Onofre 3	11	0.0%	0.0%	0.0%
yes	Connecticut	Millstone 2	24	21.4%	10.7%	5.4%
yes	Connecticut	Millstone 3	34	28.9%	14.5%	7.2%
no	Florida	Crystal River 3	5	0.0%	0.0%	0.0%
no	Florida	St Lucie 1	25	0.0%	0.0%	0.0%
no	Florida	St Lucie 2	32	0.0%	0.0%	0.0%
no	Florida	Turkey Point 3	21	0.0%	0.0%	0.0%
no	Florida	Turkey Point 4	22	0.0%	0.0%	0.0%
yes	Georgia	Hatch 1	23	20.6%	10.3%	5.2%
yes	Georgia	Hatch 2	27	23.8%	11.9%	5.9%
yes	Georgia	Vogtle 1	36	30.4%	15.2%	7.6%
yes	Georgia	Vogtle 2	38	31.7%	15.9%	7.9%
yes	Illinois	Braidwood 1	15	14.0%	7.0%	3.5%
yes	Illinois	Braidwood 2	16	14.9%	7.4%	3.7%
yes	Illinois	Byron 1	13	12.2%	6.1%	3.1%
yes	Illinois	Byron 2	15	14.0%	7.0%	3.5%

Probability of Zirconium Fire at Spent Fuel Pools

Preliminary Estimates Over Remaining Reactor Operation

Probability of No Outside Assistance	**50%**
Probability of Spontaneous Zirconium Ignition	**50%**

Within Area of Probable Power System Collapse	State	Plant	Years Remaining in Reactor Operation	Long-Term LOOP Probability	Probability of Water Boil-Off	Zirconium Fire Probability
yes	Illinois	Clinton	15	14.0%	7.0%	3.5%
yes	Illinois	Dresden 2	18	16 5%	8.3%	4.1%
yes	Illinois	Dresden 3	20	18.2%	9.1%	4.6%
yes	Illinois	La Salle 1	11	10.5%	5.2%	2.6%
yes	Illinois	La Salle 2	12	11.4%	5.7%	2.8%
no	Illinois	Quad Cities 1	21	0.0%	0.0%	0.0%
no	Illinois	Quad Cities 2	21	0.0%	0.0%	0.0%
no	Iowa	Duane Arnold	3	0.0%	0.0%	0.0%
no	Kansas	Wolf Creek	34	0.0%	0.0%	0.0%
no	Louisiana	River Bend	14	0.0%	0.0%	0.0%
no	Louisiana	Waterford	13	0.0%	0.0%	0.0%
yes	Maryland	Calvert Cliffs 1	23	20.6%	10.3%	5.2%
yes	Maryland	Calvert Cliffs 2	25	22.2%	11.1%	5.6%
yes	Massachusetts	Pilgrim	1	1.0%	0.5%	0.3%
yes	Michigan	Cook 1	23	20.6%	10.3%	5.2%
yes	Michigan	Cook 2	26	23.0%	11.5%	5.7%
yes	Michigan	Enrico Fermi 2	14	13.1%	6.6%	3.3%
yes	Michigan	Palisades	20	18.2%	9.1%	4.6%
no	Minnesota	Monticello	19	0.0%	0 0%	0.0%
no	Minnesota	Prairie Island 1	2	0.0%	0.0%	0.0%
no	Minnesota	Prairie Island 2	3	0.0%	0.0%	0.0%
no	Mississippi	Grand Gulf	13	0.0%	0.0%	0.0%
no	Missouri	Callaway	13	0.0%	0.0%	0.0%
no	Nebraska	Cooper	3	0.0%	0.0%	0.0%
no	Nebraska	Fort Calhoun	22	0.0%	0.0%	0.0%
yes	New Hampshire	Seabrook	19	17.4%	8.7%	4.3%
yes	New Jersey	Hope Creek	15	14.0%	7.0%	3.5%
yes	New Jersey	Oyster Creek	18	16.5%	8.3%	4.1%
yes	New Jersey	Salem 1	5	4.9%	2.5%	1.2%
yes	New Jersey	Salem 2	9	8.6%	4.3%	2.2%

Probability of Zirconium Fire at Spent Fuel Pools

Preliminary Estimates Over Remaining Reactor Operation

Probability of No Outside Assistance	50%
Probability of Spontaneous Zirconium Ignition	50%

Within Area of Probable Power System Collapse	State	Plant	Years Remaining in Reactor Operation	Long-Term LOOP Probability	Probability of Water Boil-Off	Zirconium Fire Probability
yes	New York	FitzPatrick	23	20.6%	10.3%	5.2%
yes	New York	Ginna	18	16.5%	8.3%	4.1%
yes	New York	Indian Point 2	2	2.0%	1.0%	0.5%
yes	New York	Indian Point 3	4	3.9%	2.0%	1.0%
yes	New York	Nine Mile Point 1	18	16.5%	8.3%	4.1%
yes	New York	Nine Mile Point 2	35	29.7%	14.8%	7.4%
yes	North Carolina	Brunswick 1	25	22.2%	11.1%	5.6%
yes	North Carolina	Brunswick 2	23	20.6%	10.3%	5.2%
yes	North Carolina	Harris	35	29.7%	14.8%	7.4%
yes	North Carolina	McGuire 1	30	26.0%	13.0%	6.5%
yes	North Carolina	McGuire 2	32	27.5%	13.8%	6.9%
yes	Ohio	Davis-Bessie	6	5.9%	2.9%	1.5%
yes	Ohio	Perry	15	14.0%	7.0%	3.5%
yes	Pennsylvania	Beaver Valley 1	5	4.9%	2.5%	1.2%
yes	Pennsylvania	Beaver Valley 2	16	14.9%	7.4%	3.7%
yes	Pennsylvania	Limerick 1	13	12.2%	6.1%	3.1%
yes	Pennsylvania	Limerick 2	18	16.5%	8.3%	4.1%
yes	Pennsylvania	Peach Bottom 2	22	19.8%	9.9%	5.0%
yes	Pennsylvania	Peach Bottom 3	23	20.6%	10.3%	5.2%
yes	Pennsylvania	Susquehanna 1	11	10.5%	5.2%	2.6%
yes	Pennsylvania	Susquehanna 2	13	12.2%	6.1%	3.1%
yes	Pennsylvania	Three Mile Island	23	20.6%	10.3%	5.2%
yes	South Carolina	Catawba 1	32	27.5%	13.8%	6.9%
yes	South Carolina	Catawba 2	32	27.5%	13.8%	6.9%
yes	South Carolina	Oconee 1	22	19.8%	9.9%	5.0%
yes	South Carolina	Oconee 2	22	19.8%	9.9%	5.0%
yes	South Carolina	Oconee 3	23	20.6%	10.3%	5.2%
yes	South Carolina	Robinson	19	17.4%	8.7%	4.3%
yes	South Carolina	Summer	31	26.8%	13.4%	6.7%

Probability of Zirconium Fire at Spent Fuel Pools

Preliminary Estimates Over Remaining Reactor Operation

Probability of No Outside Assistance	50%
Probability of Spontaneous Zirconium Ignition	50%

Within Area of Probable Power System Collapse	State	Plant	Years Remaining in Reactor Operation	Long-Term LOOP Probability	Probability of Water Boil-Off	Zirconium Fire Probability
yes	Tennessee	Sequoyah 1	9	8.6%	4.3%	2.2%
yes	Tennessee	Sequoyah 2	10	9.6%	4.8%	2.4%
yes	Tennessee	Watts Bar	24	21.4%	10.7%	5.4%
no	Texas	Comanche Peak 1	19	0.0%	0.0%	0.0%
no	Texas	Comanche Peak 2	22	0.0%	0.0%	0.0%
no	Texas	South Texas 1	16	0.0%	0.0%	0.0%
no	Texas	South Texas 2	17	0.0%	0.0%	0.0%
yes	Vermont	Vermont Yankee	1	1.0%	0.5%	0.3%
yes	Virginia	North Anna 1	27	23.8%	11.9%	5.9%
yes	Virginia	North Anna 2	29	25.3%	12.6%	6.3%
yes	Virginia	Surry 1	21	19.0%	9.5%	4.8%
yes	Virginia	Surry 2	22	19.8%	9.9%	5.0%
yes	Washington	Columbia	12	11.4%	5.7%	2.8%
yes	Wisconsin	Kewaunee	2	2.0%	1.0%	0.5%
yes	Wisconsin	Point Beach 1	19	17.4%	8.7%	4.3%
yes	Wisconsin	Point Beach 2	22	19.8%	9.9%	5.0%

Probable Fatalities Due to Zirconium Cladding Fires

NUREG-1738 predicted early fatalities and long-term consequences should zirconium cladding fires occur. A summary of tabular information in NUREG-1738 concludes:

> An examination of Figure 3.7-1 indicates the following:
>
> - ***Early fatality consequences for spent fuel pool accidents can be as large as for a severe reactor accident even if the fuel has decayed several years.*** This is attributable to the significant health effect of ruthenium, and the ruthenium-106 half-life of about 1 year. There is also an important but lesser contribution from cesium.
> - A large ruthenium release fraction is important to consequences, but not more important than the consequences of a reactor accident large early release.
> - The effect of early evacuation (if possible) is to offset the effect of a large ruthenium release fraction. This effect is comparable to that for reactor accidents.
> - For the low ruthenium source term, no early fatality is expected after 1 year decay even with late evacuation.
>
> For the longer term consequences Figure 3.7-2 indicates:
>
> - ***Long-term consequences remain significant as long as a fire is possible. These consequences are due primarily to the effect of cesium-137, which remains abundant even in significantly older fuel because of its long (30-year) half-life.*** Ruthenium and evacuation have notable long-term consequences but do not change the conclusion.
>
> (Emphasis added.)

NUREG-1738 contains the following estimates of individual fatality risk:

Table 3.7-2 Consequences of an SFP Accident With a Low Ruthenium Source Term (per event)

Time After Shutdown	Mean Consequences for Low Ruthenium Source Term (Surry population, 95% evacuation)			
	Early Fatalities	Societal Dose (p-rem within 50 miles)	Individual Risk* of Early Fatality (within 1mile)	Individual Risk* of Latent Cancer Fatality (within 10 miles)
Late Evacuation				
30 days	2	$5.58x10^{6}$	$1.27x10^{-2}$	$1.88x10^{-3}$
90 days	1	$5.43x10^{6}$	$9.86x10^{-3}$	$1.82x10^{-3}$
1 year	1	$5.28x10^{6}$	$7.13x10^{-3}$	$1.68x10^{-3}$
2 years	-	$5.12x10^{6}$	$5.64x10^{-3}$	$1.58x10^{-3}$
5 years	-	$4.90x10^{6}$	$3.18x10^{-4}$	$1.43x10^{-3}$
10 years	-	$4.72x10^{6}$	$1.63x10^{-3}$	$1.29x10^{-3}$
Early Evacuation				
30 days	-	$4.12x10^{6}$	$8.36x10^{-4}$	$9.92x10^{-4}$
90 days	-	$4.02x10^{6}$	$6.83x10^{-4}$	$9.62x10^{-4}$
1 year	-	$3.95x10^{6}$	$5.44x10^{-4}$	$9.09x10^{-4}$
2 years	-	$3.87x10^{6}$	$4.41x10^{-4}$	$8.71x10^{-4}$
5 years	-	$3.77x10^{6}$	$2.54x10^{-4}$	$8.14x10^{-4}$
10 years	-	$3.69x10^{6}$	$1.47x10^{-4}$	$7.70x10^{-4}$

* Conditional on event - Total frequency for all events is shown in Table 3.1 as less than $3x10^{-6}$ per year.

The consequences in Table 3.7-1 are based on the upper bound source term described in Appendix 4B. With the exception of ruthenium and fuel fines, the release fractions are from NUREG-1465, "Accident Source Terms for Light-Water Nuclear Power Plants" (Ref. 1), and include the ex-vessel and late in-vessel phase releases. The ruthenium release fraction is for a volatile fission product in an oxidic (rather than metallic) form. This is consistent with the experimental data reported in Reference 8. The source term is considered to be bounding for several reasons. First, rubbling of the spent fuel after heatup to about 2500 OK is expected to limit the potential for ruthenium release to a value less than that for volatile fission products. Second, following the Chernobyl accident, ruthenium in the environment was found to be in the metallic form (Ref. 2). Metallic ruthenium (Ru-106) has about a factor of 50 lower dose conversion factor (rem per Curie inhaled) than the oxidic ruthenium assumed in the Melcor Accident Consequence Code System (MACCS) calculations. Finally, the fuel fines release fraction is that from the Chernobyl accident (Ref. 3). This is considered to be bounding because the Chernobyl accident involved more extreme conditions (i.e., two explosions followed by a prolonged graphite fire) than an SFP accident. In subsequent discussions, this source term is referred to as the high ruthenium source term.

The consequences obtained using the source term in NUREG-1465 (which treats ruthenium as a less volatile fission product) in conjunction with SFP fission product inventories are provided in Table 3.7-2 for comparison. In subsequent discussions, this source term is referred to as the low ruthenium source term.

The consequence calculations for both the high and low ruthenium source terms assume that all of the fuel assemblies discharged in the final core off-load and the previous 10 refueling outages participate in the SFP fire. These assemblies are equivalent to about 3.5 reactor cores. Approximately 85 percent of all the ruthenium in the pool is in the last core off-loaded since the ruthenium-1 06 half-life is about 1 year. For cesium-1 37, with a 30-year half-life, the inventory decays very slowly and is abundant in all of the batches considered. The staff assumed that the number of fuel assemblies participating in the SFP fire remains constant and did not consider the possibility that fewer assemblies might be involved in an SFP fire in later years because of substantially lower decay heat in the older assemblies. Based on the limited analyses performed to date, fire propagation is expected to be limited to less than two full cores 1 year after shutdown (see Appendix 1A). Thus, the assumption that 3.5 cores participate adds some conservatism to the calculation of long-terms effects associated with cesium, but is not important with regard to the effects of ruthenium.

The above fatality estimates were originally developed for the population surrounding the Surry site in Virginia but as NUREG-1738 describes, the estimates can be applied to other populations because they are for individual risk rather than population risk. For the purposes of analysis in this petition, we selected the individual risks for one year after shutdown, the equivalent of one year after removal of fuel rods from the reactor core. For optimism, we used individual risk estimates for "Consequences of an SPF Accident With a Low Ruthenium Source Term (per event)," as specified in Table 3.7-2 in NUREG-1738, instead of the high ruthenium source term estimates. We also selected the "95% Late Evacuation" scenario; while the actual evacuation percentage might be substantially lower in the case of grid outage and attendant communication system failures, we confine ourselves to the NUREG-1738 fatality estimates for the sake of optimism.

Population within a radius of plant sites can be estimated using block data from the 2000 US Census (the most recent data currently available). For each plant we obtained the population within 1 mile and 10 mile radiuses using the LandView6 computer program from the US Census Bureau. Zirconium fire probabilities for each plant can be multiplied by population and individual risk factors to obtain probable early fatalities and cancer deaths.

Because most nuclear power plants are located in unpopulated areas, the number of residents within 1 mile of plants is low in most cases. In fact, 37 out of 104 plant sites have no residents within 1 mile. Accordingly, the estimates for early fatalities are low.

However, the number of people living within 10 miles of nuclear power plant sites is more significant, ranging from 2,851 for the Columbia site in Washington State to 257,474 at the Indian Point site north of New York City.

For some plants, probable deaths are zero because they are sited outside of the Area of Probable Power System Collapse. Over the United States as a whole, including areas outside of the Area of Probable Power System Collapse, we estimate 3.92 probable early fatalities and 3,170 probable cancer deaths for the period over which the reactors continue operating.

Probable Fatalities Due to Loss of Power for Spent Fuel Pools

Preliminary Estimates Over Remaining Reactor Operation

Probability of No Outside Assistance	**50%**
Probability of Spontaneous Zirconium Ignition	**50%**

Within Area of Probable Power System Collapse	State	Plant	Zirconium Fire Probability	Pop. within 1 Mile	Pop. within 10 Miles	Probable Early Fatalities	Probable Cancer Fatalities
yes	Alabama	Browns Ferry 1	5.0%	0	32,751	0.00	27
yes	Alabama	Browns Ferry 2	5.2%	0	32,751	0.00	28
yes	Alabama	Browns Ferry 3	5.6%	0	32,751	0.00	31
no	Alabama	Farley 1	0.0%	0	9,795	0.00	0
no	Alabama	Farley 2	0.0%	0	9,795	0.00	0
no	Arizona	Palo Verde 1	0.0%	0	3,302	0.00	0
no	Arizona	Palo Verde 2	0.0%	0	3,302	0.00	0
no	Arizona	Palo Verde 3	0.0%	0	3,302	0.00	0
no	Arkansas	Arkansas Nuclear 1	0.0%	231	45,451	0.00	0
no	Arkansas	Arkansas Nuclear 2	0.0%	231	45,451	0.00	0
no	California	Diablo Canyon 1	0.0%	0	24,084	0.00	0
no	California	Diablo Canyon 2	0.0%	0	24,084	0.00	0
no	California	San Onofre 2	0.0%	0	74,169	0.00	0
no	California	San Onofre 3	0.0%	0	74,169	0.00	0
yes	Connecticut	Millstone 2	5.4%	517	117,615	0.20	106
yes	Connecticut	Millstone 3	7.2%	517	117,615	0.27	143
no	Florida	Crystal River 3	0.0%	0	18,663	0.00	0
no	Florida	St Lucie 1	0.0%	0	160,073	0.00	0
no	Florida	St Lucie 2	0.0%	0	160,073	0.00	0
no	Florida	Turkey Point 3	0.0%	0	104,389	0.00	0
no	Florida	Turkey Point 4	0.0%	0	104,389	0.00	0
yes	Georgia	Hatch 1	5.2%	0	8,339	0.00	7
yes	Georgia	Hatch 2	5.9%	0	8,339	0.00	8
yes	Georgia	Vogtle 1	7.6%	0	2,990	0.00	4
yes	Georgia	Vogtle 2	7.9%	0	2,990	0.00	4
yes	Illinois	Braidwood 1	3.5%	884	32,361	0.22	19
yes	Illinois	Braidwood 2	3.7%	884	32,361	0.23	20
yes	Illinois	Byron 1	3.1%	21	24,887	0.00	13
yes	Illinois	Byron 2	3.5%	21	24,887	0.01	15

Probable Fatalities Due to Loss of Power for Spent Fuel Pools

Preliminary Estimates Over Remaining Reactor Operation

Probability of No Outside Assistance	50%
Probability of Spontaneous Zirconium Ignition	50%

Within Area of Probable Power System Collapse	State	Plant	Zirconium Fire Probability	Pop. within 1 Mile	Pop. within 10 Miles	Probable Early Fatalities	Probable Cancer Fatalities
yes	Illinois	Clinton	3.5%	0	12,326	0.00	7
yes	Illinois	Dresden 2	4.1%	134	64,843	0.04	45
yes	Illinois	Dresden 3	4.6%	134	64,843	0.04	50
yes	Illinois	La Salle 1	2.6%	5	13,923	0.00	6
yes	Illinois	La Salle 2	2.8%	5	13,923	0.00	7
no	Illinois	Quad Cities 1	0.0%	0	30,985	0.00	0
no	Illinois	Quad Cities 2	0.0%	0	30,985	0.00	0
no	Iowa	Duane Arnold	0.0%	7	101,695	0.00	0
no	Kansas	Wolf Creek	0.0%	0	4,846	0.00	0
no	Louisiana	River Bend	0.0%	53	24,633	0.00	0
no	Louisiana	Waterford	0.0%	256	80,758	0.00	0
yes	Maryland	Calvert Cliffs 1	5.2%	30	40,524	0.01	35
yes	Maryland	Calvert Cliffs 2	5.6%	30	40,524	0.01	38
yes	Massachusetts	Pilgrim	0.3%	613	69,854	0.01	3
yes	Michigan	Cook 1	5.2%	114	53,351	0.04	46
yes	Michigan	Cook 2	5.7%	114	53,351	0.05	52
yes	Michigan	Enrico Fermi 2	3.3%	21	87,086	0.00	48
yes	Michigan	Palisades	4.6%	29	31,619	0.01	24
no	Minnesota	Monticello	0.0%	94	43,181	0.00	0
no	Minnesota	Prairie Island 1	0.0%	219	26,923	0.00	0
no	Minnesota	Prairie Island 2	0.0%	219	26,923	0.00	0
no	Mississippi	Grand Gulf	0.0%	0	7,628	0.00	0
no	Missouri	Callaway	0.0%	11	6,238	0.00	0
no	Nebraska	Cooper	0.0%	0	4,665	0.00	0
no	Nebraska	Fort Calhoun	0.0%	17	17,244	0.00	0
yes	New Hampshire	Seabrook	4.3%	852	117,769	0.26	86
yes	New Jersey	Hope Creek	3.5%	0	32,622	0.00	19
yes	New Jersey	Oyster Creek	4.1%	1,275	120,110	0.38	83
yes	New Jersey	Salem 1	1.2%	0	32,622	0.00	7
yes	New Jersey	Salem 2	2.2%	0	32,622	0.00	12

Probable Fatalities Due to Loss of Power for Spent Fuel Pools

Preliminary Estimates Over Remaining Reactor Operation

Probability of No Outside Assistance	50%
Probability of Spontaneous Zirconium Ignition	50%

Within Area of Probable Power System Collapse	State	Plant	Zirconium Fire Probability	Pop. within 1 Mile	Pop. within 10 Miles	Probable Early Fatalities	Probable Cancer Fatalities
yes	New York	FitzPatrick	5.2%	10	38,737	0.00	34
yes	New York	Ginna	4.1%	177	53,810	0.05	37
yes	New York	Indian Point 2	0.5%	1,510	257,474	0.05	22
yes	New York	Indian Point 3	1.0%	1,510	257,474	0.11	43
yes	New York	Nine Mile Point 1	4.1%	10	38,571	0.00	27
yes	New York	Nine Mile Point 2	7.4%	10	38,571	0.01	48
yes	North Carolina	Brunswick 1	5.6%	314	24,186	0.12	23
yes	North Carolina	Brunswick 2	5.2%	314	24,186	0.12	21
yes	North Carolina	Harris	7.4%	0	53,629	0.00	67
yes	North Carolina	McGuire 1	6.5%	120	118,694	0.06	130
yes	North Carolina	McGuire 2	6.9%	120	118,694	0.06	137
yes	Ohio	Davis-Bessie	1.5%	90	17,061	0.01	4
yes	Ohio	Perry	3.5%	189	76,201	0.05	45
yes	Pennsylvania	Beaver Valley 1	1 2%	470	145,409	0.04	30
yes	Pennsylvania	Beaver Valley 2	3.7%	470	145,409	0.12	91
yes	Pennsylvania	Limerick 1	3.1%	661	213,586	0.14	110
yes	Pennsylvania	Limerick 2	4.1%	661	213,586	0.19	148
yes	Pennsylvania	Peach Bottom 2	5.0%	127	41,081	0.04	34
yes	Pennsylvania	Peach Bottom 3	5.2%	127	41,081	0.05	36
yes	Pennsylvania	Susquehanna 1	2.6%	163	53,058	0.03	23
yes	Pennsylvania	Susquehanna 2	3.1%	163	53,058	0.04	27
yes	Pennsylvania	Three Mile Island	5.2%	358	185,780	0.13	161
yes	South Carolina	Catawba 1	6.9%	191	140,492	0.09	162
yes	South Carolina	Catawba 2	6.9%	191	140,492	0.09	162
yes	South Carolina	Oconee 1	5 0%	18	71,183	0.01	59
yes	South Carolina	Oconee 2	5 0%	18	71,183	0.01	59
yes	South Carolina	Oconee 3	5.2%	18	71,183	0.01	62
yes	South Carolina	Robinson	4.3%	600	33,649	0.19	25
yes	South Carolina	Summer	6.7%	24	10,567	0.01	12

Probable Fatalities Due to Loss of Power for Spent Fuel Pools

Preliminary Estimates Over Remaining Reactor Operation

Probability of No Outside Assistance	50%
Probability of Spontaneous Zirconium Ignition	50%

Within Area of Probable Power System Collapse	State	Plant	Zirconium Fire Probability	Pop. within 1 Mile	Pop. within 10 Miles	Probable Early Fatalities	Probable Cancer Fatalities
yes	Tennessee	Sequoyah 1	2.2%	637	83,152	0.10	30
yes	Tennessee	Sequoyah 2	2.4%	637	83,152	0.11	33
yes	Tennessee	Watts Bar	5.4%	0	19,322	0.00	17
no	Texas	Comanche Peak 1	0.0%	0	28,126	0.00	0
no	Texas	Comanche Peak 2	0.0%	0	28,126	0.00	0
no	Texas	South Texas 1	0.0%	0	2,779	0.00	0
no	Texas	South Texas 2	0.0%	0	2,779	0.00	0
yes	Vermont	Vermont Yankee	0.3%	412	33,943	0.01	1
yes	Virginia	North Anna 1	5.9%	93	15,516	0.04	15
yes	Virginia	North Anna 2	6.3%	93	15,516	0.04	16
yes	Virginia	Surry 1	4.8%	0	117,247	0.00	94
yes	Virginia	Surry 2	5.0%	0	117,247	0.00	98
yes	Washington	Columbia	2.8%	4	2,851	0.00	1
yes	Wisconsin	Kewaunee	0.5%	35	9,911	0.00	1
yes	Wisconsin	Point Beach 1	4.3%	2	20,361	0.00	15
yes	Wisconsin	Point Beach 2	5.0%	2	20,361	0.00	17
Totals						3.92	3,170

Event Fatalities Due to Power System Collapse

While the preceding analysis examined probable fatalities due to power system collapse, actual fatalities would not be piecemeal—either radiation release would occur and result in fatalities, or not. In the present section, we show a projection of total fatalities from zirconium fires and radiation release. To avoid double-counting of population surrounding nuclear power plants and spent fuel pools, the analysis is done on a per-site basis rather than a per-pool basis.

The MELCOR severe accident computer code used by the NRC estimates fatalities based on societal dose of radiation, using a linear relationship between dose and fatalities. If two spent fuel pools ignite rather than one, the projected fatalities would be twice as large. Accordingly the below analysis multiplies the individual risk of fatalities from NUREG-1738 by the number of reactors (and associated spent fuel pools) at a site.

Our analysis shows that 11,598 individuals live within 1 mile of nuclear power plant sites and 3.6 million live within 10 miles of sites. In the event of a long-term commercial power grid collapse, 119 early fatalities and 77,705 cancer deaths are projected, assuming that outside assistance cannot be provided to nuclear power plants and that all spent fuel pools experience spontaneous zirconium ignition. This projection would represent an upper probabilistic bound for radiation fatalities, within the individual risk methodology of NUREG-1738.

Reasonable people might assert that the individual risk methodology of NUREG-1738 is unduly optimistic. NUREG-1738 assumes no early fatalities for individuals living more than one mile away from nuclear power plant sites and assumes no cancer deaths for individuals living more than 10 miles away. Nonetheless, for the sake of optimism, we use the NUREG-1738 methodology.

Spent Fuel Pool Fatalities in Event of Power System Collapse

Preliminary Estimates

Risks from NUREG-1738:

Individual Risk of Early Fatality (Within 1 Mile), Late Evacuation	0.71%
Individual Risk of Latent Cancer Fatality (Within 10 Miles), Late Evacuation	1.68%

Within Area of Probable Power System Collapse	State	Nuclear Power Plant Site	Number of Reactors	Population within 1 Mile	Population within 10 Miles	Early Fatalities	Latent Cancer Fatalities
yes	Alabama	Browns Ferry 1/2/3	3	0	32,751	0	1,651
no	Alabama	Farley 1 & 2	2	0	9,795	0	0
no	Arizona	Palo Verde 1/2/3	3	0	3,302	0	0
no	Arkansas	Arkansas Nuclear 1 & 2	2	231	45,451	0	0
no	California	Diablo Canyon 1 & 2	2	0	24,084	0	0
no	California	San Onofre 2 & 3	2	0	74,169	0	0
yes	Connecticut	Millstone 2 & 3	2	517	117,615	7	3,952
no	Florida	Crystal River 3	1	0	18,663	0	0
no	Florida	St Lucie 1 & 2	2	0	160,073	0	0
no	Florida	Turkey Point 3 & 4	2	0	104,389	0	0
yes	Georgia	Hatch 1 & 2	2	0	8,339	0	280
yes	Georgia	Vogtle 1 & 2	2	0	2,990	0	100
yes	Illinois	Braidwood 1 & 2	2	884	32,361	13	1,087
yes	Illinois	Byron 1 & 2	2	21	24,887	0	836
yes	Illinois	Clinton	1	0	12,326	0	207
yes	Illinois	Dresden 2 & 3	2	134	64,843	2	2,179
yes	Illinois	La Salle 1 & 2	1	5	13,923	0	234
no	Illinois	Quad Cities 1 & 2	2	0	30,985	0	0
no	Iowa	Duane Arnold	1	7	101,695	0	0
no	Kansas	Wolf Creek	1	0	4,846	0	0
no	Louisiana	River Bend	1	53	24,633	0	0
no	Louisiana	Waterford	1	256	80,758	0	0
yes	Maryland	Calvert Cliffs 1 & 2	2	30	40,524	0	1,362
yes	Massachusetts	Pilgrim	1	613	69,854	4	1,174
yes	Michigan	Cook 1 & 2	2	114	53,351	2	1,793
yes	Michigan	Enrico Fermi 2	1	21	87,086	0	1,463
yes	Michigan	Palisades	1	29	31,619	0	531
no	Minnesota	Monticello	1	94	43,181	0	0
no	Minnesota	Prairie Island 1 & 2	2	219	26,923	0	0
no	Mississippi	Grand Gulf	1	0	7,628	0	0
no	Missouri	Callaway	1	11	6,238	0	0
no	Nebraska	Cooper	1	0	4,665	0	0
no	Nebraska	Fort Calhoun	1	17	17,244	0	0

Spent Fuel Pool Fatalities in Event of Power System Collapse (continued)

Preliminary Estimates

Risks from NUREG-1738:

Individual Risk of Early Fatality (Within 1 Mile), Late Evacuation 0.71%

Individual Risk of Latent Cancer Fatality (Within 10 Miles), Late Evacuation 1.68%

Within Area of Probable Power System Collapse	State	Nuclear Power Plant Site	Number of Reactors	Population within 1 Mile	Population within 10 Miles	Early Fatalities	Latent Cancer Fatalities
yes	New Hampshire	Seabrook	1	852	117,769	6	1,979
yes	New Jersey	Hope Creek/Salem 1 & 2	3	0	32,622	0	1,644
yes	New Jersey	Oyster Creek	1	1,275	120,110	9	2,018
yes	New York	FitzPatrick	1	10	38,737	0	651
yes	New York	Ginna	1	177	53,810	1	904
yes	New York	Indian Point 2 & 3	2	1,510	257,474	22	8,651
yes	New York	Nine Mile Point 1 & 2	2	10	38,571	0	1,296
yes	North Carolina	Brunswick 1 & 2	2	314	24,186	4	813
yes	North Carolina	Harris	1	0	53,629	0	901
yes	North Carolina	McGuire 1 & 2	2	120	118,694	2	3,988
yes	Ohio	Davis-Bessie	1	90	17,061	1	287
yes	Ohio	Perry	1	189	76,201	1	1,280
yes	Pennsylvania	Beaver Valley 1 & 2	2	470	145,409	7	4,886
yes	Pennsylvania	Limerick 1 & 2	2	661	213,586	9	7,176
yes	Pennsylvania	Peach Bottom 2 & 3	2	127	41,081	2	1,380
yes	Pennsylvania	Susquehanna 1 & 2	2	163	53,058	2	1,783
yes	Pennsylvania	Three Mile Island	1	358	185,780	3	3,121
yes	South Carolina	Catawba 1 & 2	2	191	140,492	3	4,721
yes	South Carolina	Oconee 1/2/3	3	18	71,183	0	3,588
yes	South Carolina	Robinson	1	600	33,649	4	565
yes	South Carolina	Summer	1	24	10,567	0	178
yes	Tennessee	Sequoyah 1 & 2	2	637	83,152	9	2,794
yes	Tennessee	Watts Bar	1	0	19,322	0	325
no	Texas	Comanche Peak 1 & 2	2	0	28,126	0	0
no	Texas	South Texas 1 & 2	2	0	2,779	0	0
yes	Vermont	Vermont Yankee	1	412	33,943	3	570
yes	Virginia	North Anna 1 & 2	2	93	15,516	1	521
yes	Virginia	Surry 1 & 2	2	0	117,247	0	3,939
yes	Washington	Columbia	1	4	2,851	0	48
yes	Wisconsin	Kewaunee	1	35	9,911	0	167
yes	Wisconsin	Point Beach 1 & 2	2	2	20,361	0	684
Totals				11,598	3,558,068	119	77,705

Comparison of Spent Fuel Pool Risk to NRC Safety Goals

NUREG-1738 contains a summary of NRC safety goals as they pertain to spent fuel pools:

> **SFP Risk Relative to the Safety Goal Policy Statement**
>
> The "Policy Statement on Safety Goals for the Operation of Nuclear Power Plants," issued in 1986, establishes goals that broadly define an acceptable level of radiological risk to the public as a result of nuclear power plant operation. These goals are used generically to assess the adequacy of current requirements and potential changes to the requirements. The Commission established two qualitative safety goals that are supported by two quantitative objectives for use in the regulatory decision-making process. The qualitative safety goals stipulate the following:
>
> - Individual members of the public should be provided a level of protection from the consequences of nuclear power plant operation such that individuals bear no significant additional risk to life and health.
> - Societal risks to life and health from nuclear power plant operation should be comparable to or less than the risks of generating electricity by viable competing technologies and should not be a significant addition to other societal risks.
>
> The following quantitative health objectives (QHOs) are used in determining achievement of the safety goals:
>
> - The risk to an average individual in the vicinity of a nuclear power plant of prompt fatalities that might result from reactor accidents should not exceed one-tenth of 1 percent (0.1 percent) of the sum of prompt fatality risks resulting from other accidents to which members of the U.S. population are generally exposed.
>
> The risk to the population in the area near a nuclear power plant of cancer fatalities that might result from nuclear power plant operation should not exceed one-tenth of 1 percent (0.1 percent) of the sum of cancer fatality risks resulting from all other causes.
>
> These QHOs have been translated into two numerical objectives as follows:
>
> - The individual risk of a prompt fatality from all "other accidents to which members of the U.S. population are generally exposed," such as fatal automobile accidents, is about $5x10^{-4}$ per year. One-tenth of 1 percent of this figure implies that the individual risk of prompt fatality from a reactor accident should be less than $5x10^{-7}$ per reactor year.
> - "The sum of cancer fatality risks resulting from all other causes" for an individual is taken to be the cancer fatality rate in the U.S. which is about 1 in 500 or $2x10^{-3}$ per year. One-tenth of 1 percent of this risk means that the risk of cancer to the population in the area near a nuclear power plant due to its operation should be limited to $2x10^{-6}$ per reactor year.

We calculated probable individual risks by determining the yearly probability of a spent fuel pool event and then multiplying by individual risks for "Consequences of an SPF Accident With a Low Ruthenium Source Term (per event)" as specified in Table 3.7-2 in NUREG-1738. We then compared probable individual risks to the NRC Safety Goals for Operation of Nuclear Power Plants.

As the below analysis shows, the probable individual risk of early fatalities at spent fuel pools exceeds the NRC safety goal by a factor of 35.7. The probable individual risk of cancer deaths exceeds the NRC safety goal by a factor of 21.0.

Spent Fuel Pool Risks for Individuals per Reactor Year

	Early Fatality	Cancer Death
Probability of Long-Term Loss of Outside Power	1.0E-02	1.0E-02
Probability of No Outside Assistance	5.0E-01	5.0E-01
Probability of Spontaneous Zirconium Ignition	5.0E-01	5.0E-01
Overall Probability of SFP Radiation Release	2.5E-03	2.5E-03
Individual Risk from SFP Event	7.13E-03	1.68E-02
Probable Individual Risk	1.78E-05	4.20E-05
NRC Safety Goal	5.00E-07	2.00E-06
Ratio of Probable Individual Risk to NRC Goal	35.7	21.0

NUREG-1738 also states the appropriate standard to be used in evaluating Large Early Release Frequency (LERF) for spent fuel pools:

> In the study, the staff stated that consequences of an SFP fire are sufficiently severe that the RG 1.174 large early release frequency baseline of 1×10^{-5} per reactor year is an appropriate frequency guideline for a decommissioning plant SFP risk and a useful measure in combination with other factors such as accident progression timing, for assessing features, systems, and operator performance for a spent fuel pool in a decommissioning plant.

We calculated the probability of LERF by multiplying the yearly probability of a long-term LOOP event, the probability of outside assistance being unavailable, and the probability of spontaneous zirconium ignition. As the below analysis shows, the risk of LERF from spent fuel pools exceeds the NRC staff guideline by over 2 orders of magnitude.

LERF Spent Fuel Pool Risk per Reactor Year

	Frequency per Reactor Year
Probability of Long-Term Loss of Outside Power	1.0E-02
Probability of No Outside Assistance	5.0E-01
Probability of Spontaneous Zirconium Ignition	5.0E-01
Overall Probability of SFP LERF	2.5E-03
NRC LERF Guideline	1.0E-05
Ratio of Probable SPF LERF to NRC Guideline	2.5E+02

For the purposes of this Petition we assume that the estimates for probability of long-term loss of outside power, probability of outside assistance, and probability of spontaneous zirconium ignition are midpoint estimates. Still, because the resulting risk assessments for spent fuel pools exceed the NRC goals for individual risk and the LERF guideline by 1-2 orders of magnitude, any of these individual probabilities could be more optimistic by an order of magnitude and the NRC safety goals would still not be met. For example, severe space weather could occur only once in one thousand years, on average, and the safety goals for individual risk would not be met. For the LERF guideline, two of three probabilities could be more optimistic by an order of magnitude and the guideline would still not be met; for example, severe space weather once in one thousand years, 95% chance of outside assistance, and/or zirconium fire only if the fuel rods have been out of the reactor core 2 months or less.

Hypothetical Design for Emergency Makeup Water System

A low-cost solution to provide emergency makeup water to spent fuel pools on an unattended basis could consist of a renewable electric power source, electrically-powered water pumps, float switches to detect water level in the spent fuel pool, and piping from a nearby water source such as a river or lake. (Nearly all nuclear power plants are adjacent to bodies of water.)

Spent Fuel Pool Water Boil-Off Rates

Time After Discharge (days)	Decay Power from Last Core (Megawatts)	Total Heat Load (Megawatts)	Boil-off Rate (Gallons per Minute)	Water Level Decrease (ft/hour)
2	16.4	18.4	130	1.00
10	8.6	10.6	74	0.60
30	5.5	7.5	52	0.42
60	3.8	5.8	41	0.33
90	3.0	5.0	35	0.28
180	1.9	3.9	27	0.22
365	1.1	3.1	22	0.18

Notes: Using typical pool sizes, it is estimated that for BWRs, we have 1040 ft3/ft depth, and for PWRs, we have 957 ft3/ft depth. Assume = 1000 ft3/ft depth for level decreases resulting from boil-off.

The sizing and cost of such a system would largely depend on the boil-off rates from the spent fuel pool. As data in above figure show (taken from NUREG-1738 Table 3.1, "Time to Bulk Boiling, and Boil-off Rates") boil-off rates depend on the time after discharge of fuel rods from the reactor core.

Example components, sources, and costs are presented below. While an appropriately designed and tested system would no doubt cost more than this estimate, we seek to show that the costs of such a system would be moderate. In any case, a simple emergency makeup water system that could operate unattended would be more reliable than the current sole dependence on human operators.

Components and Costs for Emergency Makeup Water System

	Quantity	Cost per Unit	Total Cost
5HP Electric Water Pump, 180 GPM	2	$1,300	$2,600
Solar/Wind Power System	4	$20,000	$80,000
Float Switch Control System	2	$100	$200
2 Inch Plastic Piping to Water Source	2	$10,000	$20,000
Miscellaneous Components	2	$25,000	$50,000
			$152,800

CONCLUSION

Ample evidence now exists, both analytical and experiential, that severe space weather has significant probability of causing widespread and persistent commercial grid outages. Nuclear plant licensees would have extreme difficulty cooling and protecting spent fuel pools under conditions of long-term commercial grid outage. Resupply of diesel fuel for backup generators and pumps would be improbable. Resupply of food and potable water for human operators and security personnel is in doubt. Commercial grid outage in excess of 30 days would likely cause water uncovering of spent fuel rods and result in zirconium cladding fires. Zirconium fires would result in substantial and fatal radiation release to the atmosphere. The data for these conclusions come not from the work of advocacy groups or private citizens, but from the work of government-sponsored commissions and regulatory bodies. Petitioner takes the reasonable position that nuclear power plant licensees should be required to implement design changes of moderate cost that would prevent fatalities and extensive radiation contamination of United States territory.

Thank you for coming to this press conference. My name is Tom Popik and I am with the Foundation for Resilient Societies. With me here today I have a group of experts to answer questions, including George Baker, professor at James Madison University and former staff to Electromagnetic Pulse (EMP) Commission; Bronius Cikotas, founder of the Asymmetrical Threat Analysis Response Center; Michael Del Rosso, research fellow of the Claremont Institute and former Chairman of the IEEE-USA Critical Infrastructure Protection Committee; Henry Kluepfel, former EMP commissioner; Charles Manto, president of Instant Access Networks ; and Michael Mariotte, executive director of Nuclear Information and Resource Service.

We are here today to talk about power grid reliability and its effect on other critical infrastructures, including nuclear power plants. Nuclear power plants require continual electric power to maintain safe operation. In particular, spent fuel pools at the plants have fuel rods that are so hot they must be immersed in water that is cooled by electrically-powered pumps. If the pumps stop working, the fuel pools will boil, just as the water in a car's engine boils when the water pump fails.

If the water in the spent fuel pools boils off and exposes the fuel rods to air, the metal cladding on the rods will catch fire, much like the metal in a 4th of July

sparkler. Because spent fuel pools are not in containment vessels, the resulting plume of radioactive material would be released into the atmosphere.

How likely is this occurrence? A report released last October by the Oak Ridge National Laboratories disclosed that each year there is a 1% chance of widespread power outage caused by solar storms. When the sun erupts, it can send a burst of charged particles toward the earth. These charged particles interact with the earth's magnetic field, inducing current in electrical transmission lines. The current flows into high-voltage transformers, overloading them and burning them out. The replacement time for high voltage transformers is 1-2 years and there are no domestic manufacturers.

When I talk about solar storms causing high-voltage transformers to burn out, I am not talking about a theoretical possibility. A solar storm in March 1989 immediately burned out a transformer at the Salem nuclear power plant in New Jersey and also caused a blackout in Quebec. Shortly after the same storm, transformers at an additional 11 US nuclear power plants failed. In 2003, a relatively weak solar storm burned out 14 high-voltage transformers in South Africa. And in 1859, British astronomer Richard Carrington observed a solar storm so enormous that it affected much of the world, burning out the telegraph equipment of the day. So we have excellent evidence that this is a real threat.

The Oak Ridge National Laboratories report shows which areas of the country are likely to experience grid collapse as a result of solar storm. It's most of the United States east of the Mississippi River and also an area out west consisting of Washington State, Oregon, and Idaho. Seventy-one out of 104 operating nuclear power plants are in this area of probable power grid collapse.

All nuclear power plants have backup diesel generators, but the Nuclear Regulatory Commission requires only 7 days of fuel. Nuclear power plants cannot generate power on their own; they must be tied into a functioning power grid.

If every one of the spent fuel pools within the area of probable power system collapse were to catch fire and release radiation, we estimate causalities of 77,000. This casualty estimate assumes that 95% of the population surrounding the nuclear power plants will evacuate. If the power is out, telephones and emergency sirens might not be working. If most people do not evacuate, the casualties could reach 1 million, because 3.6 million Americans live within 10 miles of a nuclear power plant.

The Foundation for Resilient Societies is not an anti-nuclear group and we do not have an anti-nuclear agenda today. Nuclear power plants provide 20% of baseload power to the United States.

We are proposing that all nuclear power plants be required to install backup cooling systems for spent fuel pools. Our formal request, called a Petition for Rulemaking, was sent to the Nuclear Regulatory Commission over the weekend. The proposed cooling system would simply add more water to the spent fuel pools to make up the water that boils off due to the heat from the fuel. Power for the pumps would come from renewable and unattended sources—solar, wind, or hydroelectric. We've developed a cost estimate for such a backup cooling system, and it would be about $150,000 per plant.

There's another solution to protect our nation's infrastructure and population. It would cost about $100,000 per transformer to protect 350 extra high voltage transformers. This would be just a few pennies a month on consumers' electric bills.

If protecting the high-voltage transformers is so inexpensive, why hasn't it been done? The short answer is that electricity generation and transmission is a fragmented business in North America, divided up among thousands of producers.

Here's the longer answer. In the United States, standards for power grid reliability are set by a private corporation, the North American Electric Reliability Corporation, or NERC. Twenty years ago the NERC Board of Trustees recognized the danger from solar storms and published a board resolution. I've brought with me several dozen copies of the original NERC board resolution, dated July 1990.

I'm not going to stand in front of you and tell you why NERC hasn't fixed this problem in 20 years. I'm going to request that you to take a copy of the 1990 board resolution inside to the technical conference at 10AM and ask the NERC executives why the high voltage transformers are not protected.

The NERC board resolution makes reference to a satellite system to forecast solar storms. Yes, there is such a satellite now, and it is well past its originally designed operational life. The satellite, if it does work, might give about 30 minutes warning. Please ask the NERC executives, "Is there a national plan to shut down the North American power grids to prevent long-term damage from solar storms?" If they say yes, you should ask how long it would take to bring the grids back up from a complete shutdown, and which geographic areas would be most affected.

We are here at the Federal Energy Regulatory Commission, the agency charged with overseeing NERC. While there are many dedicated and competent people working at this agency, they don't have the current legal authority to force grid reliability standards on NERC.

In late 2010, a principled senior official from the Federal Energy Regulatory Commission visited the office of Congressman Roscoe Bartlett and told him if the United States were to experience a solar storm of magnitude similar to the 1859 Carrington Event, the power grid would collapse for 1-2 years, resulting in the likely death of 75% of the US population.

I've talked to several reporters about our petition for nuclear power plants and they told me, "Tom, the real story here is not nuclear plants, but that large cities such as New York would become uninhabitable without electric power." And I agree with those reporters.

In 2010, the US House of Representatives recognized the danger of solar storms and unanimously passed the Grid Reliability and Infrastructure Protection (GRID) Act. This legislation would have allowed the Federal Energy Regulatory Commission to set electric reliability standards.

Unfortunately, the GRID Act died in the Senate due to the actions of just a few senators. The average service of a US senator is 13 years, which means that there is a 13% chance of severe solar storm and resulting power grid collapse during their tenure. The chance of dying from playing Russian roulette is one-in-six, or 16%, so not protecting the power grid is just a bit better than playing Russian roulette with the lives of 225 million Americans.

In closing, I call on the Nuclear Regulatory Commission to require backup cooling systems for nuclear power plants. I also call on the US Congress and the President to pass legislation to protect the North American power grids.

Now we'll take questions.

NERC Position Statement on
Solar Magnetic Disturbance Forecasting
Approved by the Board of Trustees
July 9, 1990

The North American Electric Reliability Council (NERC) strongly urges that improvements be made to the SMD forecasting accuracy of the National Oceanic & Atmospheric Administration. With the current activity on the sun projected to continue well into the 1990s, NERC believes that a forecasting procedure to provide at least one hour notice and an accuracy of at least 90% is required. This security margin will allow sufficient time to implement special operating procedures.

The geomagnetic induced currents (GIC) that are imposed on electric systems as a result of severe solar magnetic disturbances (SMD) pose a threat to the reliability of the interconnected electric networks in the U.S. and Canada. The GICs cause transformers to saturate and overheat. This results in depressed system voltages, failure or misoperation of critical system voltage control devices, and damage to the transformers themselves. On March 13, 1989, a severe SMD caused the total shutdown of the Hydro-Québec system in Canada. Electric utilities across the northern latitudes of the U.S also experienced transformer damage, depressed voltages, and the forced tripping of several voltage control devices. While no widespread blackouts have yet occurred, the incident demonstrated the potential damage to equipment and risk to system reliability. As a result, several control areas have established SMD operating guidelines and study groups.

The nature of the sudden onset of SMD requires that an effective SMD forecasting mechanism be in place to provide system operators with sufficient time to take preventive measures to protect the reliability of the network. Current forecasting technology has not proved to be sufficiently accurate or timely.

A NERC report, "March 13, 1989 Geomagnetic Disturbance," recommends the use of blocking devices to protect high voltage transformers:

Neutral-Blocking Capacitor

Capacitors installed between transformer neutrals and grounds can be very effective in blocking ground-induced currents. Ideally, the capacitor should be very simple, should not increase voltage stress on transformer insulation, should not have to be bypassed during faults (eliminating the necessity for a complex bypass device) and should have a low 60 Hz impedance (to avoid any impact on the system grounding coefficient). The cost of such a device, will of course, have to be weighed against its simplicity, robustness, and reliability. Hydro-Québec is currently studying a capacitor of this sort and if findings are promising, a prototype will be installed for field testing and evaluation of long-term reliability and performance.

Huffert, Anthony

From: Huffert, Anthony
Sent: Thursday, April 14, 2011 4:24 AM
To: Call, Michel; Gepford, Heather
Subject: FW: Health Working Group

From: Walcott, Naomi [mailto:WalcottN@state.gov]
Sent: Thursday, April 14, 2011 3:05 AM
To: Huffert, Anthony
Subject: Health Working Group

Tony,

I work with Bruce Howard, also at the Embassy, who passed me your contact information. I am working at the Embassy on coordinating among offices and individuals working on health-related aspects to the current situation. Would I be able to drop by at your convenience to talk with you about what you'll be working on and what the Protective Measures Team does?

Also, there is a Health Working Group meeting that will meet next Tuesday from 2:30 – 3:30 in the Press Briefing Room #2 (second floor). Would you be available or interested to attend to meet some of the others in the Embassy who handle various aspects of health and safety issues? It will likely be chaired by Suzanne Basalla, the Ambassador's Senior Advisor.

Best regards,
Naomi

Naomi Walcott
Second Secretary
Environment, Science, Technology and Health Unit
Economic Section
U.S. Embassy Tokyo
Tel: (03) 3224-5315
Fax: (03) 3224-5019
Email: walcottn@state.gov

This email is UNCLASSIFIED.

From: Wiggins, Jim
Sent: Monday, April 11, 2011 6:31 PM
To: Virgilio, Martin
Cc: Weber, Michael
Subject: Fw: Results Senate EPW staff briefing
Attachments: Senate committee staff briefing april 11 2011.pptx

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From: McDermott, Brian
To: Wiggins, Jim; Evans, Michele
Cc: Milligan, Patricia; Thaggard, Mark; Morris, Scott
Sent: Mon Apr 11 17:57:16 2011
Subject: Results Senate EPW staff briefing

A dozen or so staffers that attended the briefing presented by Trish Milligan. Was well received and the staffers were engaged, asking good questions.

Questions were almost all centered on EP programs and what is required. Did not ask about specific topics from the short or long term TF activities.

There were two "what if" questions that Trish did a nice job of answering:

Q: Would we need a 50 mi EPZ if all the workers walked away? Basic answer was that additional responders are called in immediately to assist and this is a practiced response.

Q: What would happen to NYC drinking water reservoirs (near IP) if there was a release? Trish described the ongoing monitoring of the water supplies under EPA and that actions would be taken, similar to the bottled water for children in Japan, if needed. She also stressed that the typical limits used by EPA for safe drinking water are based on a 70 year exposure.

Brian

Brian J. McDermott
(b)(6)

From: Milligan, Patricia
To: Decker, David
Cc: McDermott, Brian
Sent: Mon Apr 11 16:42:37 2011
Subject: Senate committee staff briefing april 11 2011.pptx

David
Attached are the slides and I've also included some of the references I mentioned.

Telephone survey document
http://www.nrc.gov/reading-rm/doc-collections/nuregs/contract/cr6953/vol2/

BBB\120

evacuation document
http://www.nrc.gov/reading-rm/doc-collections/nuregs/contract/cr6864/

post Katrina evacuation document
http://www.nrc.gov/reading-rm/doc-collections/nuregs/contract/cr6981/

NRC's Japan Page
http://www.nrc.gov/japan/japan-info.html

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Protecting People and the Environment

Nuclear Regulatory Commission

Emergency Preparedness and Planning for Commercial Nuclear Power Plants

Briefing for Senate Environment and Public Works Committee Staff

April 11, 2011

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United States Nuclear Regulatory Commission
Protecting People and the Environment

NRC Mission – What Do We Do?

- The mission of the NRC is to license and regulate the Nation's civilian use of byproduct, source, and special nuclear materials in order to **protect public health and safety, promote the common defense and security, and protect the environment.**

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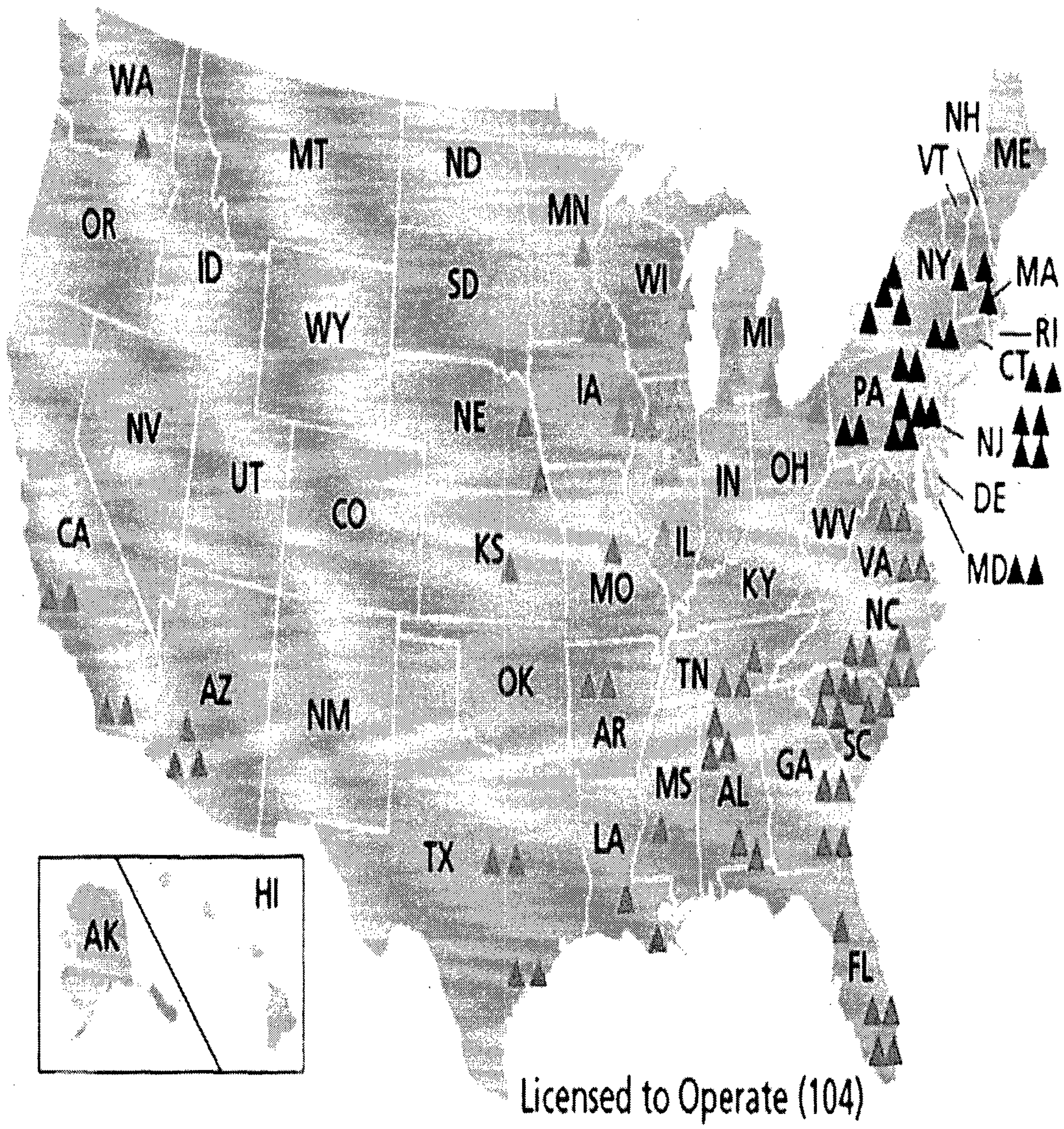
Protecting People and the Environment

Operating Commercial Power Reactors



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Emergency Preparedness (EP)

- NRC has overall responsibility for licensing decisions
  - On-site emergency preparedness evaluated by NRC
  - Off-site emergency preparedness evaluated by FEMA

- Nuclear Power Plant EP programs (supported by state/local plans) are intended to reduce dose to the public during a radiological emergency

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Basis for Emergency Planning

- What is the basis for the existing Emergency Plans for the nuclear power plants in US?
  - Emergency planning in the US is based on a range of accidents including most severe
  - Two emergency planning zones (EPZs) around each NPP.
  - Exact size and shape of EPZ is a result of detailed planning which includes consideration of the specific conditions at each site, unique geographical features of the area, and demographic information.
  - Preplanned strategy for an EPZ provides a substantial basis to support activity beyond the planning zone.
  - 16 planning standards for emergency preparedness
    - 10.CFR.50.47 and NUREG-0654/FEMA-REP-1

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Emergency Preparedness Planning

- Required components of NPP EP
  - Alert and notification plans and systems
    - Notification of offsite authorities
    - Prompt notification of public
  - Evacuation plans
    - Transportation dependent
    - School children
    - Normal and extreme conditions
  - Protective Action Recommendation Scheme
    - Evacuation, sheltering, KI as necessary

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Emergency Preparedness Planning cont.

- Means for controlling radiological exposures for emergency workers
- Arrangements for medical services for contaminated individuals
- General plans for recovery and reentry
- Periodic communications with public to detail emergency plans; i.e. reception centers
  - Yearly information brochures

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Emergency Preparedness Planning cont.

- Offsite radiological consequence assessment capability
  - Dose calculations
  - Field teams
- Emergency Response Organization
  - Staffing requirements
  - Training
  - Drills and exercises

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Emergency Planning Zones and Protective Action Recommendations

- Two emergency planning zones (EPZ) around each nuclear power plant
  - 10 mile EPZ – plume exposure planning zone
  - 50 mile EPZ – ingestion exposure planning zone

- EPZ size established:
  - to protect against most accident sequences
  - to provide a substantial basis for expansion of response efforts as needed beyond the EPZ distances

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NRC Response to an Event

- Operations officers on duty 24/7
  - Activate Operations center as necessary
- Headquarters, Regional and Site based Teams
- Support State and local authorities
  - Protective action recommendations
- Interface with White House, Congress

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Fukushima Nuclear Power Station
NRC Evacuation Recommendation

U.S.NRC
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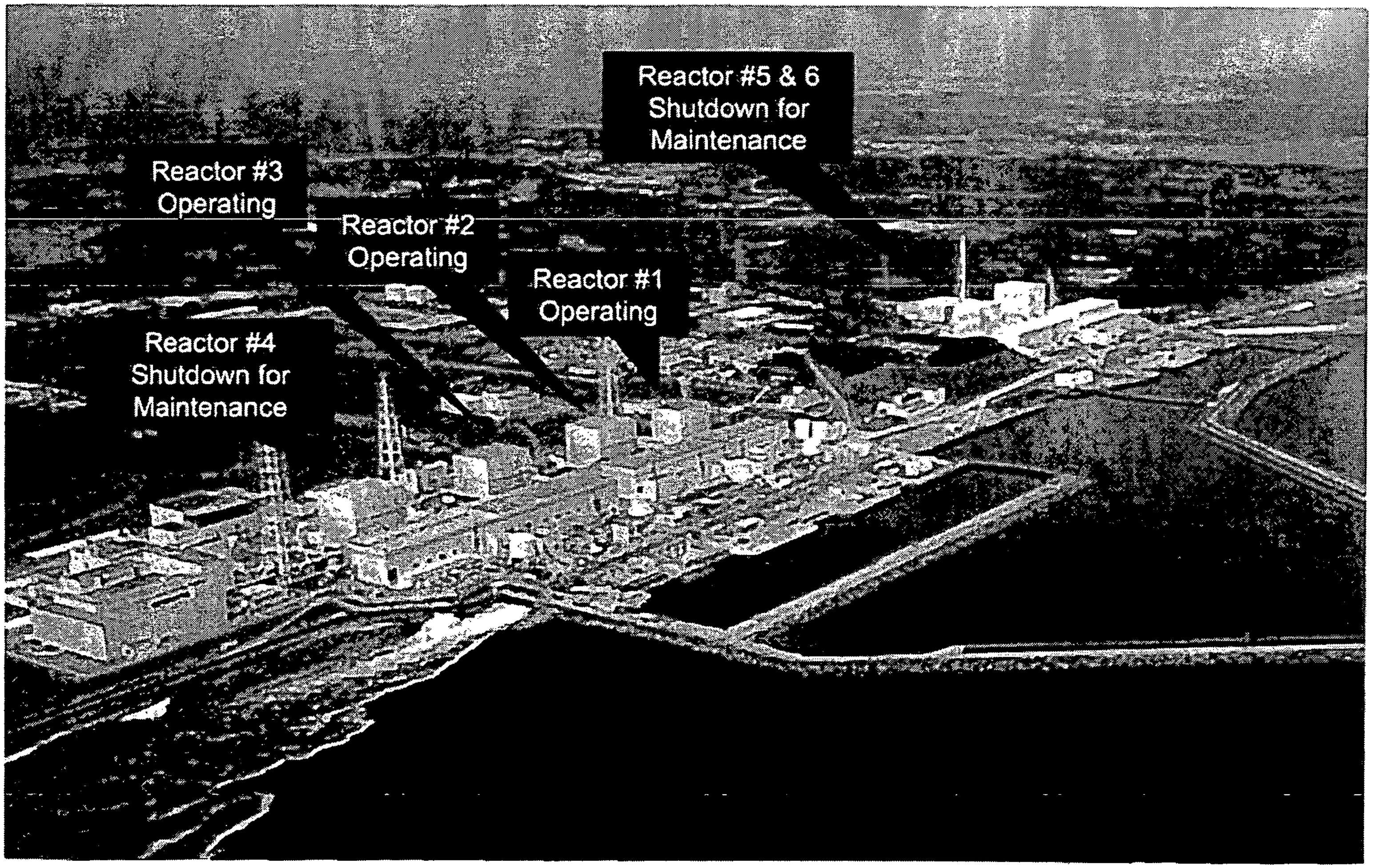
Overview of Fukushima Daiichi Nuclear Power Station



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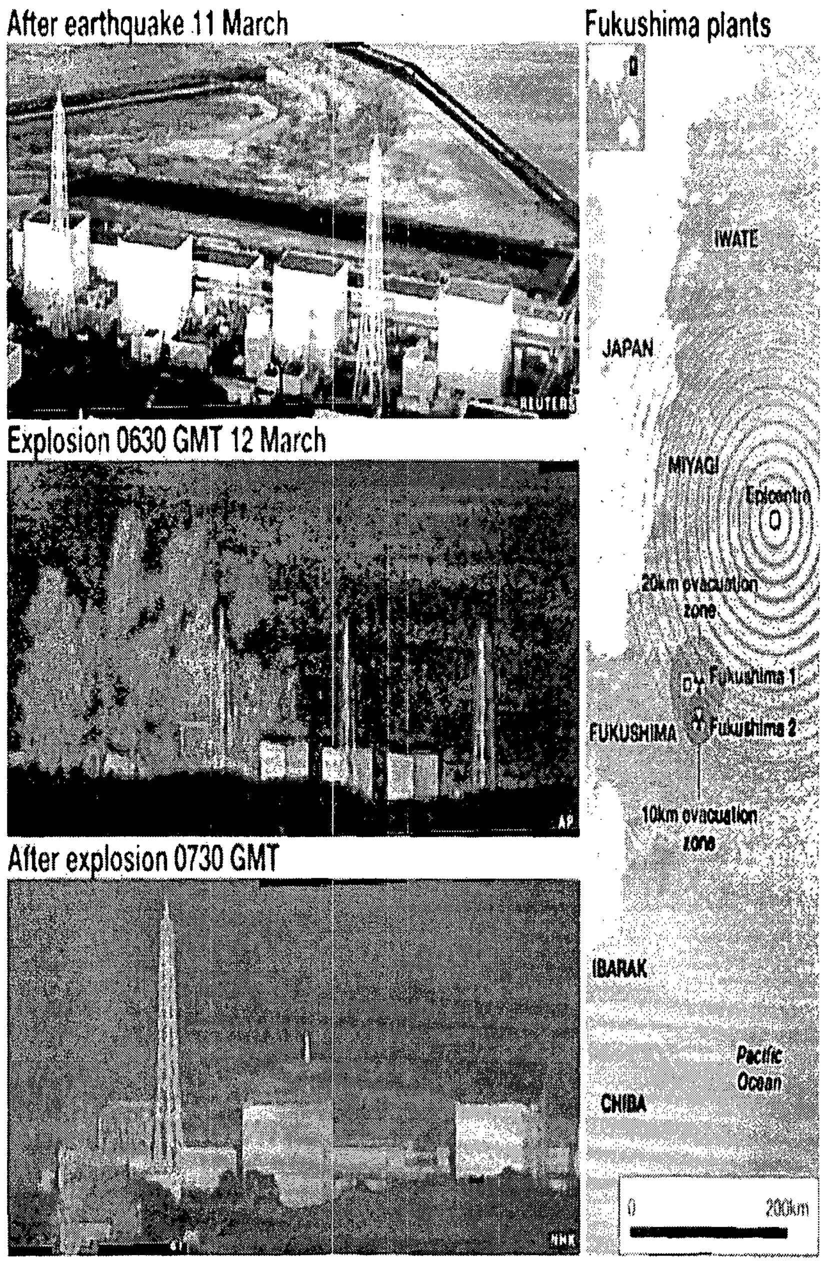
3/11 Earthquake & 3/12 Unit 1 Hydrogen Explosion



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Emergency Planning Zones and Protective Action Recommendations Why 50 miles?

- Limited and uncertain data was available
- Significant challenges to 4 units/spent fuel pools on site
- Potential for large offsite release existed
- Elevated dose rates on site presented challenges to crews attempting to stabilize reactor
- Limited offsite data suggested serious damage to fuel
- Winds shifting from out to sea to land

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Emergency Planning Zones and Protective Action Recommendations

Why 50 miles?

- US government cannot affect the outcomes in Japan
- US government can only take actions to protect its citizens
- Evacuation recommendation to 50 miles afforded protection to US citizens in uncertain and challenging conditions

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Domestic Considerations

- No U.S. Health Effects from radiation fall out from Fukushima
- U.S. Plants Designed for External Events
- NRC has initiated additional inspections at all U.S. Plants
- NRC conducting Near-Term and Long-Term Reviews.

Coe, Doug

From: Boyce, Thomas (OIS)
Sent: Tuesday, April 12, 2011 10:39 AM
To: Coyne, Kevin
Cc: Correia, Richard; Coe, Doug; Ibarra, Jose; Parks, Jazel
Subject: RE: Additoinal Information Multiple FOIA Requests

Yes, but rather than update you with just an e-mail address, I will have someone contact you. I am on a conference call right now where we are trying to enhance our support for these requests

Tom Boyce
Director, OIS

From: Coyne, Kevin
Sent: Monday, April 11, 2011 6:22 PM
To: Boyce, Thomas (OIS)
Cc: Correia, Richard; Coe, Doug; Ibarra, Jose; Parks, Jazel
Subject: RE: Additoinal Information Multiple FOIA Requests

Mr Boyce –

I am one of the individuals specifically named in the recent MSNBC FOIA request for all emails sent and received during a defined period. I had sent an email last Thursday to the "ICOD.Support@nrc.gov" as per your direction below to obtain assistance in collecting, organizing, and printing out emails (including attachments) captured by the FOIA, but have yet to receive a response from anyone from OIS (see attached) Is there a different mailbox that is now being used or a different procedure for obtaining OIS support for this activity? Any help from OIS on this matter is definitely appreciated –

Thanks!

Kevin

Kevin Coyne, P.E., Ph.D.
Chief, Probabilistic Risk Assessment Branch
Division of Risk Analysis, Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
(301) 251-7586 (work)

(b)(6)

888/121

From: Boyce, Thomas (OIS)
Sent: Friday, April 01, 2011 1:52 PM
To: Boyce, Thomas (OIS); Hamilton, Brandi; Clarke, Deanna; Bettis, Ashley; Whetstine, Jack; Marks, Sharon; Hopkins, Rhonda; Clayton, Kathleen; Jaegers, Cathy; Fleming, Barbara; Davis, Catherine; Tressler, Patricia; Poland, Catherine; Rodgers, Mary; Correa, Yessie; Coates, Anissa; Craver, Patti; Gorham, Tajuan; Walker(NRR), Sandra; Wimbush, Andrea; Raynor, Catherine; Belmore, Nancy; Warner, MaryAnn; Hudson, Sharon; Ellis, Marv; Rossi, Roberta; Crutchley, Mary Glenn; Hernandez, Pete; Nibert, Patty; Remsburg, Kristy; Vincent, Leslie; Alexander, Christine; Wilding, Sally; Picon-Colon, Reinaldo; Shay, Jason; Crouch, Nicole; Boyd, Lena
Cc: Janney, Margie; Nichols, Russell; Sealing, Donna; Paradiso, Karen; Landau, Mindy; Clayton, Kathleen; McDermott, Brian; Morris, Scott; Holahan, Patricia; Erlanger, Craig; Thaggard, Mark; Correia, Richard; Layton, Michael; Wimbush,

Andrea; Gitter, Joseph; Nelson, Robert; Howe, Allen; Ruland, William; Bahadur, Sher; Craver, Patti; Mamish, Nader; Mitchell, Linda; Hayden, Elizabeth; Shannon, Valerie; Vietti-Cook, Annette; Champ, Billie; Case, Michael; Richards, Stuart; Gibson, Kathy; Scott, Michael; Coe, Doug; Coyne, Kevin; Parks, Jazel; Powell, Amy; Droggitis, Spiros; Belmore, Nancy; Hirsch, Patricia; Remsburg, Kristy; Pulliam, Timothy; Rodgers, Mary; Whetstine, Jack; Corbett, James; Shields, James; Rich, Thomas; Holonich, Joseph; Schaeffer, James; Evans, Michele; Rheaume, Cynthia; Boger, Bruce; Grobe, Jack; Givvines, Mary; Uhle, Jennifer; Valentin, Andrea; Dorman, Dan; Matthews, David; Akstulewicz, Frank; Madden, Patrick; Correa, Yessie; Baker, Pamela; Manning, Louis; Coleman, Judy; Travick, Vanette; Holt, BJ; Choe, Jeannie; Hays, Myra; Munroe, Stacey; Holahan, Gary; Dean, Bill; Kardaras, Tom; Ordaz, Vonna; Ferrell, Kimberly; McKelvin, Sheila; Mike, Linda; Hart, Ken; Laufer, Richard; Bavol, Rochelle; Shea, Pamela; Bates, Andrew; Wright, Darlene; Lewis, Antoinette; Raphael, Mary Jean; Muessle, Mary; Andersen, James; Wagner, Katie; Flanagan, Michelle; Marshall, Jane; Haney, Catherine; Kinneman, John; Kokajko, Lawrence; Doolittle, Elizabeth; Ford, William; Smith, James; Smith, Shawn; White, Bernard; Bailey, Marissa; Davis, Jack; Mohseni, Aby; Tschiltz, Michael; Weaver, Doug; Eitreim, Anthony; Hiltz, Thomas; Smith, Brian; Habighorst, Peter; Johnson, Robert; Campbell, Larry; Silva, Patricia; Rivera-Lugo, Richard; Larche, Linda; Walker, Tracy; Smith, Sharon; Trent, Glenn; Wert, Leonard; Howell, Art; Casto, Chuck; Ash, Darren; Schaeffer, James
Subject: Additoinal Information Multiple FOIA Requests

Subject: Multiple FOIA Requests

On March 28 I asked you to give me until the end of the week to develop some additional guidance and, hopefully, some automated tools to aid in how we handle the multiple FOIA requests we are receiving. Since that time, we have received even more FOIA requests. I have met with OIS staff to discuss guidance and possible solutions. OIS staff continues to meet with many of you who are involved in processing these requests to support your efforts. Here is where we are today:

We have received duplicate or very similar requests and we're confident that we will receive more requests for identical, similar or additional information. The OIS FOIA staff is aware of this situation and has not been tasking the agency when the requests are duplicates. They are sending these requests to the appropriate offices "for your information" so that you are aware of them, but the OIS FOIA staff will answer them from the information you provide on the earlier request(s) of that nature.

To assist with FOIA requests that require e-mail collection, OIS will provide technical support to search for e-mail messages based on specific criteria. This includes searching e-mail boxes, copying the messages into one e-mail folder and consolidating the entire e-mail folder into one document using Adobe that can be forwarded to the NRC Copy Center for printing. If you need assistance with e-mail search, please send an e-mail request to ICOD Support@nrc.gov. *(NOTE: This mailbox will be available beginning on Tuesday, April 5th, 2011).*

As always, the Customer Support Center can assist you with general e-mail support (e.g. creating folders, search, etc.), please contact the Customer Support Center, 301-415-1234, Option 2.

We have encountered difficulty printing attachments to e-mails. We are testing that and will provide the group with an update next week on our test results for printing the embedded file attachments using a third-party utility. Meanwhile, for those of you who have decided to print your own e-mails, the instructions for converting an individual e-mail message to a new PDF, and the instructions for converting an e-mail folder to a new PDF are attached.

Additionally, based on input from the Office FOIA Coordinators, OIS is currently reviewing additional technical solutions related to automating large FOIA requests. We will provide periodic updates regarding the status of these efforts.

The Office of Administration, Division of Administrative Services, Publications Branch, Reproduction Section, is able to assist you with printing some of the large volumes of e-mails. A request may be submitted on NRC Form 20. To facilitate this, provide the files to them on PDF format on a CD, DVD, or a NRC encrypted thumb drive. The Reproduction Section can accept job requests via the reproduction.resource@nrc.gov e-mail box. For rush requests, please call ahead to (301) 415-2070.

It is understood that those of you whose resources have been strained by responding to the events in Japan are also dealing with the surge in FOIA requests about these evets. I realize that the normal response times required by the FOIA will not be met because of these exigent circumstances. I will discuss with the Deputy Executive Director for Corporate Management about the service level metrics and how we can adjust them to accommodate this unusually large number of requests. We will update you on the metric discussion in the near future.

There has been some misunderstanding about the meaning of an expedited FOIA request. An expedited request means that the request goes to the front of the already existing FOIA queue. The intent is to give this request priority for processing more quickly than would otherwise occur if it were placed at the end of the first-in, first-out queue. It does not mean that we must divert critical resources from other mission related work. However, I ask that you continue to work on these FOIA requests as your current resources allow. These requests cannot simply be set aside indefinitely without progress in addressing the request(s). The expectation is that progress will be made on these on a weekly, if not daily basis. Additionally, the OIS FOIA staff is thoroughly analyzing each request for expedited processing or fee waiver and applying the legal criteria. Expedited processing and fee waivers will only be granted when the criteria are met, and I am sure there will continue to be requests that meet these criteria. The OIS FOIA staff will tell you if a request has been granted expedited processing or a fee waiver, or whether a fee estimate is necessary.

Thomas Boyce
Deputy Chief Information Officer
Director, Office of Information Services
Nuclear Regulatory Commission
301-415-8700

Huffert, Anthony

From: Hinds, Lynda J [HindsLJ@state.gov] on behalf of Tokyo Staff Assistant [AEX02TX@state.gov]
Sent: Saturday, April 16, 2011 7:15 PM
To: (b)(6) damian.peko@nuclear.energy.gov; Dorman, Dan; Daniel.Blumenthal@nnsa.doe.gov; (b)(6) Debevec, Jacob; Duncan, Aleshia D; Fiser, Erich; (b)(6) Gepford, Heather; (b)(6) Halladay, Timothy; Harrell, Benjamin L; Hinds, Lynda J; HOO Hoc; Huffert, Anthony; (b)(6) Jay Frogness (b)(6) Jensen, Justina; jhughart@ofda.gov; Monninger, John; (b)(6) (b)(6) (b)(6) Johnstone, Gregg M; (b)(6) joseph.hughart@foh.hhs.gov; (b)(6) (b)(6) Foggie, Kirk; latrice (b)(6) (b)(6) Lewis, Brian M; LIA01 Hoc; LIA02 Hoc; Long, Kristopher; Mears, Jeremy M; (b)(6) Morales, Russell A; (b)(6) NITOPS@nnsa.doe.gov, (b)(6) PMT12; (b)(6) (b)(6) (b)(6) Devercelly, Richard; (b)(6) (b)(6) Robinson, Alex; Stowe, (b)(6) Uchida, (b)(6) Vietas, Jay; Cook, William; Wong, Christopher
Subject: FW: URGENT:no remaining water in the waste processing facility （資料送付）
Attachments: 110415モニタリングのプレス英文.pdf, 010025075204-1-9052-20110416135941-00001.pdf, No95_info1500_April15_extract(set).docx; No96_info0800_April16_extract(set).docx; No96E_Conditions.pdf

Lynda Hinds
Staff Assistant
(03) 3224- 5370

From: PROTOCOLOFFICE-EM [mailto:protocoloffice-em@mofa.go.jp]
Sent: Saturday, April 16, 2011 6:49 PM
To: PROTOCOLOFFICE-EM
Subject: URGENT:no remaining water in the waste processing facility （資料送付）

—Urgent—
Official Notice
(16th April 2011)

To All Missions (Embassies, Consular posts and International Organizations in Japan)

BBS\122

The Ministry of Foreign Affairs has the honour to send the attached data sheets provided by the Ministries concerned on the status of the FUKUSHIMA NPP for the perusal of Missions.

List of attachments

1. **Levels of radioactive contaminants in foods (data reported on 15nd April 2011) (Ministry of Health, Labour and Welfare)**
2. Sum up of radionuclide test results (up-to-date Report as of 20:30, 15 April 2011)
3. **The instruction associated with food by Director-General of the Nuclear Emergency Response Headquarters (as of 14 April 2011)**
4. **Press Release "Evaluation of Environment Radiation Monitoring Results" Original released at 16:45 April 15, 2011**
5. **Seismic Damage Information (the 95th Release) (as of 15:00 April 15th, 2011)**
6. **Seismic Damage Information (the 96th Release) (As of 08:00 April 16th, 2011)**
7. **Conditions of Fukushima Dai-ichi Nuclear Power Station Unit 1-6 (As of 7:00 April 16th, 2011)**

(END)

Press Release
(This is provisional translation. Please refer to the official version in Japanese)

Evaluation of Environment Radiation Monitoring Results

Original released at 16:45 April 15, 2011
Nuclear Safety Commission

Nuclear Safety Commission (NSC) evaluates the Environmental Monitoring Results (※), 20km or more far from Fukushima Dai-ichi Nuclear Power Plant (NPP), published by Ministry of Education, Culture, Sports, Science and Technology (MEXT). The evaluation results based on the information published between at 10:00 on April 14, 2011 and at 10:00 on April 15 are described as below:

※ *refer to http://www.mext.go.jp/english/radioactivity_level/detail/1303962.htm*

1. Ambient radiation dose around Fukushima Dai-ichi NPP

- Observation of ambient radiation dose rate at 20km or more far from Fukushima dai-ichi NPP found a relatively higher dose rate locally at several measuring points. It however does not reach the level that affects people's health.
- A part of area where the integrated dose was high value, and annual cumulative dose after the onset of the accident would potentially reach 20 mSv was set to be "Deliberate Evacuation Area".

We need to further watch a variation of dose rate carefully, considering other factors such as weather and wind direction.

2. Dust sampling in the air around Fukushima Dai-ichi NPP

- With regard to the measuring result of the dust sample collected at 20 km or more far from Fukushima dai-ichi NPP on April 12 and 13, the maximum I-131 radioactivity was 1.38Bq/m^3 (1.38×10^{-6}Bq/cm^3); maximum Cs-137 radioactivity was 1.53Bq/m^3 (1.53×10^{-6}Bq/cm^3).
- For both I-131 and Cs-137, the values are lower than the concentration limit (Note1).

We need to further watch a variation of dust sampling data carefully, considering other factors such as weather and wind direction.

3. Airborne monitoring

- We obtained measuring result from the airborne monitoring.

4. Environmental sample around Fukushima Dai-ichi NPP

- Monitoring results was obtained on the land water (pond or rain), soil, fallout and sea water. Weed and land water showed relatively higher values; we further need continued measurement on the drinking water (tap water) and foods.

- According to the result collected on April 13, the maximum radioactive concentration of I-131 and Cs-137 in the seawater was as follows: on the surface layer, 64.1Bq/L (6.41×10^{-2}Bq/cm^3) for I-131 and 54.3Bq/L (5.43×10^{-2}Bq/cm^3) for Cs-137, and in the low layer (depth: 23 to 162m), not detected for both I-131 and Cs-137. The maximum radioactive concentration in the dust above the sea was 12.3Bq/m^3 (1.23×10^{-5}Bq/cm^3) for I-131 and 11.4Bq/m^3 (1.14×10^{-5}Bq/cm^3) for Cs-137.

- It is considered that the concentration of radioactive materials emitted into the seawater will be diluted since it is diffused along with the tidal current before actually ingested by marine life such as fish and seaweed.

- For the sea products, be aware of the information announced by the Ministry of Health, Labor and Welfare (MHLW) regarding relevant intervention.

We also need to continue environmental monitoring, in view of various elements such as change of weather.

5. Environmental radioactivity level survey by prefecture

1) Ambient radiation dose rate

Some prefectures showed a higher value compared with the average values obtained before the accident, however, it does not affect people's health.

2) Drinking water (tap water)

- Be aware of the information related announced by the MHLW regarding relevant intervention.

- In the prefectures of Miyagi, Fukushima, Tochigi and others, readings of drinking water (tap water) monitoring were 2.9Bq/kg for radioactive iodine and 0.41Bq/kg for radioactive cesium at maximum as far as the data on radioactivity level in drinking water by prefecture published by MEXT was evaluated. Both were lower than the indices to limit ingestion of food and drink (Note2).

We consider that further monitoring is needed on a continuous basis.

(Note)

(Note 1) Limits of the radioactivity in the air outside the peripheral monitoring area boundary as specified by the law are 5×10^{-6}Bq/cm^3 for I-131 and 3×10^{-5}Bq/cm^3 for Cs-137.

(Note 2) Indices to limit ingestion of drinking water shown on "Regulatory Guide of Emergency Preparedness for Nuclear Facilities" are 300Bq/kg for I-131 and 200Bq/kg for Cs-137.

Levels of radioactive contaminants in foods (data reported on 15 April 2011)

Note: This data sheet compiles individual test results shown in corresponding press release written in Japanese, available at

http://www.mhlw.go.jp/stf/houdou/bukyoku/iyaku.html

	Press release date	Food origin		Sampling date	Food tested	Level of radioactive contaminants in food (expressed as radionuclide levels (Bq/kg)).		
		Prefecture	Area			Iodine-131	Cesium-134	Cesium-137
1	15-Apr-11	Kanagawa	Ebina-shi	14-Apr-11	raw milk	ND	ND	
2	15-Apr-11	Kanagawa	Ninomiya-machi	14-Apr-11	shiitake	ND	ND	
3	15-Apr-11	Chiba	Choshi fishery harbor	14-Apr-11	sardine	ND	8	
4	15-Apr-11	Chiba	Choshi fishery harbor	13-Apr-11	squid	ND	ND	
5	15-Apr-11	Chiba	Katsuura tobu fishery harbor	13-Apr-11	bonito	ND	ND	
6	15-Apr-11	Hyogo	Minamawaji-shi	14-Apr-11	lettuce	ND	ND	ND
7	15-Apr-11	Chiba	Asahi-shi	14-Apr-11	garland chrysanthemum	120	47	
8	15-Apr-11	Chiba	Asahi-shi	14-Apr-11	garland chrysanthemum	39	14	
9	15-Apr-11	Chiba	Asahi-shi	14-Apr-11	parsley	88	65	
10	15-Apr-11	Chiba	Asahi-shi	14-Apr-11	parsley	340	89	
11	15-Apr-11	Chiba	Asahi-shi	14-Apr-11	celery	ND	ND	
12	15-Apr-11	Chiba	Asahi-shi	14-Apr-11	celery	ND	ND	
13	15-Apr-11	Chiba	Asahi-shi	14-Apr-11	sanchu asian lettuce	160	36	
14	15-Apr-11	Chiba	Asahi-shi	14-Apr-11	sanchu asian lettuce	56	26	
15	15-Apr-11	Chiba	Asahi-shi	14-Apr-11	qing-geng-cai	ND	ND	
16	15-Apr-11	Chiba	Asahi-shi	14-Apr-11	qing-geng-cai	ND	ND	
17	15-Apr-11	Chiba	Katori-shi	14-Apr-11	spinach	40	17	
18	15-Apr-11	Chiba	Katori-shi	14-Apr-11	spinach	37	ND	
19	15-Apr-11	Chiba	Tako-machi	14-Apr-11	spinach	260	15	
20	15-Apr-11	Chiba	Tako-machi	14-Apr-11	spinach	290	27	
21	15-Apr-11	Niigata	Not known	14-Apr-11	cucumber	ND	ND	
22	15-Apr-11	Niigata	Not known	14-Apr-11	tona	ND	ND	
23	15-Apr-11	Niigata	Not known	14-Apr-11	komatsuna	ND	ND	
24	15-Apr-11	Niigata	Not known	14-Apr-11	komatsuna	ND	ND	
25	15-Apr-11	Niigata	Not known	14-Apr-11	spinach	ND	ND	
26	15-Apr-11	Gunma	Not known	14-Apr-11	spinach	64	87	
27	15-Apr-11	Gunma	Not known	14-Apr-11	qing-geng-cai	ND	5	

News Release

Extract

April 16, 2011
Nuclear and Industrial Safety Agency

Seismic Damage Information (the 96th Release)
(As of 08:00 April 16th, 2011)

Nuclear and Industrial Safety Agency (NISA) confirmed the current situation of Onagawa NPS, Tohoku Electric Power Co. Inc.; Fukushima Dai-ichi and Fukushima Dai-ni NPSs, Tokyo Electric Power Co. Inc. (TEPCO); Tokai Dai-ni NPS, Japan Atomic Power Co. Inc. as follows:

Major updates are as follows.

1. Nuclear Power Stations (NPSs)

- Fukushima Dai-ichi NPS

· Fresh water spray of around 140t for Unit 4 using Concrete Pump Truck (50t/h) was started (From 14:30 till 18:29 April 15th)

· 3 sandbags filled with Zeolite were placed between the Inlet Screen Pump Room of Unit 3 and the Inlet Screen Pump Room of Unit 4. (From 14:30 till 15:45 April 15th)

· Temporary boards to stop water (4 steel plates out of 7) were installed on the ocean-side of the Inlet Bar Screen of Unit 2. (From 9:00 till 14:15 April 15th)

· The test implementation of spraying antiscattering agent to prevent the spread of radioactive materials on the ground surface was carried out in the area of about 1,900 m² on the mountain-side of the Common Pool. (From 11:30 till 13:00 April 15th)

· Removal of rubble (Amount equivalent to a container) using remote-control heavy machineries was carried out. (From 09:00 till 15:45 April 15th)

· As a countermeasure for tsunami, the distribution boards, etc. for the pumps injecting water to the reactors of Units 1 to 3 were transferred to a hill. (From 10:19 till 17:00 April 15)

News Release

Extract

経済産業省

April 15, 2011
Nuclear and Industrial Safety Agency

Seismic Damage Information (the 95th Release)
(As of 15:00 April 15th, 2011)

Nuclear and Industrial Safety Agency (NISA) confirmed the current situation of Onagawa NPS, Tohoku Electric Power Co. Inc.; Fukushima Dai-ichi and Fukushima Dai-ni NPSs, Tokyo Electric Power Co. Inc. (TEPCO); Tokai Dai-ni NPS, Japan Atomic Power Co. Inc. as follows:

Major updates are as follows.

1. Nuclear Power Stations (NPSs)

- Fukushima Dai-ichi NPS
  - Fresh water spray over the Spent Fuel Pool of Unit 4 using Concrete Pump Truck (50t/h) was started. (14:08 April 15th).
  - The temperature of water in the Common Spent Fuel Pool was around 33℃ at 06:20 April 15th.
  - Videotaping using an unmanned helicopter was carried out in order to grasp the situations of reactor buildings for Units 1 to 4. (From 08:02 till 09:55 April 15th)

2. Actions taken by NISA

(April 15th)

NISA strictly alerted TEPCO and directed it orally to prepare the measures for preventing the recurrence regarding the delay in the notification of the dismissal of Nuclear Emergency Preparedness Manager, accompanied with the personnel changes dated on 1 April, in accordance with Article 9, paragraph 5 of the Act on Special Measures Concerning Nuclear Emergency Preparedness.

For more information: NISA English Home Page http://www.nisa.meti.go.jp/english/index.html

緊急時における食品の放射能測定マニュアル

平成１４年３月

厚生労働省医薬局食品保健部監視安全課

MANUAL OF RADIOACTIVITIY MEASUREMENT OF FOOD UNDER EMERGENCY SITUATIONS

MARCH 2002

INSPECTION AND SAFETY DIVISION
DEPARTMENT OF FOOOD SAFETY
PHARMACEUTICAL AND FOOD SAFETY BUREAU
MINISTRY OF HEALTH, LABOR AND WELFARE

the external exposure by rare gases.

The implementation of this protection measure with the stable iodine must be decided in combination with the other protection measures of sheltering, evacuation, etc., by taking into account the release condition of radioactive materials. As for the protection measures for nearby residents by the stable iodine, the instruction for administering the drug are shown in Table 4.2.

Table 4.2 Instructions for Protective administration of stable iodine

When the nuclear disaster countermeasure headquarters implement the administration of the stable iodine, it is required that side effects from wrong administration should be avoided; the stable iodine should be appropriately controlled; and nearby residents should certainly take the stable iodine as soon as possible. In practice, it is better to preventively administer the stable iodine to individual residents at a place where they evacuate rather than to distribute the drug to the home of nearly residents beforehand. (1) Object persons of taking stable iodine The object persons must be under 40 years of age except that the following persons must be excluded from the administration of the drug: ・ A person with a past history of iodine hypersensitivity ・ A person with a past history of contrast medium hypersensitivity ・ A person with a past history of hypocomplementemia or is under treatment of the disease ・ A person with a past history of Duhring dermatitis herpetiformis or under treatment of the disease These four items above must be described in a pamphlet or the like, in order to distribute the stable iodine to those who do not fall under these items. (2) Dosage The stable iodine must be administered to a person once. If the second administration of the drug must be considered, the evacuation of residents must be prioritized. (3) Dosage and administration The dosage and administration are listed below.

Object person	Iodine amount	Amount of potassium iodide
Newborn	12.5 mg	16.3 mg
Infant aged 1 month or older but under 3 years (Note 1)	25 mg	32.5 mg
Child aged 3 years or older but under 13 years (Note 2)	38 mg	60 mg
Persons aged 13 years or older but under 40 years (Note 3)	76 mg	100 mg

(Note 1)

When the stable iodine is given to a newborn or an infant aged 1 month or older but under 3 years, it is appropriate at present to give the drink prepared by dissolving the original drug of pharmaceutical potassium iodide (powder) in water (sterilized distilled water, purified water, or injectable water) and adding an appropriate amount of single syrup.

(Note 2)

When the stable iodine is given to a child aged 3 years or older but under 13 years, if the child is 3 years or older but under 7 years, it is appropriate at present to give the drink prepared by dissolving the original drug of pharmaceutical potassium iodide (powder) in water (sterilized distilled water, purified water, or injectable water), and adding an appropriate amount of single syrup. In the case the child is 7 years or older but under 13 years, it is appropriate to give a tablet of pharmaceutical potassium iodide (containing 38 mg of iodine and 50 mg of potassium iodide) to the child.

(Note 3)

When the stable iodine is given to a person of 13 years or older but under 40 years, it is appropriate to give two tablets (containing 76 mg of iodine and 100 mg of potassium iodide) to the person.

(Note 4)
As for the administration of pharmaceutical potassium iodide from the point of school ages, object persons of 7 years or older but under 13 years are generally primary school children, and object persons of 13 years or older are junior high school students or older. Therefore, it is practical to evenly give two tablets of pharmaceutical potassium iodide to children in the first to six grades of the primary school to promptly respond to emergency situations. Also, attention must be paid to the fact that some children cannot take tablets, even though they are seven years or older.
(Note 5)
It is not necessary to give the stable iodine to persons of 40 years or older because there is no increase in the probability of thyroid cancer, etc. from exposure to radioactive iodine.
(Note 6)
Pharmaceutical potassium iodine, sterilized distilled water, purified water, injectable water, single syrup, etc., must be always prepared against occurrence of nuclear disasters. They must appropriately be maintained and their expiration dates must be observed.

(3) Criteria of Restriction on Food and Drink Ingestion

As radioactive elements relating to restriction on food and drink ingestion, cesium is selected on the basis of lessons learnt through Chernobyl accident in ex-Soviet Union, in addition to iodine, uranium and plutonium originated from radioactive plume. For the purpose of exposure reduction for the nearby residents by these nuclides, Table 4.3 shows the criteria for restriction on food and drink ingestion, of which numbers indicate measured concentration of radioactive materials.
It should be noted that these criteria are indicative numbers on the basis of which the headquarter for disaster countermeasures starts to discuss the necessity of restriction on food and drink ingestion.

Table 4.3 Criteria of Restriction on Food and Drink Ingestion

Target Nuclide	Radioactive Iodine (representative nuclide of mixed nuclides : ^{131}I)
Drinking Water	above 3×10^2 Bq/kg
Milk, Dairy Products	
Vegetables (Other than Root Crops)	above 2×10^3 Bq/kg

Target Nuclide	Radioactive Cesium
Drinking Water	above 2×10^2 Bq/kg
Milk, Dairy Products	
Vegetables	above 5×10^2 Bq/kg
Crops	
Meat, Egg, Fish, others	

Target Nuclide	Uranium
Drinking Water	above 20 Bq/kg
Milk, Dairy Products	
Vegetables	above 1×10^2 Bq/kg
Crops	
Meat, Egg, Fish, others	

Target Nuclide	Plutonium and other nuclides of transuranic elements (total radioactive concentration of ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{241}Am, ^{242}Cm, ^{243}Cm, ^{244}Cm)
Drinking Water	above 1 Bq/kg
Milk, Dairy Products	
Vegetables	above 10 Bq/kg
Crops	
Meat, Egg, Fish, others	

Note : For the criteria of restriction on commercial foods for infants, 20 Bq/kg shall be applied to uranium, 1 Bq/kg to plutonium and nuclides of transuranic elements. Nevertheless, these criteria shall be applied to cooked meal ready to be served.

As for quantification of radioactive concentration in the above foods and drinks, the documents below shall be referred to.

- radioactive iodine — Vol. 15 of Radioactivity Measurement Methods Series by Science and Technology Agency "Radioactive Iodine Measurement Methods at Emergency"
- radioactive cesium — Vol. 7 "Gamma-Ray Spectrometry by Germanium Semi-Conductor Detector" and Vol. 24 "Sample Pretreatment for Gamma-Ray Spectrometry at Emergency" of the same series

· uranium	Vol. 14 "Uranium Analysis Methods" of the same series
· plutonium and nuclides of trans-uranic element	Vol. 12 "Plutonium Analysis Methods", Vol. 21 "Americium Analysis Methods", Vol. 22 "Plutonium and Americium Sequential Analysis Methods" of the same

It is necessary to rapidly obtain estimated dose to implement adequate protective measures at emergency.

The System for Prediction of Environmental Emergency Dose Information (SPEEDI) network system calculates migration and diffusion of radioactive bloom based on information of release source and meteorological data allowing for geology. It can also indicate dose incurred by external exposure to rare gas, thyroid dose by inhalation of iodine, etc. on the computer screen

When necessary data are inputted such as information on the site where emergency event occurred (released nuclides and released amount, etc.), meteorological observation information collected by continuous monitoring systems of local governments, data of AMeDAS (Automated Meteorological Data Acquisition System) operated by Japan Meteorological Agency, etc, SPEEDI can treat statistical predictions of wind velocity and direction up to 6 hours ahead and, base on these predictions, calculate evolution of radioactive bloom. At emergency, Ministry of Education, Culture, Sports, Science and Technology (MEXT) can instruct to indicate the calculation results on 2D images and the concerned entities at headquarters for nuclear disaster countermeasures can use these results.

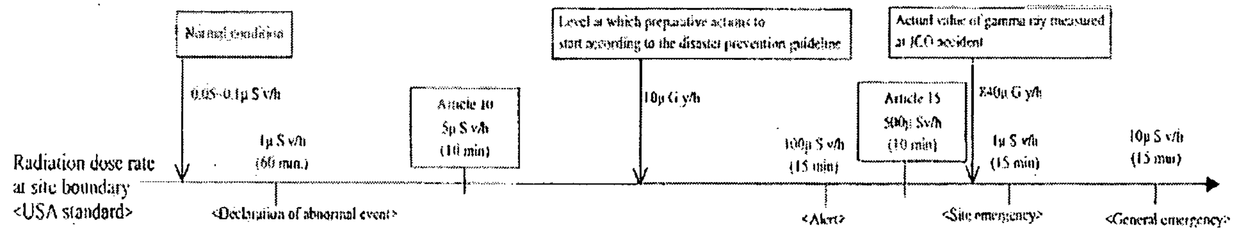
Below is the example of data indicated on a 2D image.

Dose Equivalent by External Exposure

Source : System for Predict of Environmental Emergency Dose Information Network System, SPEEDI (Ministry of Education Culture, Sports, Science and Tech.)

Fig. 4.1 Calculation of Estimated Dose using SPEEDI Network System

1 About Dose Rate Criteria



(Note)

Declaration of abnormal event :	minor event susceptible to develop more serious one if operators' mistake of equipment malfunctions, or event with signs of more serious situation by unidentified causes (when downward trend of plant safety level is suspected)
	Nuclear operator shall report to NRC, the state, etc.
Alert :	Minor event susceptible to develop more serious one if operators' mistake of equipment malfunctions, or event with signs of more serious situation by unidentified causes (when excessive downward trend of plant safety level is suspected)
	Operator deploys its countermeasure actions at the site and prepares site dose monitoring. NRC and the states are in emergency standby.
Site emergency :	Significant radioactive materials are being released or predicted
	Deployment of full emergency actions and setout of off-site dose monitoring and consultation of countermeasures by NRC and the states.
General emergency :	When core damage or fusion is in progress or imminent.
	Evacuation and other actions are deployed.

2. Evolution of radiation dose at site boundary

(1) with rainfall : up to 0.2 μ Gy/h

(2) with lightning : 100μ G/h (instantaneous value)

(3) passage of transport vessel : up to 20μ Gy/h (for a few minutes)

(4) others (passage of RI administrator (radiography vehicle), on-site RT inspection, etc.) : up to 100μ Gh/h (instantaneous value)

Fig. 4.2 Dose Rate Criteria (comparison with the U.S.A.)

5. Emergency Environmental Radiation Monitoring

5.1 Objectives

"Emergency Monitoring" is specially planned environment monitoring to obtain information about radioactive materials or radiation in the nearby environment, when abnormal release of radioactive materials or radiation is in progress or probable at NPP. It consists of two phases: the first stage monitoring is promptly conducted when nuclear emergency occurs: the second stage monitoring evaluates general effects to the nearby environment. The specific objectives are as follows.

The below A to C correspond to the first stage monitoring, and D to F to the second stage monitoring.

A. Estimation of air dose rate and concentration of radioactive material (iodine, uranium or plutonium) in the atmosphere in the vicinity of NPP
B. Estimation of concentration of radioactive materials (iodine, uranium or plutonium) in samples collected from the environment affected by radioactive material release.
C. Rapid evaluation of estimated dose in the nearby environment
D. Detailed estimation of concentration of radioactive materials in the atmosphere measured in the above A. by increasing measured nuclides, etc.
E. Detailed estimation of concentration of radioactive materials in samples collected from the environment measured in the above B. by increasing measured nuclides, etc.
F. Estimation of dose actually incurred by the nearby residents

Based on the Law on Special Measures for Nuclear Disaster, at the stage of reporting from nuclear operator, it is required to reinforce normal monitoring, to obtain information on the state inside the facilities from nuclear operator, and according to event evolution, to start preparation of emergency monitoring. When an event with signs of nuclear emergency arises, emergency monitoring must be started.

5.2 Stages

A. The First Stage Monitoring

The first stage monitoring must be promptly started immediately after nuclear emergency appears. The results of this monitoring are used, with meteorological information and data collected by SPEEDI network system, to evaluate estimated dose. Based on these data, decision is taken on protective measures. Therefore, rapidness is

most needed at this stage and the accuracy required is less than that required for the second stage.

The radioactive materials and radiation mainly targeted at the first stage monitoring, are rare gas, iodine, uranium in state of aerosol, plutonium, neutron and gamma ray in the atmosphere, depending on nuclear facilities or accident types.

B. The Second Stage Monitoring

For the second stage monitoring, more accuracy and less rapidity are required than for the first stage monitoring. The second stage monitoring is implemented in more large area than for the first stage monitoring, to evaluate and confirm the general effects to the nearby environment by radioactive materials or radiation

In the second stage monitoring, the targeted radioactive materials are those required to estimate cumulative dose and exposure of human body.

The results of this monitoring are used to lift different protective measures and also contribute to prevent rumors.

5.3 Emergency Monitoring System

To implement emergency monitoring, a monitoring center and several monitoring teams are to be organized, under the local headquarters for disaster countermeasures, in the vicinity of NPP in accidental conditions. It is required to determine prior to any emergency the role of chief of the center and monitoring teams. The main functions that monitoring center and monitoring teams must possess are as follows.

(1) Monitoring Center

A. It has a chief who is responsible for planning of emergency monitoring, commands and supervises emergency monitoring activities.

B. It organizes emergency monitoring team and distributes materials, etc.

C. It collects information, predicts and estimates radiation in the environment and radiation exposure of the nearby residents and reports rapidly the accurate results to the local headquarters for emergency countermeasures.

(2) Monitoring Team

A. It conducts emergency monitoring activities, such as air dose rate measurement, concentration measurement of radioactive materials in the atmosphere, collection and measurement of environmental samples.

B. It rapidly reports accurate data obtained by emergency monitoring to monitoring center.

6. Emergency Medical Treatment for Exposure Injuries

6.1 Basic Approach to Emergency Medical Treatment for Exposure Injuries

The philosophy of emergency medical treatment for exposure injuries is to stand on the principle of first-aid and disaster medical treatment giving the first priority to human lives, which can be summarized as "the best treatment for anybody at any time anywhere".

Specifically, starting form the common understanding that any patients must be equally treated without any distinction between NPP workers and vicinity residents, it is required to prepare a system by which exposed patients can be smoothly and promptly examined and treated by dispensing adequate education and training for personnel engaged in emergency medical treatment for exposure injuries. From medical viewpoint, responding system must be built not only for nuclear emergency situation at NPP, but also for near nuclear emergency situation as personnel might need medical treatment for exposure injuries. Therefore, this system shall seek to get alignment with general first-aid and emergency medical treatment systems in operation in normal time and under unusual situations including nuclear emergency, it shall be integrated into not only disaster medical treatment system but also wide-area emergency medical treatment system, when necessary, to get further effectiveness.

The basic approach is described in the following sections.

6.2 Characteristics of Medical Treatment for Exposure Injuries

Characteristics of medical treatment for exposure injuries are as follows.

(1) Medical Treatment for Events with Low Frequency

Though contamination by radioactive materials with exposure and exposure to radioactive materials or radiation are events with low frequency, medical treatment can be effective when adequate measures are routinely prepared in normal time.

(2) Anxiety about radioactive materials and radiation

Radioactive materials and radiation generally cause anxiety, as they cannot be detected by human senses. However, their effects to the human body can be easily quantified if compared with infections. Therefore, the medical staff can treat patients without any anxiety if they are sufficiently prepared, educated and trained.

(3) Exposure and Contamination by Radiation Easily Measured

Because degree of contamination and radiation dose can be measured physically, treatment program can be planned and implemented in cooperation with personnel capable to estimate radiation dose and to implement expansion prevention measures (hereinafter referred to as "radiation management staff"), personnel concerned with nuclear engineering, etc.

6.3 Emergency Medical Treatment System for Exposure Injuries

(1) Initial Medical Treatment System for Exposure Injuries

A. Initial Medical Treatment for Exposure Injuries at NPP

In addition to the emergency medical treatment of exposed patients, surveillance, screening and exposure dose measurement are implemented. Then, decontamination and contamination expansion preventing measures are performed and exposed patients are rapidly conveyed to emergency medical treatment institutions for exposure injuries according to degree of contamination and exposure of patients.

B. Initial Responding Actions Performed for the Public in Refuge

At public refuges, surveillance, screening and exposure dose measurements are performed for the vicinity public. At the same time, evacuation itinerary and passage times shall be investigated and these data are managed.

C. Initial Medical Treatment for Exposure Injuries at Medical Institutions

The initial medical institutions for exposure injuries in the vicinity of NPP treat, in principle, patients conveyed from public refuges and NPP.

The initial medical institutions for exposure injuries are those which routinely implement emergency medical treatment in normal time. Patients can receive initial decontamination such as wiping off and first-aid treatment.

At emergency, consideration should be given to the fact that many vicinity residents, etc., driving by psychological anxiety, visit different medical institutions and public refuges, etc to seek examinations, though they have no need for specific medical treatments.

(2) Secondary Medical Treatment System for Exposure Injuries

After the initial medical treatment for exposure injuries, patients with residual contamination and those who are supposed to be significantly exposed, are transferred and hospitalized to secondary medical institution. At secondary medical institution for exposure injuries, in addition to whole body decontamination by shower, treatment of contaminated wounds, etc. degree of contamination and exposure dose measurements are performed by measurement using whole body counter and analyses of blood and urine. Secondary medical institutions also start medical treatments for patients with localized exposure and high dose exposure.

(3) Tertiary Medical Treatment System for Exposure Injuries

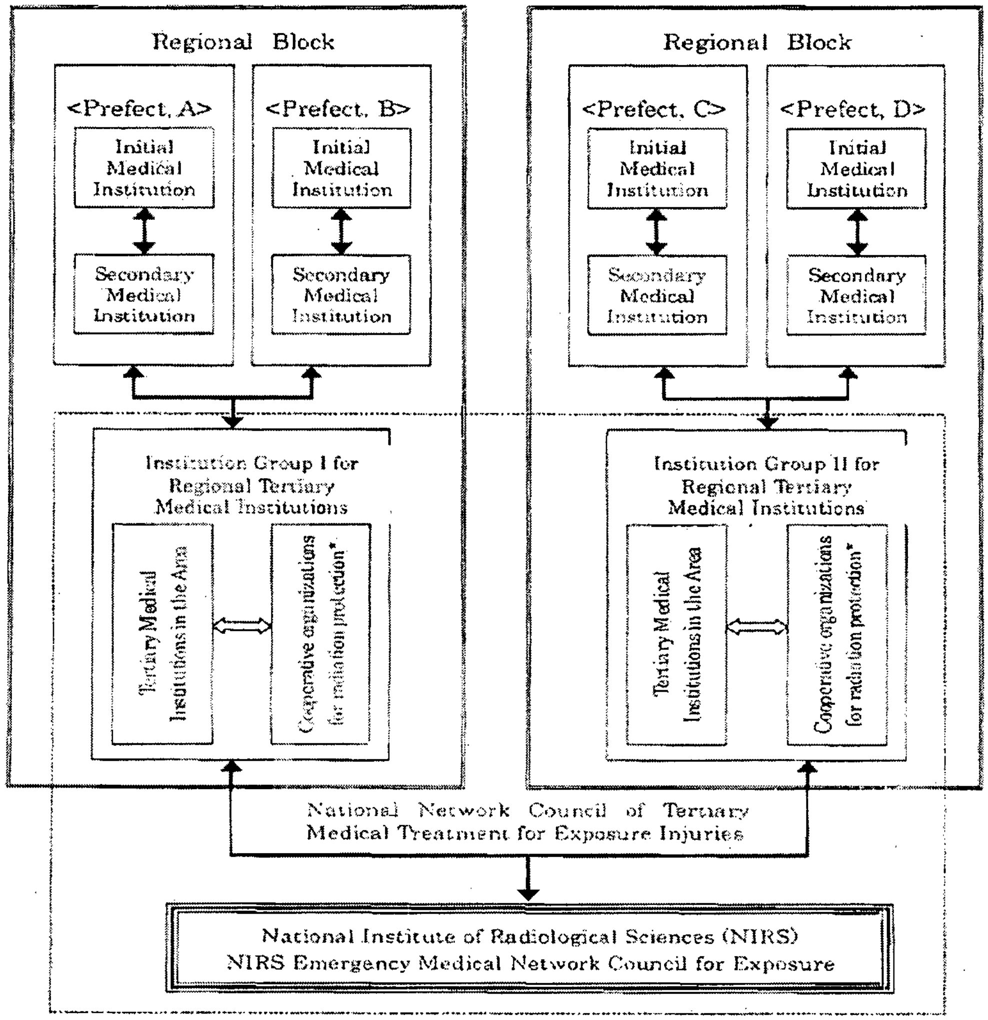
As the results of the secondary medical treatments, those who need more specialized diagnosis of injuries for radiation exposure and those who have serious internal exposure, are transferred to tertiary medical institutions in the area (these institutions are preferably hospitals attached to national or public universities capable to implement multi-disciplinary and high-level specialized treatments).

Tertiary medical institutions in the area form, with cooperative organizations for radiation protection (organizations which cooperate with emergency medical institutions for exposure injuries in the fields of dose estimation and radiation protection, etc.) institution group for regional tertiary medical treatment for exposure injuries, which assures tertiary medical treatment for exposure injuries
This institution group of tertiary medical institutions cooperates mutually with National Institute of Radiological Sciences (NIRS) in treatment of exposed patients and long-term medical investigations. The institution group also forms regional block in cooperation with secondary medical institutions for exposure injuries to build more effective medical treatment system for exposure injuries. Tertiary medical institution in the area coordinates convey of patients and technical cooperation among medical institutions in its regional block.

NIRS is placed as the key institution of tertiary medical institutions. NIRS (including NIRS Emergency Medical Network Council for Exposure Injuries) implements high-level specialized decontamination and medical treatments, in the mutual cooperation with medical institutions dispensing high-level integrated medical treatment, and gives necessary assistance and advise to groups of tertiary medical institutions for exposure injuries in the nation. NIRS also acts as tertiary medical institution for exposure injuries in the region.

For those who show clear signs of significant exposure judging by their exposure dose, degree of contamination and general health conditions, etc., it is more practical to directly take the actions of the secondary or tertiary medical treatment, omitting the initial medical treatment. In this case, the doctors engaged in the actual treatments must decide adequate institution to which patient will be conveyed or transferred, considering mutual cooperation among secondary or tertiary medical institutions to get better equilibrium among medical institutions in medical treatment capability and resources.

Figure 1 shows concept of emergency medical treatment system for exposure injuries of initial, secondary and tertiary medical institutions. Table 1 summarizes outline of emergency medical treatment system for exposure injuries.



* Organizations which cooperate with medical institutions in exposure dose estimation, radiation protection, etc.

Flow of patients, cooperation in medical treatment, advise of experts, dispatch, instructions

Role sharing

Fig. 6.1 Concept of Emergency Medical Treatment System for Exposure Injuries of Initial, Secondary and Tertiary Medical Institutions

Table 6.1 Outline of Emergency Medical Treatment System for Exposure Injuries

Classification	Initial Medical Treatment	Secondary Medical Treatment	Tertiary Medical Treatment
Treatment Form	Home-care treatment	Hospitalization	Hospitalization with specialized treatment
Medical Institutions, etc.	1. Public refuges (first-aid station) 2. Public health center 3. Medical facilities at NPP (on-site first-aid station) 4. Vehicle, ship, air plane 5. Medical institutions designated by regional disaster prevention planning *1,2	Medical institutions designated by regional disaster prevention planning, etc.	1. National Institute of Radiological Sciences (NIRS) (including NIRS Emergency Medical Network Council for Exposure) 2. Tertiary medical institutions in the area
Surveillance, Screening and Dose Estimation	1. Surveillance of contaminated part 2. Screening 3. Individual dose estimation by handy radiation measurement	1. Surveillance of contaminated part 2. Screening 3. Specialized individual dose estimation (Technical assistance from tertiary medical institutions)	1. Surveillance of contaminated part 2. Highly specialized individual dose estimation
Decontamination	Easy decontamination such as wiping off	Decontamination using shower facilities, etc.	In addition to decontamination performed by initial and secondary medical institutions, highly specialized decontamination such as lung purification
Medical Treatment	1. Preventing measures against radiation injuries by administration of potassium iodide, etc. 2. Advanced Cardiac Life Support (ACLS) *3, etc. 3. First-aid treatment for complicated injuries (wound, burn, etc.) 4. First-aid treatment for internally exposed patients	1. Start of examination and treatment for patients with localized exposure 2. Start of examination and treatment for patient with high dose exposure 3. Treatment of complicated injuries 4. Start of examination and treatment for internal exposure, etc.	1. Examination and treatment for patients with localized exposure in serious conditions 2. Examination and treatment for patients with high dose exposure 3. Treatment of serious complicated injuries 4. Examination and treatment for internally exposed patients in serious conditions, etc.
Materials, etc.	Materials needed by medical staff who treat emergency outpatients with exposure injuries	Shower facilities for decontamination, materials of information system for wide-area disaster medical treatment, others	Materials for specialized dose estimation, materials of information system for wide-area disaster medical treatment, others
Cooperation for patient treatment	1. Completion of treatment without hospitalization 2. Examination and treatment → transfer	1. Inpatient care 2. Start of examination and treatment → transfer	Transfer among specialized medical institutions

Education & Training	1. Implementation of education & training 2. Preparation of emergency medical treatment manual for exposure injuries	1. Implementation of education & traning 2. Preparation of emergency medical treatment manual for exposure injuries	1. Implementation of education & training 2. Preparation of emergency medical treatment manual for exposure injuries 3. Education of key persons for medical treatment for exposure injuries
Assistant Function	1. Cooperation among medical institutions and nuclear utilities (different survey meter, dispatch of radiation management staff, etc.) 2. Cooperation and mutual support among nuclear utilities, etc.	1. Initial medical treatment for exposure injuries, mutual technical assistance for secondary medical institutions 2. Hiring of emergency medical equipment for nuclear emergency, etc.	1. Coordination within the regional block 2. Technical assistance to other emergency medical institutions for exposure injuries, dispatch of experts 3. Hiring of emergency medical equipment for nuclear emergency, etc.
Observation	1. Several medical institutions may share some treatment capabilities among existing refuges, public health center, emergency medical institutions, etc. 2. Preparation of initial first-aid treatment for contaminated patients	1. Existing medical institutions may mutually share some examination and treatment capabilities, such as radiation measurement, decontamination and emergency medical treatment. 2. At creation or move of emergency medical institution for exposure injuries, the materials and equipment needed for emergency medical treatment for exposure injuries are preferably installed in the same institution.	

*1. Facilities where contaminated patients can be treated are to be prepared (medical institutions in the vicinity of NPP)

*2. Including medical institutions contracted with nuclear utilities, capable to dispense emergency treatment

*3. Advanced Cardiac Life Support

6.4 Organization

At nuclear emergency, it is necessary to improve effectiveness of response by building organizations shown on Figure 6.1.

6.5 Role of Each Organization

A. Medical Team of Joint Council of Nuclear Disaster Countermeasures

Joint Council of Nuclear Disaster Countermeasures set up at Off-Site Center is composed by representatives of national and local governments, nuclear utilities, etc. The medical team integrated into Joint Council of Nuclear Disaster Countermeasures collects information on emergency medical treatment activities for exposure injuries and coordinates wide-area medical activities. It also keep in close contact with medical group at the Nuclear Disaster Countermeasures Headquarters of local government and medical institutions to give advise and instruction as necessary.

B. Medical Group at the Nuclear Disaster Countermeasures Headquarters of Local Government

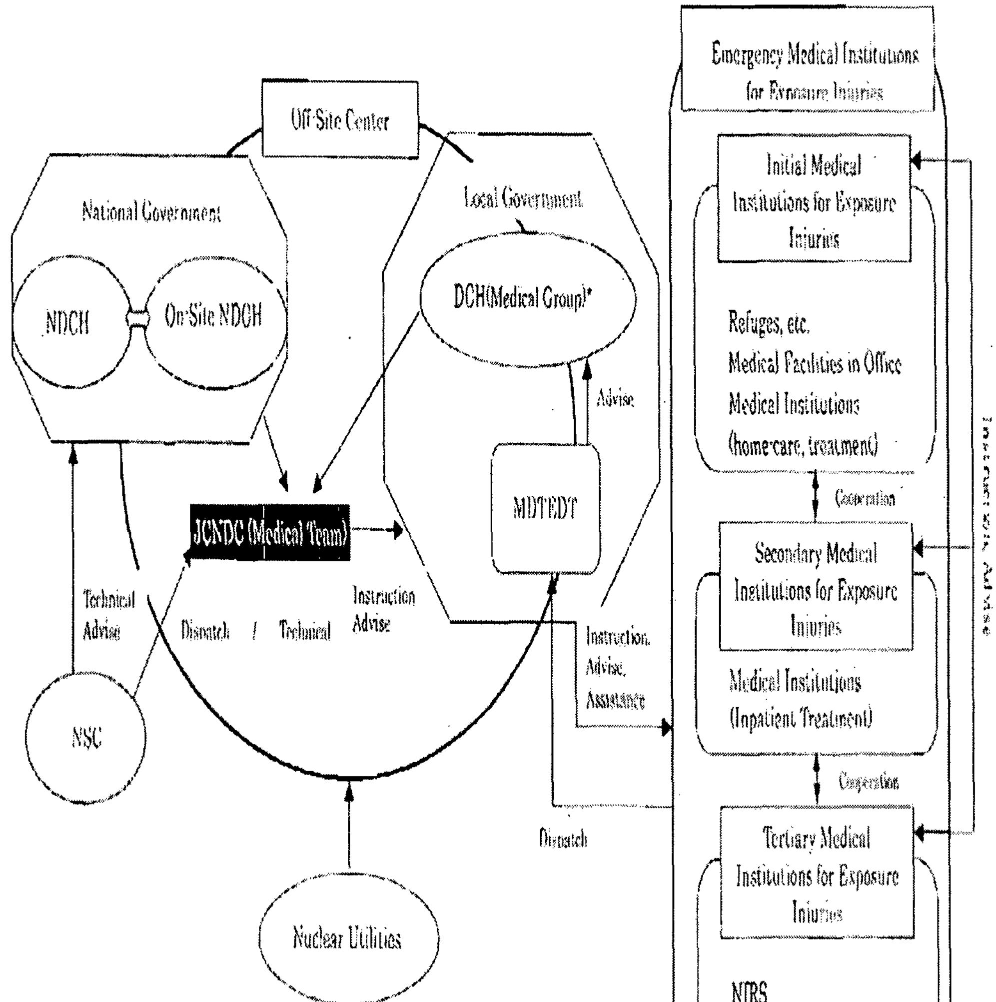
Medical group at the Nuclear Disaster Countermeasures Headquarters of local government is composed by concerned staff of local government, regional medical institutions, public health centers, etc. It collects information on medical activities on site and gives advice and instruction to initial and secondary medical institutions.

C. Medical Dispatch Team for Emergency Dose Treatment

Medical Dispatch Team for Emergency Dose Treatment is composed mainly by medical staff from tertiary medical institutions. Under the Nuclear Disaster Countermeasures Headquarters of local government, MDTEDT gives instructions to staff of initial and secondary medical institutions about examination and treatment of exposed patients, as well as implements medical treatment activities in cooperation with these institutions

D. Emergency Medical Treatment Institutions for Exposure Injuries, etc.

Emergency Medical Treatment Institutions for Exposure Injuries are composed by initial medical institutions treating outpatients, secondary medical institutions implementing inpatient medical treatment and tertiary medical institutions implementing specialized inpatient medical treatment. According to roles of each category of institutions, surveillance (identification of contamination by radioactive materials by handy measurement), screening, dose estimation, decontamination, examination and treatment. In addition to cooperation framework for initial, secondary and tertiary medical institutions, similar framework is also needed to get assistance from other medical institutions implementing high level medical treatment and Japan Red Cross hospitals.



Note:
NDCH: Nuclear Disaster Countermeasures Headquarters
NSC: Nuclear Safety Commission
DCH: Disaster Countermeasure Headquarters
MDTEDT: Medical Dispatch Team for Emergency Dose Treatment
JCNDC: Joint Council of Nuclear Disaster Countermeasures
NIRS: National Institute of Radiological Sciences
CORP: Cooperative Organizations for Radiation Protection

* Prefecture sets up the Site Emergency Center as necessary

APPENDIX

Laws and Guidelines related to Emergency Preparedness at Nuclear Power Stations

Annex Laws and Guidelines related to Emergency Preparedness at Nuclear Power Stations

I. Basic Law on Emergency Preparedness

(1) Basic Law on Emergency Preparedness (Excerpt)

(Law No. 223, November 15, 1961)
Latest Revision: Law No.99, May 31, 2000

(Objectives)
Article 1. This law is a provision for the establishment of necessary disaster countermeasures systems through the national government, local governments and other public agencies to protect the national land, and the lives, health, and assets of the citizens from disaster, and clarifies the parties responsible for the same. It also specifies the principles regarding preparation of disaster countermeasures plans, disaster prevention, disaster emergency countermeasures, financial measures for disaster recovery and disaster countermeasures, and fundamentals of other necessary disaster countermeasures, thereby contributing to the development and promotion of comprehensive and systematic disaster countermeasures administration to maintain social order and ensure public welfare.

(Definition)
Article 2. The terminology used in this law is defined in the following respectively.
(1). Disaster Disaster means damage due to wind storm, heavy rainfall, heavy snowfall, flood, high tide, earthquake, tsunami, volcanic eruption and other abnormal natural phenomena, or large fire and/or explosion, and other causes specified in government ordinances according to the disaster level.

(Responsibility of the National Government)
Article 3. The National Government shall be responsible for taking all possible steps with respect to disaster countermeasures by mobilizing all of its organizations and functions, in view of its mission to protect the national land, and lives, health, and assets of citizens from disaster.
2. In order to perform the responsibility referred to in the preceding paragraph, the National Government is to prepare a plan that should be the bases of disaster prevention, disaster emergency countermeasures, and disaster recovery, execute the said plan in accordance with the legislation, make promotion and overall coordination of the affairs or activities handled by the local governments, designated public agencies, and designated local public agencies etc., and rationalize the bearing of expenses in connection with disasters.
3. In performing the assigned duties, the designated administrative agencies and designated local administrative agencies have to cooperate each other to ensure the full performance of the responsibility of the National Government referred to in the Paragraph 1
4 The chiefs of the designated administrative agencies and designated local administrative agencies shall recommend, instruct, advise, and take other adequate measures for the relevant prefectures or municipalities with regard to their duties so that the preparation and execution of the local disaster countermeasures plans in accordance with the provisions of this Law should be performed smoothly by the relevant prefectures and municipalities.

(Responsibility of Prefectures)
Article 4. In order to protect the region of the prefectures, and the lives, health, and assets of the residents of the relevant prefectures from disaster, the prefectural governments shall have a responsibility, by the cooperation of the related agencies and other local governments, to prepare disaster countermeasures plans with regard to the regions of the relevant prefectures, execute the same in accordance with the regulations, assist the municipalities and designated local public agencies within the region in the performance of their duties and activities for disaster countermeasures, and make an overall coordination.
2. Prefectural agencies shall cooperate each other in the performance of their assigned duties so that the responsibility of the prefectural governments referred to in the preceding paragraph should be fully accomplished.

(Responsibility of Municipalities)
Article 5. Being bases of local governments, the municipal governments shall, prepare plans for disaster countermeasures in regard to the regions of the relevant municipalities with cooperation of the related agencies and other local governments, and shall execute the same in accordance with the legislation on their own responsibility, in order to protect the regions of the relevant municipalities, and the lives, health, and assets of the residents of the relevant municipalities from disaster
2. The mayors of municipalities shall make efforts to develop such organizations as fire fighting agencies and flood control squadrons, and enrich the organizations established in public organizations aiming for disaster countermeasures within the administrative territory of the relevant municipalities and voluntary organizations of residents for disaster countermeasures established by the spirit of neighbors cooperation (referred to as "voluntary disaster countermeasures organizations" in Article 8, Paragraph 2), and make full use of the functions of municipalities, in order to accomplish the responsibility referred to in the preceding paragraph.
3. In performing the assigned duties, municipal agencies such as fire fighting agencies and flood control squadrons shall cooperate each other so that the responsibility of municipalities provided for in the paragraph 1 should be fully accomplished.

(Responsibility of Designated Public Agencies and Designated Local Public Agencies)
Article 6. The designated public agencies and designated local public agencies shall prepare plans for disaster

countermeasures with regard to their respective duties, execute the same in accordance with the legislation, and shall be responsible for cooperating the relevant prefectures and municipalities in relation to their duties, so that the preparation and execution of disaster countermeasures plans in accordance with the provisions of this Law should be conducted smoothly by the National Government as well as prefectural and municipal governments.

2. In view of the public nature of their duties or the public interest, the designated public agencies and designated local public agencies have to contribute to disaster countermeasures through their respective duties.

(Establishment of Central Disaster Prevention Council and Assigned Duties)

Article 11. The Central Disaster Prevention Council shall be established in the Cabinet's Office.

2. The Central Disaster Council shall be responsible for the following items.

(i) To prepare the basic plan of disaster countermeasures and promote the execution of the same.

(ii) To prepare plans regarding emergency measures and promote the execution of the same on the occasion of emergency disasters.

(iii) To deliberate important issues regarding disaster countermeasures in response to an inquiry from the Prime Minister.

(vii) The affairs placed under its authority in accordance with the provisions of the legislation, aside from the above items.

4. The Prime Minister shall submit the following items to the Central Disaster Prevention Council for deliberation.

(i) Basic policies on disaster countermeasures

(ii) Important items regarding overall coordination of disaster countermeasures.

(iii) General principles on emergency measures needed temporarily on the occasion of emergency disasters.

(iv) Proclamation of emergency situation of disaster.

(v) Other important matters relating to disaster countermeasures to be deemed necessary by the Prime Minister.

(Organization of the Central Disaster Prevention Council)

Article 12. The Central Disaster Prevention Council shall consist of a chairman and council members.

2. The chairman shall be the Prime Minister.

(Disaster Countermeasure Headquarters)

Article 23. Prefectural governors or municipal mayors may establish a disaster countermeasure headquarters in accordance with the prefectural or municipal disaster countermeasures plans when the above is deemed necessary to enhance disaster countermeasures when a disaster has occurred or is likely to occur in the jurisdiction of the said prefectures or municipalities.

2. The head of the disaster countermeasures headquarters shall be the general manager of the disaster countermeasures headquarters, who shall be the prefectural governor or a municipal mayor.

(Establishment of Emergency Disaster Countermeasures Headquarters)

Article 24. When an emergency disaster occurs, in view of the scale and other circumstances whereof a special necessity is recognized in order to enhance disaster emergency countermeasures, the Prime Minister may establish the Emergency and Disaster Countermeasures Headquarters in the Prime Minister's Office on a temporary basis regardless of the provisions of National Government Organization Law, Article 40, Item 2.

(Organization of Emergency and Disaster Countermeasures Headquarters)

Article 25. The head of the Emergency and Disaster Countermeasures Headquarters shall be the General Manager of the Headquarters and shall be a state minister.

(Establishment of Urgency and Disaster Countermeasures Headquarter)

Article 28-2. When an extraordinary and intense emergency disaster occurs, and a special necessity is recognized in order to enhance temporary damage restoration measures, the Prime Minister may, subject to the approval of the Cabinet Council, establish the Urgency and Disaster Countermeasures Headquarters in the Prime Minister's Office on a temporary basis regardless of the provisions of National Government Organization Law, Article 8, Item 3.

(Organization of Urgency and Disaster Countermeasures Headquarters)

Article 28-3. The head of the Urgency and Disaster Countermeasures Headquarter shall be the General Manager of the Headquarters and shall be the Prime Minister. (or the state minister designated by it in advance in the case that there are unavoidable circumstances under which the Prime Minister can not assume the position.)

(Preparation and Official Announcement of the Basic Plan of Disaster Countermeasures)

Article 34. The Central Disaster Prevention Council shall prepare the Basic Plan of Disaster Countermeasures; examine the same, taking the result of scientific research on disaster and disaster prevention and the situations of previous disaster as well as the effect of the disaster emergency countermeasures applied thereto into consideration on an annual basis; and shall revise the same when it is deemed necessary to do so.

Article 35. The Basic Plan of Disaster Countermeasures shall cover the following:

(i) Comprehensive, long-term planning regarding disaster countermeasures.

(ii) Matters requiring stress in the plan of disaster countermeasures and the local disaster countermeasures plan.

(iii) Matters that shall be the standards for the preparation of the plan of disaster countermeasures and local disaster countermeasures and shall be recognized as necessary by the Central Disaster Prevention Council, aside from those referred to in the preceding items.

(Plan of Disaster Countermeasures of the Designated Administrative Agencies)

Article 36 The chiefs of the designated administrative agencies sholl prepare the plan of disaster countermeasures in conjunction with the assigned duties in accordance with the Basic Plan of Disaster Countermeasures, shall examine the same on an annual basis, and shall revise the same when it is deemed necessary to do so.

(Prefectural Local Disaster Countermeasures Plans)

Article 40. Prefectural disaster countermeasures councils shall prepare prefectural local disaster countermeasures plans in conjunction with the jurisdiction of the relevant prefectures in accordance with the Basic Plan of Disaster Countermeasures, shall examine the same on an annual basis, and shall revise the same when deemed necessary. In this instance, the relevant prefectural local disaster countermeasures plans shall not be contrary to the plan of disaster countermeasures.

(Municipal Local Disaster Countermeasures)

Article 42. Municipal disaster countermeasures councils (or municipal mayors of the relevant municipalities where a municipal disaster countermeasures council is not established; the same would apply hereunder in this article) shall prepare municipal local disaster countermeasures plans in conjunction with the jurisdiction of the said municipalities in accordance with the Basic Plan of Disaster Countermeasures, examine the same on an annual basis, and shall revise the same when deemed necessary. In this case, the relevant municipal local disaster countermeasures plans shall not be contrary to the plan of disaster countermeasures or prefectural local disaster countermeasures plans of the prefectures containing the relevant municipalities within their jurisdiction.

(2) Ordinance for the Enforcement of the Basic Law on Emergency Preparedness (Excerpt)
(Government Ordinance No. 288, July 9, 1962)
Latest Revision: Ordinance No 553, December 27, 2000

(Causes Specified by the Government Ordinance)

Article 1. The causes specified under Item 1, Article 2 of the Basic Law on Disaster Countermeasures (hereinafter referred to as "the Law") shall be those large-scale accidents involving the release of a large amount of radioactive materials, the sinking of a vessel resulting in heavy casualties, and the like.

(3) Basic Plan for Emergency Preparedness (Summary)

Volume 10. "Nuclear Emergency Response"
(Central Emergency Prevention Council May, 2000)

1. Preface
- Each body decides that countermeasures are taken so that it can respond to all the situations assumed, and establishes systems, which can cope with them even when an unexpected situation occurs.
- The emergency preparedness guideline " Emergency Preparedness of Nuclear Installations", defined by the Nuclear Safety Commission in special and technical items should be respected.

2 Emergency Prevention

(1) Collection of information・Establishment of communication systems
- The national government, local governments, nuclear operators, etc. collect information even in nights and holidays in order to expect perfectness in nuclear emergency prevention and establish communication systems.
- The national government and local governments establish and maintain a leased communication line network.

(2) Establishment of emergency response systems
- The national government (Cabinet Office) establishes and maintains the operation center equipped with required machinery and materials.
- Regulatory ministries and offices establish and maintain the operation center equipped with required machinery and materials such as an emergency speedi radioactivity influence prediction system (hereinafter referred to as "SPEEDI network system"), an emergency response support system (hereinafter referred to as "ERSS").
- The national government, local governments, nuclear operators, etc. establish emergency personnel gathering systems.
- The national government establishes the Nuclear Emergency Response Headquarter and the Local Nuclear Emergency Response Headquarter immediately after the declaration of a nuclear emergency situation. Moreover, the national government specifies a countermeasure facility beforehand where related staff of the national government, local governments, and nuclear operators, etc. meet, share information and carry out emergency situation countermeasures.
- The Nuclear Safety Commission establishes emergency gathering systems such as an emergency technical advice organization, etc.
- The national government, public institutions, nuclear operators, etc. establish an emergency monitoring system.
- The national government establishes a specialist dispatch system.
- The national government defines beforehand the transfer measures of necessary personnel to the Local Nuclear Emergency Response Headquarters, etc.
- The local governments make a plan concerning evacuation and guidance beforehand, and make known widely to residents in everyday life about evacuation places, the evacuation methods, etc.
- The national government and local governments establish the emergency medical dispatch system for emergency medical activities.

(3) Emergency preparedness drills, training and spread of knowledge of emergency preparedness
- The national government, local governments, nuclear operators, etc. carry out practical training.
- The national government, local governments and nuclear operators complete and reinforce trainings of emergency prevention personnel.
- The national government and local governments make efforts in the spread and education of knowledge of emergency

preparedness to residents.

(4) Promotion of the research about emergency prevention, etc.

- The national government makes efforts in promotion of the technology and research of nuclear emergency prevention.

3 Emergency Response

(1) Notifications of specific event occurrence information

- A nuclear operator notifies the Official Residence (Cabinet Office), the Ministry of Economy, Trade and Industry, the local government and the Senior Specialist for Nuclear Emergency etc. within 15 minutes after a specific event discovery or receipt of a report of discovery.
- A local government notifies the Senior Specialist for Nuclear Emergency, when the numerical detection value, which should be notified as a specific event occurrence, is discovered in a monitoring post. The Senior Specialist for Nuclear Emergency directs to check the situation of the installation to the nuclear operator and reports the result to the Ministry of Economy, Trade and Industry and the local government.

(2) Reports of the emergency operator activity information, damage information, etc. after a specific event occurrence

- A nuclear operator reports periodically situation of the installation, situation of emergency response activities of the nuclear operator and the situation of the Emergency Response Headquarters, situation of damage, etc. to the Official Residence (Cabinet Office), the Ministry of Economy, Trade and Industry, the local government, the Senior Specialist for Nuclear Emergency, etc.
- The national government holds related ministries and government offices emergency response connection meeting and a local emergency response connection meeting consisting of related bodies.
- The Ministry of Economy, Trade and Industry directs to the Senior Specialist for Nuclear Emergency to collect information at the spot and to perform connection, adjustment, etc. among the nuclear operator, the local government, the local emergency response connection meeting, etc.

(3) Connection of the emergency response activity information and emergency information after a declaration of nuclear emergency situation.

- Local Nuclear Emergency Response Headquarter, specific public institutions, local governments of the emergency response enforcement zone, specific district public institutions, the nuclear operator and other related organizations share continuously required information. Moreover, each organization performs adjustment required about the emergency response.

(4) Activity for the early grasp of radioactivity influence

- A local government strengthens monitoring at ordinary times, when a report of specific event occurrence is received from a nuclear operator.
- While the national government predicts the state of nuclear reactor installation etc. by ERSS, it carries out radioactivity influence prediction by SPEEDI network system, and connects information required for enforcement of emergency response to the local government, etc.

(5) Response after the declaration of nuclear emergency situation

- The Prime Minister establishes the Nuclear Emergency Response Headquarter, which makes himself the director general. (The deputy director-general is the Minister Specializing in Safety Regulation.)
- The Nuclear Emergency Response Headquarter Director establishes the Local Nuclear Emergency Response Headquarter.
- The Local Nuclear Emergency Response Headquarter succeeds quickly office works of the local emergency response connection meeting.
- The director of the Local Nuclear Emergency Response Headquarter is the vice minister of the ministries and government offices specializing in safety regulation.
- The Local Nuclear Emergency Response Headquarter organizes a Joint Council for Nuclear Emergency Response in local emergency response facility with the emergency response headquarters (or local response headquarter) of prefectures and municipal governments which have jurisdiction of enforcement zone of emergency response. The director of the Local Nuclear Emergency Response Headquarter, each emergency response headquarters of prefectures and municipal governments, specification public institutions and the nuclear operator, etc. constitute this Council.
- Roles and assignments of the Joint Council for Nuclear Emergency Response are discussed and fixed by related organizations beforehand. In the Joint Council for Nuclear Emergency Response, the work group of a small number of people is selected beforehand, which defines the response policies in the spot in an emergency.
- The Nuclear Safety Commission calls an emergency technical advice organization immediately, sends a member of the Nuclear Safety Commission and a member of the emergency response investigation committee specified beforehand to the spot when a report of specific event occurrence is received from ministries and government offices for safety regulation.
- The Nuclear Safety Commission performs technical advice about emergency response to the Nuclear Emergency Response Headquarter director.

(6) Emergency response activity

- The Self-Defense Forces dispatches a corps for emergency.
- The local governments carry out response activities of evacuation guidance of residents etc., shipment regulation of contaminated food, ingestion restriction of food and drink, stable iodine-tablet recipe directions, etc. if needed.
- The local governments, the Self-Defense Forces, etc. carry out rescue and first aid activities. The National Police Agency and the Fire Protection Agency carry out measures for wide area aids, such as sending of a wide area rescue team and an

emergency fire protection rescue team respectively, if needed.
- The emergency exposure medical treatment team consisting of the medical personnel of the National Institute of Radiological Sciences, National Hospitals, and attached hospitals of National Universities etc. carries out medical activities at the spot.
- The Nuclear Emergency Response Headquarter, the Local Nuclear Emergency Response Headquarter, specific governmental agencies, specific public institutions, local governments, and nuclear operators offer exact and fine information.

4. Emergency Restoration
- When recognizing that it becomes unnecessary to carry out emergency response, the Prime Minister hears opinions of the Nuclear Safety Commission, and declares release of a nuclear emergency situation.
- Local governments cancel various restriction measures based on investigation of the area by environmental monitoring etc. and judgments of specialists sent by the national government and emergency response investigation committee of the Nuclear Safety Commission, etc.

II. Special Law of Emergency Preparedness for Nuclear Disaster

(1) Special Law of Emergency Preparedness for Nuclear Disaster (Excerpt)

(Law No. 156, December 17, 1999)

(Purpose)

Article 1. In view of the particularity of nuclear disaster this Law stipulates the responsibilities of nuclear operators for nuclear disaster prevention and special measures such as the issue of the Notification of Activating Nuclear Emergency Organization, the establishment of a Nuclear Disaster Countermeasures Headquarters, the implementation of immediate emergency countermeasures, and other issues related to nuclear disasters; and tightens countermeasures against nuclear disasters in conjunction with the Law for the Regulations of Nuclear Source Material, Nuclear Fuel Material and Reactors (hereinafter referred to as "LRNR"), the Basic Law on Disaster Countermeasures , and other laws on the prevention of nuclear disasters, with the ultimate goal of protecting the life, body and property of national from hazard in the event of nuclear disasters.

(Duties of nuclear operators)

Article 3. In accordance with the provisions of this Law and related laws, nuclear operators are obliged to take the safest measures to prevent the occurrence of nuclear disasters (including the probability of a nuclear disaster), measures to prevent the propagation of nuclear disasters and measures for restoration therefrom.

(Duties of the national government)

Article 4. In accordance with the provisions of this Law and related laws, the national government shall take measures necessary for the implementation of immediate emergency countermeasures including the establishment of a Nuclear Disaster Countermeasures Headquarters, provision of necessary instructions to local authorities, and for the implementation of nuclear disaster prevention countermeasures and ex-post-facto countermeasures of nuclear disasters, in order to fulfil its obligations as prescribed in Article 3 Paragraph 1 of the Basic Law on Disaster Countermeasures.

2. The chiefs of designated administrative agencies (or the designated administrative agency itself, if a committee or council system agency; also applies to the succeeding provisions; the same shall apply hereinafter except for Article 17 Paragraph 6 Clause 3 and Article 20 Paragraph 3) and of designated local administrative agencies shall provide recommendations and advice to local authorities and take appropriate measures with respect to assigned duties in their charge, in order to allow smooth execution of nuclear disaster prevention countermeasures, immediate emergency countermeasures, and ex-post-facto countermeasures of nuclear disasters by local authorities, as stipulated in this Law.

3. The competent Minister shall properly exert competencies stipulated in this Law, instruct and advise nuclear operators, and take appropriate measures, in order to allow smooth implementation of nuclear disaster prevention countermeasures, immediate emergency countermeasures, and ex-post-facto countermeasures of nuclear disasters by nuclear undertakes in accordance with the provisions in this Law.

(Duties of local authorities)

Article 5. In accordance with the provisions of this Law and related laws, local authorities shall fulfil their duties concerning nuclear disasters as prescribed in Article 4 Paragraph 1 and Article 5 Paragraph 1of the Basic Law on Disaster Countermeasures, by taking measures necessary for the implementation of nuclear disaster prevention countermeasures, immediate emergency countermeasures, and ex-post-facto countermeasures of nuclear disasters.

(Disaster prevention work plan of nuclear operators)

Article 7. In accordance with the provisions of the order of the competent Ministry, at each establishment of nuclear enterprise, nuclear operators shall prepare a disaster prevention work plan of nuclear operators with respect to nuclear disaster prevention countermeasures, immediate emergency countermeasures, ex-post-facto countermeasures of nuclear disasters, and other measures necessary to prevent the occurrence and propagation of nuclear disasters and to restore therefrom. Once prepared, these plans shall be reviewed annually and revised as necessary.

3. When a nuclear operator has prepared or modified a disaster prevention work plan in accordance with the provisions of Paragraph 1, it shall immediately report this fact to the competent Minister and release essential details of the preparation or the modification to the public.

4. When a nuclear operator is deemed to be in violation of the provisions of Paragraph 1, or its disaster prevention work plan of nuclear operators is not deemed sufficient to prevent the occurrence or propagation of nuclear disasters involving

the establishment of nuclear enterprise, the competent Minister may order the nuclear operator to modify the plan or prepare the alternative to it.

(Nuclear disaster prevention organization)

Article 8. Nuclear operators shall organize a nuclear disaster prevention organization at each of their establishments.

(Management personnel for nuclear disaster prevention)

Article 9. Nuclear operators shall appoint management personnel for nuclear disaster prevention at each of their establishments to manage the nuclear disaster prevention organization.

(Notification duty of management personnel for nuclear disaster prevention)

Article 10. When the management personnel for nuclear disaster prevention detect or are notified of the detection , by means of the methods designated by government ordinance, of radiation doses exceeding the level designated by government ordinance, or of other events designated by government ordinance near the boundary of the area of the establishment of nuclear enterprise, they shall immediately report the finding to the competent Minister, competent prefectural governor, competent mayor of the municipality, and governors of the related neighboring local governments (or if the event occurs during transportation outside an establishment, to the competent Minister and to the prefectural governor and mayor of the municipality who have jurisdiction over the area in which the event occurred, as stipulated by the order of the competent Ministry and the disaster prevention plan of nuclear operators. Upon being so notified, the competent prefectural governor and governors of the related neighboring local governments shall report the event to the mayors of the related surrounding municipalities.

2. The prefectural governor or the mayor of the municipality , who has been notified in accordance with the prescription in the former part of the preceding Paragraph, may request the competent Minister to dispatch personnel who have special knowledge to assess the situation in accordance with the provision of the government ordinance, at which time the competent Minister shall dispatch personnel who are deemed appropriate.

(Designation of the Off-site Centers)

Article 12. For each establishment of nuclear enterprise, the competent Minister shall designate facilities as bases for immediate emergency countermeasures taken by the persons as prescribed in Article 26 Paragraph 2. These facilities (hereinafter referred to as the "Off-site Center") shall be located in an area of the prefecture where the relevant establishment is located, and meet other requirements as prescribed by the order of the competent Ministry.

(Disaster prevention exercise plan by the national government)

Article 13. A disaster prevention exercise prescribed in Article 48 Paragraph 1 of the Basic Law on Disaster Countermeasures, as applicable after amended as per the provisions of Article 28 Paragraph 1, (excluding those executed by responsible personnel for disaster prevention as designated in the relevant Paragraph in accordance with the provisions of a disaster prevention plan or a disaster prevention work plan of nuclear operators), shall be executed according to plan prepared by the competent Minister in accordance with the order of the competent Ministry.

(Notification of Activating Nuclear Emergency)

Article 15. When a nuclear emergency situation as prescribed in the succeeding Paragraphs is deemed to have occurred, the competent Minister shall immediately submit to the Prime Minister both drafts of notification as prescribed in the succeeding Paragraph and instructions as per the provisions of Paragraph 3, in addition to provide necessary information on the situation.

(i) The radiation dose reported to the competent Minister in accordance with the former part of the provisions of Article 10 Paragraph 1 or the radiation dose detected by the methods and radiation-measuring devices designated in the government ordinance exceeds the threshold for radiation doses in abnormal level designated in the government ordinance.

(ii) An event designated in the government ordinance as indicating the occurrence of a nuclear emergency situation, in addition to the events prescribed in the preceding Clause.

2. Upon receipt of the report and drafts prescribed in the preceding Paragraph, the Prime Minister shall immediately issue an official announcement (hereinafter referred to as "Notification of Activating Nuclear Emergency Organization") concerning a notification of a nuclear emergency situation and the items outlined in the succeeding Clauses.

(i) Areas where immediate emergency countermeasures should be taken

(ii) Summary of the nuclear emergency situation.

(iii) Issues exhaustively notified to residents, visitors, and public and private groups in the areas designated in Clause (a) (hereinafter referred to as "residents"), in addition to the information in the preceding Clauses (1) and (2).

3. Upon receipt of the information and drafts prescribed in Paragraph 1, the Prime Minister shall immediately provide instructions and/or recommendations of refuge by evacuation or sheltering to the mayors of municipalities and prefectural governors who have jurisdiction over the areas designated in Clause (1) of the preceding Paragraph, in accordance with the provisions of Article 60 Paragraphs 1 and 5 of the Basic Law on Disaster Countermeasures, as applicable after being amended as per the provisions of Article 28 Paragraph 2, and provide instructions of other measures related to immediate emergency countermeasures.

4. Once immediate countermeasures to prevent the propagation of a nuclear disaster are deemed no longer necessary, the Prime Minister shall immediately consult the Nuclear Safety Commission and issue an official announcement to cancel the nuclear emergency situation (hereinafter referred to as "a Notification of Deactivating Nuclear Emergency Organization").

(Establishment of Nuclear Disaster Countermeasures Headquarters)

Article 16. After issuing Notification of Active Nuclear Emergency Organization, the Prime Minister shall establish Nuclear Disaster Countermeasures Headquarters temporarily at the Prime Minister's Office after holding a Cabinet council,

for executing immediate emergency countermeasures concerning relevant nuclear emergency situation, irrespective of the provisions of Article 83 of the National Government Organization Law (Law 48-120).
(Organization of the Nuclear Disaster Countermeasures Headquarters)
Article 17. The Prime Minister (or a Minister of State appointed in advance should the Prime Minister be deemed under unavoidable circumstances) shall act as the Superintendent General of the Nuclear Disaster Countermeasures Headquarters, a chief of the Headquarters.
(Competency of the Superintendent General of the Nuclear Disaster Countermeasures Headquarters)
Article 20. 4 When deemed necessary to request support from the Defense Agency for swift and efficient implementation of the immediate emergency countermeasures in its implementation zone notified by the relevant Nuclear Disaster Countermeasures Headquarters, the Superintendent General of the Nuclear Disaster Countermeasures Headquarters may direct the Director-General of the Defense Agency to dispatch the troops in accordance with the provisions of Article 8 of the Self-Defense Forces Law.
(Joint Council of Nuclear Disaster Countermeasures)
Article 23. Once a Notification of Activating Nuclear Emergency has been issued, the On-Site Nuclear Disaster Countermeasures Headquarters and the Disaster Countermeasure Headquarters of the prefecture and municipalities which have jurisdiction over the implementation zone of the immediate emergency countermeasures, in which the Notification has been issued, shall establish a Joint Council of Nuclear Disaster Countermeasures in order to exchange the information on the relevant nuclear disaster and to aid cooperation in implementing their immediate emergency countermeasures.
(Technical Experts for Nuclear Disaster Prevention)
Article 30. Technical Experts for Nuclear Disaster Prevention shall be appointed in the Ministry of Education, Culture, Sports and Technology and the Ministry of Economy, Trade and Industry.
2. Technical Experts for Nuclear Disaster Prevention shall provide guidance and advice to the establishments of nuclear enterprise designated , by the Director-General of the Minister of Education, Culture, Sports and Technology or the Minister of Economy, Trade and Industry, as those for which they are responsible. Relevant guidance and advice shall be given to the preparation of nuclear disaster prevention work plans of nuclear operators in accordance with the provisions of Article 7 Paragraph 1, the establishment of nuclear disaster prevention organizations in accordance with Article 8 Paragraph 1, and the nuclear disaster prevention countermeasures implemented by nuclear operators. Technical Experts shall further collect necessary information to recognize the situation upon receipt of reports in accordance with the provisions of the former part of Article 10Paragraph 1, provide advice for the collection of information and emergency measures implemented by local public agencies, and handle any additional affairs necessary to smoothly prevent the occurrence and propagation of nuclear disasters.

(2) Ordinance for the Enforcement of the Special Law of Emergency Preparedness for Nuclear Disaster (Excerpt) (Government Ordinance No.195, April 5, 2000)

(Events to be reported)
Article 4. The reference value specified in the government ordinance in Article 10 Paragraph 1 of the Law is a radiation dose of 5 micro Sv per hour.
2. The detection of radiation dose in accordance with the government ordinance of Article 10 Paragraph 1 of the Law shall be performed by measuring the gamma ray radiation dose per unit of time (which shall be two minutes or less) by one or more of the radiation-measuring devices installed in accordance with the provisions of Article 11 Paragraph 1 of the Law, converting it into a value per hour, and determining whether this value is higher than the radiation dose specified in the preceding Paragraph. No radiation dose shall be deemed to be detected if the measured value falls within the purview of one of the succeeding Clauses.
(i) The radiation dose is detected at only one point (with the restriction that the detection time is less than 10 minutes).
(ii) The radiation dose is detected during a thunderstorm
3. When the radiation doses, detected as per the provisions of the proceeding Paragraph, at all radiation-measuring devices installed in accordance with the provisions of Article 11 Paragraph 1 of the Law are less than that in Paragraph 1, and the value measured by one or more of the relevant radiation-measuring devices is 1 micro Sv or more per hour, the detection of radiation dose in accordance with the provisions of Article 10 Paragraph 1 of the Law shall be performed by totaling the radiation dose detected by the relevant radiation-measuring devices in accordance with the relevant Paragraph and the neutron radiation dose measured in accordance with the provisions of the order of the competent Ministry in the vicinity of the facilities for the operation of reactors, irrespective of the provisions of the preceding Paragraph.
4. The event to be specified by the government ordinance in Article 10 Paragraph 1 of the Law is one of those specified in the succeeding Clauses.
(i) A radiation dose over the reference value specified in Paragraph 1 is detected in accordance with the provisions of Paragraph 2 or the preceding Paragraph.
(ii) Radioactive materials whose radiation level is higher than the reference value specified as equivalent to the radiation dose as specified in Paragraph 1 by the order of the competent Ministry at the boundary of the relevant establishment of nuclear enterprise, are detected at the ventilation tubes, wastewater draining points, or similar points in the facility for the operation of reactors of the relevant establishment.
(iii) The radiation dose or radioactive materials specified in the succeeding items are detected at locations (excluding those specified in the preceding Clause) other than in specified control zones (i.e., the zone specified by the order of the

competent Ministry where radiation exposure dose for personnel shall be controlled) inside the facility for the operation of reactors within the site of the relevant establishment.

(a) Radiation dose of 50 micro Sv or more per hour.

(b) Radioactive materials which exceed the reference quantity specified in the order of the competent Ministry as equivalent to a dose of 5 micro Sv per hour at the relevant locations.

(iv) A radiation dose of 100 micro Sv or more is detected in accordance with the provisions of the competent Ministry at a point 1m distant from a vessel used for transportation outside an establishment.

(v) Inability to shut down a reactor as specified in Article 23 Paragraph 1 Clause 1 of the Law for the Regulations of Nuclear Source Material, Nuclear Fuel Material, and Reactors (Law 57-166) by inserting normal neutron absorbents ,where a reactor being referred to as "an operational power reactor" in Article 6 Paragraph 4 Clause 4 of the relevant Law, and other events specified, for each characteristic of the facility for the operation of reactors and of the vessels used for the transport outside an establishment, by the order of the competent Ministry as potentially leading to a nuclear emergency, in addition to those specified in the preceding Clauses.

(Nuclear emergency situation)

Article 6. The radiation-measuring devices specified in the government ordinance in Article 15 Paragraph 1 Clause 1 of the Law shall be installed in the prefecture of the competent prefectural governor or governors of the related neighboring local governments and have performance equivalent to that of the radiation-measuring devices specified in Article 11 paragraph 1 of the Law.

2. The measuring method specified in the government ordinance in Article 15 Paragraph 1 Clause 1 of the Law shall be performed by repeating measurement of gamma ray radiation doses per unit of time (which shall be 10 minutes or less) and converting them into values per hour, wherein the relevant value is deemed as not detected if detection occurs during a thunderstorm.

3. The reference values specified in the government ordinance in Article 15 Paragraph 1 Clause 1 of the Law shall be those in the succeeding Clauses for the detected radiation doses specified therein.

(i) 500 micro Sv per hour: for the detected radiation doses as specified in Article 4 Paragraph 4 Clause 1 (i.e., the doses obtained by totaling the neutron radiation dose specified in Paragraph 4 Clause 3 and the doses measured by the relevant radiation-measuring devices when the values measured by one or more of the radiation-measuring devices installed in accordance with the provisions of Article 11 Paragraph 1 of the Law, are 5 micro Sv or more), or the radiation dose detected by the method in the preceding Paragraph and by using the radiation-measuring devices in Paragraph 1.

(ii) 5mSv per hour: for the detected radiation doses specified in the item (a) in Article 4 Paragraph 4 Clause 3.

(iii) 10mSv per hour: for the detected radiation doses specified in Article 4 Paragraph 4 Clause 4.

4. The event specified as indicating the occurrence of a nuclear emergency situation in Article 15 Paragraph 1 Clause 2 of the Law is one of those specified in the succeeding Clauses.

(i) Radioactive materials whose radiation levels at the boundary of the relevant establishment are equivalent to or exceed the reference value specified by the competent Ministry as equivalent to the dose specified in Clause 1 of the preceding Paragraph are detected at the locations specified in Article 4 Paragraph 4 Clause 2 in accordance with the provisions of the competent Ministry.

(ii) Radioactive materials whose radiation levels at the locations specified in Article 4 Paragraph 4 Clause 3 are equivalent to or exceed the reference value specified by the competent Ministry as equivalent to 500 micro Sv per hour are detected at relevant locations in accordance with the provisions of the competent Ministry.

(iii) Nuclear fuel materials are at a stage of criticality (i.e., a state where a fission chain reaction is continuing) within the facilities for the operation of reactors (excluding the interior of reactor main bodies).

(iv) Inability to shut down an operational power reactor by inserting emergency neutron absorbents, and other events specified, for each characteristic of the facility for the operation of reactors and the vessels used for the transportation outside an establishment, by order of the competent Ministry as indicating the occurrence of a nuclear emergency, in addition to those specified in the preceding three Clauses.

III. The emergency preparedness guidelines "Emergency Preparedness of Nuclear Installations"

(Excerpt)
(Decision of the Nuclear Safety Commission, June 1980)
Latest Revision: June, 2001

Chapter 1 Preface
Chapter 2 Emergency Preparedness-General
Chapter 3 Zone to be Performed Substantial Emergency Preparedness
3-2 Selection of Zone

Standards of "Zone to be Performed Substantial Emergency Preparedness"(hereinafter referred to as EPZ (Emergency Planning Zone)) are defined with sufficient margin in a distance from a nuclear facility even assuming situations, which cannot dare happen technically in nuclear installations making sufficient safety countermeasures. (Abbreviation) The standards of EPZ are shown in Table 1 depending on types of nuclear installations.

Table 1 Standard of EPZ depending on types of nuclear installations

Types of installations	Distance (radius) of standard of EPZ
Nuclear power stations, nuclear reactors in a research and development stage, and nuclear reactors of more than 50MW in experimental research stage	About 8-10km

Chapter 4 Emergency Environmental Radiation Monitoring

4-1 Objective, etc.

In a nuclear installation, when there is an unusual release of radioactive materials or radiations or its fear, an environmental monitoring planned particularly in order to obtain the information about radioactive materials or radiations of circumference environment, is called "emergency monitoring" and it consists of the 1st phase monitoring performed quickly at the time of occurrence of a nuclear emergency situation and the 2nd phase monitoring carried out to assess the general influence to the circumference environment. (Followings are abbreviated)

Chapter 5 Guideline for Enforcement of Emergency Response

5-1 Notification Criteria and Emergency Situation Judgment Criterion in the Abnormal Situation Occurrence

In the Special Law for Nuclear Emergency, considering the characteristic of nuclear installations, relations with countermeasure activities, etc., criteria about preparation and start of nuclear emergency preparedness activities are defined so that it can apply to all nuclear installations

(1) Notification criteria to related persons and response to applicable events

1) Contents of notification criteria

(a) At the vicinity of boundary of a nuclear installation, dose rate of space radiations at one point of 5microSv/h or more for more than 10min. or at more than two points simultaneously 5microSv/h or more (when gamma rays are 1microSv/h or more, the total doses of 5microSv/h or more by measuring neutrons, excluding case due to thunders.)

(b) Release of the radioactive materials with which a radioactivity level after spreading corresponds 5microSv/h or more near the boundary of a nuclear installation at normal release portions, such as a stack, etc. (release which corresponds 50microSv or more by an event when it is managed by accumulated release).

(c) A space radiation dose rate of 50microSv/h or more, or release of radioactive materials corresponding to 5microSv/h or more in the place outside a management zone etc. when a fire, explosion, etc. arises.

(d) A space radiation dose rate of 100microSv/h or more, or radioactive materials etc. in the point 1m from a transportation container when an accident occurred during conveyance outside nuclear installations.

(e) Occurrence of a criticality accident or a state of its fear.

(f) Individual events based on the characteristic of nuclear installations in light water reactors and shut down of the nuclear reactor by insertion of control rods cannot be performed.

2) Responses when an event applicable to notification criteria occurs

(a) Responses of nuclear operators

While a nuclear operator should notify to the national government, prefectural governors, and municipal governors quickly, he carries out emergency response required for the grasp of the information about the influence on residents in the vicinity, etc. and prevention of occurrence or expansion of a nuclear emergency and also needs to report the development of the incident to these organizations precisely.

(b) Responses of the national government

While the national government collects quickly the incident information, etc. in the nuclear installation through the Senior Specialist for Nuclear Emergency, it needs to send personnel and specialists of Japan Atomic Energy Research Institute etc. to the spot. Moreover, response to alert conditions such as attaining share of the information between the related persons and discussing countermeasures should be prepared according to the expansion situation of the incident by holding the emergency response connection meeting between related ministries and government offices, etc.

(c) Responses of local governments

Prefectural and municipal governments need to collect information, obtaining cooperation of the Senior Specialist for Nuclear Emergency and to prepare an alert condition according to the expansion situation of the incident. Moreover, from the viewpoint of the grasp of the influence to the circumference, while the monitoring at usual times is strengthened, preparation of emergency monitoring is started.

Besides, this stage is strictly a stage of preparation required for prevention of occurrence or expansion of a nuclear emergency and responding pertinently is important so as not to give unnecessary anxiety and confusion to residents in the related organizations. In addition, as response at the spot in an initial stage, the role of the Senior Specialist for Nuclear Emergency is important, and contents of performances, etc. need to be defined beforehand.

(2) A nuclear emergency situation and its response

1) The contents of the judgment criteria of nuclear emergency situations

(a) At vicinity of the boundary of a nuclear installation, dose rate of space radiation in a point of 500microSv/h or more for more than 10 minute or 500microSv/h or more at more than two points simultaneously. (Total dose of 500microSv/h or more by measuring dose of neutrons also, when dose of gamma rays is 5microSv/h or more, but excluding dose due to thunder.)

(b) A release of the radioactive materials with which a radioactivity level after spreading corresponds 500microSv/h

or more near the boundary of a nuclear installation at normal release portions, such as a stack, etc. (a release which corresponds 5mSv or more by an event when it is managed by accumulated release).

(c) A space radiation dose rate of 5mSv/h or more, or a release of radioactive materials corresponding to 500microSv/h or more in the place outside a management zone etc. when a fire, explosion, etc. arises.

(d) A space radiation dose rate of 10mSv/h or more, or radioactive materials etc. in the point 1m from the transportation container when an accident occurred during conveyance outside nuclear installations.

(e) Occurrence of a criticality accident

(f) A nuclear reactor cannot be shut down by operations such as pouring of borate in a light water reactor in individual events based on the characteristics of the nuclear installation.

2) Response to nuclear emergency situations

(a) Responses of nuclear operators

Nuclear operators need to carry out emergency response for prevention of occurrence, or expansion of a nuclear emergency.

(b) Responses of the national government and local governments

The national government declares a nuclear emergency situation and at the same time it establishes the Nuclear Emergency Response Headquarter. Local governments establish Emergency Response Headquarters and carry out emergency response. The Joint Council for Nuclear Emergency Response which consists of the local response headquarter of the national government, response headquarters of prefectureal and municipal governments, etc. is organized in the off site center, in order to share information, to perform cooperated emergency response and it is important to take proper measures to reduce influence of radiation and not to give unnecessary anxiety and confusion to residents in the vicinity.

5-2 (Omission)

5-3 Indices for protective measures

Indices for taking protective measures are expressed as the dose (prediction dose) expected to receive for individuals if certain measures are not taken, or measured values as concentration of radioactive materials in food and drink.

Although a predicted dose will be presumed from the mode of an abnormal situation, the release situation of radioactive materials or radiations, meteorological information, SPEEDI network system, etc., information from emergency monitoring etc. are not necessarily obtained at early times of presumption. Therefore, when the measured values by emergency monitoring are obtained, it is effective to correct the calculated values by SPEEDI network system etc. one by one based on these values.

(1) Indices of sheltering and evacuation, etc.

Based on "The Radiation Level of Emergency Response on the Extensive Release Incident of Radioactive Materials" (reply of Radiation Council 1967), the indices of sheltering, evacuation, etc. taking into account the efficiency of protective countermeasures are shown in Table 2.

Table 2 Indices about sheltering and evacuation etc.

Anticipated radiation dose (unit: mSv)		Contents of protective countermeasures
Effective dose by external exposure	Equivalent dose by internal exposure · Equivalent dose of the childhood thyroid gland by radioactive iodine · Equivalent dose of the bone surface or the lung by uranium · Equivalent dose of the bone surface or the lung by plutonium	
10~50	100~500	Residents need to do indoor sheltering in own houses, etc. In that case, air tightness should be attended by shutting windows, etc. In the case that the neutrons or gamma rays are directly released from nuclear installations, residents need to sheltering in concrete building or evacuation when the Local Nuclear Emergency Response Headquarter indicates it.
50 or more	500 or more	Residents need to take indoor sheltering to concrete building or to be evacuated according to directions.

We decided that a certain width is given to the index of sheltering, evacuations, etc. The reason is that a protective measures should not be determined by only the dose, but it should be determined in considering the possibility of realization of countermeasures, a risk of being generated by performing, the influencing population scale and the dose to be reduced, and for that flexibility is needed for enforcement of protective countermeasures. Moreover, advices or directions about actions of circumference residents, etc. performed by emergency response headquarters are expected to be given to unit of certain area and prediction doses change with places in the area. That is the reason why index has a width.

In addition, it is required to define a certain area and to carry out step by step after considering the scale of an unusual situation and weather conditions according to the above mentioned index, when a protective countermeasures of indoor sheltering or sheltering in concrete buildings or evacuation are actually applied.

(2) The indices about ingestion restrictions of food and drink

In addition to iodine, uranium and plutonium in radioactive plumes as radioactive elements related to ingestion restriction of food and drink, cesium was selected based on the experience of the Chernobyl accident of former USSR.
Indices about ingestion restrictions of food and drink are shown as measured concentration of the radioactive materials in Table 3 determined from the viewpoint that exposures of these nuclides for residents in the vicinity are reduced.
These Indices further show standard when emergency response headquarters etc. start considerations about the ingestion restriction measure of food and drink to be appropriate or not.

Table 3 Indices of ingestion restriction of food and drink

Objects	Radioactive iodine (representative nuclide of mixed nuclides: ^{131}I)
Drink water Milk and dairy products	3×10^2 Bq/kg or more
Vegetables (excluding rootcrop and potato)	2×10^3 Bq/kg or more
Objects	**Radioactive cesium**
Drink water Milk and dairy products	2×10^2 Bq/kg or more
Vegetables Grain Meat, egg, fish, etc.	5×10^2 Bq/kg or more
Objects	**Uranium**
Drink water Milk and dairy products	20Bq/kg or more
Vegetables Grain Meat, egg, fish, etc.	1×10^2 Bq/kg or more
Objects	**Alpha nuclides of plutonium and transuranium (sum of radioactivity concentration of ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{242}Pu, ^{241}Am, ^{242}Cm, ^{243}Cm, ^{244}Cm)**
Drink water Milk and dairy products	1Bq/kg or more
Vegetables Grain Meat, egg, fish, etc.	10Bq/kg or more

Chapter 6 Emergency Medical Treatment

6-3 Emergency medical treatment for radiation exposure

(1) Initial medical treatment system for radiation exposure

1) Initial medical treatment for patients exposed to radiation at nuclear installation

The initial treatment includes first aid for patients, surveillance, screening and measurement of dosage, followed by decontamination or prevention of further spread of contamination, and transfer of patients to the medical institutions.

2) Initial response for residents taking refuge in shelters etc.

The initial response includes surveillance, screening and measurement of dosage, and collection and filing of information on evacuation paths and duration of evacuation.

3) Initial medical treatment at medical institutions

Medical institutions in the vicinity of nuclear installations treat patients transferred there from shelters or nuclear installations, and practice decontamination and emergency treatment.
The institutions for initial medical treatment of radiation exposure are those which practice emergency treatment daily, and they give simple decontamination or first aid such as wiping-off or the like.

It should be taken note of that, in emergency, many residents may visit medical institutions or shelters and seek unnecessary medical treatment out of mental uneasiness.

(2) Secondary medical treatment system for radiation exposure

After initial medical treatment, patients with residual contamination or with considerable damage are to be transferred to medical institutions and hospitalized for secondary medical treatment, which includes whole body decontamination by shower, medical treatment for contaminated wound, and measurement of contamination and dosage. It also includes treatment for partially or severely exposed patients.

(3) Tertiary medical treatment system for radiation exposure

Following subsequent medical treatment, patients with severe exposure from external or internal radiation are to be transferred to medical institutions for tertiary medical treatment. Medical institutions attached to national universities are recommendable for their special interdisciplinary expertise.

Local medical institutions for tertiary medical treatment obtain cooperation from local radiation protection institutions in measuring dosage and providing radiation protection.

Local medical institutions for tertiary medical treatment, in cooperation with the National Institute of Radiological Sciences, practice treatment of patients, long term medical check, etc. Local medical institutions for special medical treatment, together with institutions for initial and subsequent medical treatment, constitute effective local medical treatment system for radiation exposure, and are responsible for coordination of transfer of patients, technological cooperation, etc. among local institutions.

The National Institute of Radiological Science is the central institute of tertiary medical treatment, practices highly professional decontamination and medical treatment in cooperation with other institutions with high expertise, and gives assistance and advice to other institutions. The National Institute of Radiological Science is one of the local medical institutions for special medical treatment, also.

Wittick, Brian

From:	Wittick, Brian
Sent:	Saturday, April 16, 2011 2:13 AM
To:	'oshima-toshiyuki@meti.go.jp'; bannai-toshihiro@meti.go.jp; satoh.takashi@tepco.co.jp; nei-hisanori@meti.go.jp; koyama-masaomi@meti.go.jp
Cc:	y-uemura@simul.co.jp
Subject:	NRC meeting schedules

Dear Bannai-san and Satoh-san,

Please note that this daily report will not be produced until meetings resume on Monday.

I hope that you have an enjoyable weekend

Best regards,

Brian Wittick
U.S. Nuclear Regulatory Commission
Japan Team International Liaison

Tel: 81-33-22-45-066

(b)(6)

BB8\123

Wittick, Brian

From: Wittick, Brian
Sent: Saturday, April 16, 2011 5:59 AM
To: Reynolds, Steven; Casto, Chuck; Garchow, Steve; Gepford, Heather; Huffert, Anthony; Mitman, Jeffrey; Moore, Carl; Lupold, Timothy; Meighan, Sean
Subject: Sunday meeting

INL robotics reps would like to meet with our NRC site team Sunday at 1200 in our embassy spaces. They would like to exchange information in preps for their ops.

Sent from NRC BlackBerry
Brian Wittick

(b)(6)

From: Reynolds, Steven
To: Casto, Chuck; Garchow, Steve; Gepford, Heather; Huffert, Anthony; Mitman, Jeffrey; Moore, Carl; Lupold, Timothy; Meighan, Sean; Wittick, Brian; Reynolds, Steven
Sent: Fri Apr 15 05:34:13 2011
Subject: Phone numbers for Japan Team #4

Chuck Casto

Steve Reynolds

Steve Garchow

Heather Gepford

Tony Huffert

Jeff Mitman (b)(6)

Carl Moore

Tim Lupold

Sean Meighan

Brian Wittick

BBB\124

Wittick, Brian

From: Wittick, Brian
Sent: Saturday, April 16, 2011 7:37 PM
To: Smiroldo, Elizabeth; Young, Francis
Subject: Re: International Cooperation

Thanks Elizabeth. NISA said they have some things going and may be interested in having us interface with the Russians in the near future. Would be helpful to know what is going on and better if we asked the Russians rather than press the Japanese on one more thing. Picture handling this crisis as a regulator with a staff in the hundreds. I was in their working spaces Friday and they look like beat puppies

Thanks

Sent from NRC BlackBerry
Brian Wittick

(b)(6)

From: Smiroldo, Elizabeth
To: Wittick, Brian; Young, Francis
Sent: Sat Apr 16 19:22:29 2011
Subject: Re: International Cooperation

Hi, Brian,
I will try to find out before my fight on Monday
Best,
Elizabeth

From: Wittick, Brian
To: Young, Francis
Cc: Smiroldo, Elizabeth
Sent: Sat Apr 16 04:24:18 2011
Subject: International Cooperation

Skip,

Can you find out what the Russians have going on with the Japanese as it pertains to dealing with this accident.

Thanks
Brian

B/25

Wittick, Brian

From: Wittick, Brian
Sent: Sunday, April 17, 2011 5:10 AM
To: LIA08 Hoc
Subject: Re: US Embassy email Addresses

I am in my hotel and do not have access to an embassy directory. Hopefully it can wait till morning. Alternately, you can try Steve Reynolds who said he was working late tonight and may still be there

Sent from NRC BlackBerry
Brian Wittick
(b)(6)

From: LIA08 Hoc
To: Wittick, Brian
Sent: Sun Apr 17 04:56:21 2011
Subject: US Embassy email Addresses

Brian,

The ET Director would like to get the email addresses for two US embassy people they are, Marc Wall and Susan / Suzanne Bacillus (not sure of the spelling).

Thanks,
Milt Murray
Liaison Team Coordinator
US Nuclear Regulatory Commission
email: lia08.hoc@nrc.gov
Desk Ph: 301-816-5185

BBB/126

Wittick, Brian

From: Wittick, Brian
Sent: Sunday, April 17, 2011 7:17 PM
To: 'bannai-toshihiro@meti.go.jp'; 'satoh takashi@tepco.co.jp'; 'nei-hisanori@meti.go.jp'; 'oshima-toshiyuki@meti.go.jp'; 'koyama-masaomi@meti.go.jp'
Cc: Casto, Chuck; Reynolds, Steven; 'y-uemura@simul.co.jp'
Subject: NRC Meetings for 18 April 2011
Attachments: NRC Meetings 18-April-2011.docx

Dear Bannai-san and Satoh-san,

Please find the schedule for NRC meetings today (attached). If you have any questions or concerns, please let me know.

Best regards,

Brian Wittick
U.S. Nuclear Regulatory Commission
Japan Team International Liaison
Tel: 81-33-22-45-066

(b)(6)

U.S. Nuclear Regulatory Commission Meetings
Monday, 18 April 2011

Time	Organization-Topic	Location
1100	NISA & TEPCO - Daily Status	TEPCO

Wittick, Brian

From: Wittick, Brian
Sent: Sunday, April 17, 2011 9:19 PM
To: 'oshima-toshiyuki@meti.go.jp'; bannai-toshihiro@meti.go.jp; satoh.takashi@tepco.co.jp; nei-hisanori@meti.go.jp; koyama-masaomi@meti.go.jp
Cc: y-uemura@simul.co.jp
Subject: RE: NRC Meetings for 18 April 2011

Dear Oshima-san,

Thank you for the information.

Best regards,
Brian

-----Original Message-----
From: 大島 俊之 [mailto:oshima-toshiyuki@meti.go.jp]
Sent: Sunday, April 17, 2011 9:02 PM
To: Wittick, Brian; bannai-toshihiro@meti.go.jp; satoh.takashi@tepco.co.jp; nei-hisanori@meti.go.jp; koyama-masaomi@meti.go.jp
Cc: Casto, Chuck; Reynolds, Steven; y-uemura@simul.co.jp
Subject: RE: NRC Meetings for 18 April 2011

Dear Brian

Thank you for your mail about the NRC schedule today.
Let me inform you that the Shielding Project meeting will be held from 14:00 to 15:00 at 1042 of the Annex building of METI today.
Many thank you for your support.

Best regards,

Toshiyuki Oshima
NISA

> -----Original Message-----
> From: Wittick, Brian [mailto:Brian.Wittick@nrc.gov]
> Sent: Monday, April 18, 2011 8:17 AM
> To: 'bannai-toshihiro@meti.go.jp'; 'satoh.takashi@tepco.co.jp';
> 'nei-hisanori@meti.go.jp'; 'oshima-toshiyuki@meti.go.jp';
> 'koyama-masaomi@meti.go.jp'
> Cc: Casto, Chuck; Reynolds, Steven; 'y-uemura@simul.co.jp'
> Subject: NRC Meetings for 18 April 2011
>
> Dear Bannai-san and Satoh-san,
>
> Please find the schedule for NRC meetings today (attached). If you
> have any questions or concerns, please let me know.
>
> Best regards,
>
>
>

688/128

> Brian Wittick
>
> U.S. Nuclear Regulatory Commission
>
> Japan Team International Liaison
>
> Tel: 81-33-22-45-066

(b)(6)

>
>

Huffert, Anthony

From: Hinds, Lynda J [HindsLJ@state.gov] on behalf of Tokyo Staff Assistant [AEX02TX@state.gov]
Sent: Sunday, April 17, 2011 10:22 PM
To: (b)(6) Alan Remick - DOE; (b)(6) Ulses, Anthony; ASINK@OFDA.GOV; (b)(6) Smith, Brooke; (b)(6) Carden, Terry; (b)(6) CherryRC@state.gov; (b)(6) Casto, Chuck; cmht@nnsa.doe.gov; (b)(6) damian.peko@nuclear.energy.gov; Dorman, Dan; Daniel.Blumenthal@nnsa.doe.gov; (b)(6) (b)(6) Debevec, Jacob; DuncanAD@state.gov; Fiser, Erich; (b)(6) Gepford, Heather; (b)(6) Halladay, Timothy; Harrell, Benjamin L; Hinds, Lynda; HOO Hoc; Huffert, Anthony; (b)(6) Jay Frogness; (b)(6) Jensen, Justina; jhughart@ofda.gov; Monninger, John; (b)(6) (b)(6) (b)(6) Johnstone, Gregg M; (b)(6) joseph.hughart@foh.hhs.gov; (b)(6) (b)(6) Foggie, Kirk; (b)(6) (b)(6) Lewis, Brian M; LIA01 Hoc; LIA02 Hoc; Long, Kristopher; Mears, Jeremy M; (b)(6) Morales, Russell A; (b)(6) narac@llnl.gov; (b)(6) NITOPS@nnsa.doe.gov; (b)(6) PMT01 Hoc; Hoc, PMT12; (b)(6) (b)(6) Devercelly, Richard; (b)(6) (b)(6) Robinson, Alex; Stowe, Jamie; (b)(6) (b)(6) (b)(6) Thur, Randy R; Nakanishi, Tony; (b)(6) Uchida (b)(6) Vietas, Jay; Cook, William
Subject: FW: Urgent: Roadmap towards Restoration
Attachments: TEPCO.zip; kaieda.zip

Lynda Hinds
Staff Assistant
(03) 3224- 5370

From: PROTOCOLOFFICE-EM [mailto:protocoloffice-em@mofa.go.jp]
Sent: Sunday, April 17, 2011 4:43 PM
To: PROTOCOLOFFICE-EM
Subject: Urgent: Roadmap towards Restoration

URGENT (15:50) Sunday 17 April 2011

To All Missions (Embassies, Consular posts and International Organizations in Japan)

Please find attached the "Roadmap towards Restoration from the Accident at Fukushima Daiichi Nuclear Power Station", that was made public at the press conference by Mr. Tsunehisa Katsumata, Chairman of the Tokyo Electric Power Company (TEPCO) at TEPCO headquarters at 3 pm today.

Please also find attached the statement by Mr. Banri Kaieda, Minister of Economy, Trade and Industry at the press conference at METI following the announcement of the Roadmap by TEPCO.

BBB/129

The Missions are kindly requested to forward this message to their headquarters as soon as possible.

Contact: International Nuclear Energy Cooperation Division, Tel 03-5501-8227

Statement of Mr. Banri Kaieda, Minister of Economy, Trade and Industry at the press conference following the announcement of Roadmap by Tokyo Electric Power Company (TEPCO)

1. Presentation at the earliest possible date of a roadmap towards settling the situation at Fukushima Daiichi Nuclear Power Station has been requested by people home and abroad, especially the residents around Fukushima Daiichi Nuclear Power Station.
TEPCO has just released this roadmap, which is an important step forward. Taking this opportunity, we would like to move from the "emergency response phase" up until now to the "planned & stabilizing action phase" in which the settlement of the situation will be aimed under the solid roadmap.
2. In response to the release of the roadmap,
   (1) The Government will request TEPCO to ensure the implementation of this roadmap steadily and as early as possible. To this end, the Nuclear and Industrial Safety Agency and others will make regular follow-up, monitoring of the progress of the works and necessary safety checks;
   (2) The Government will request TEPCO to ensure the mobilization and deployment of workers, the procurement and preparation of equipment and materials, and the arrangement of accommodation and other facilities, which are necessary to ensure implementation of the roadmap;
   (3) At the end of Step 2, the release of radioactive materials will be under control. At this stage, the Government will, following advices of the Nuclear Safety Commission of Japan, review the "Deliberate Evacuation Area" and the "Evacuation Prepared Area". Up until that time, we will consider the details of review criteria, and will decontaminate the widest possible area.
   By implementing this, we would like to announce, within 6 to 9 months as our target, to the residents of some of the areas whether they will be able to come home.

(Division in Charge)
Nuclear and Industrial Safety Agency
Nuclear Safety Public Relations and Training Division

Roadmap towards Restoration from the Accident
at Fukushima Daiichi Nuclear Power Station

April 17th, 2011
Tokyo Electric Power Company

With regard to the accident at Fukushima Daiichi Nuclear Power Station due to the Tohoku-Chihou-Taiheiyo-Oki Earthquake occurred on Friday, March 11th, 2011, we are currently making our utmost effort to bring the situation under control. This announcement is to notify the roadmap that we have put together towards restoration from the accident.

1. Basic Policy

By bringing the reactors and spent fuel pools to a stable cooling condition and mitigating the release of radioactive materials, we will make every effort to enable evacuees to return to their homes and for all citizens to be able to secure a sound life.

2. Targets

Based on the basic policy, the following two steps are set as targets: "Radiation dose is in steady decline" as "Step 1" and "Release of radioactive materials is under control and radiation dose is being significantly held down" as "Step 2." Target achievement dates are tentatively set as follows: "Step 1" is set at around 3 months and "Step 2" is set at around 3 to 6 months after achieving Step 1.

3. Immediate Actions

Immediate actions were divided into three groups, namely, "I. Cooling", "II. Mitigation", "III. Monitoring and Decontamination." For the following five issues—"Cooling the Reactors," "Cooling the Spent Fuel Pools," "Containment, Storage, Processing, and Reuse of Water Contaminated by Radioactive Materials (Accumulated Water)," "Mitigation of Release of Radioactive Materials to Atmosphere and from Soil," and "Measurement, Reduction and Announcement of Radiation Dose in Evacuation Order/Planned Evacuation/ Emergency Evacuation Preparation Areas"—targets are set for each of the five issues and various countermeasures will be implemented simultaneously.

Please see the attachment for detailed actions.

We would like to deeply apologize again for the grave inconvenience and anxiety that the broad public has been suffering due to the accident at the Fukushima Daiichi Nuclear Power Station. We will continue to make every endeavor to bring the situation under control.

April 17, 2011

Tokyo Electric Power Company

Roadmap towards Restoration from the Accident at Fukushima Daiichi Nuclear Power Station

1. Basic Policy

By bringing the reactors and spent fuel pools to a stable cooling condition and mitigating the release of radioactive materials, we will make every effort to enable evacuees to return to their homes and for all citizens to be able to secure a sound life.

2. Targets

- Based on the basic policy, the following two steps are set as targets:
  - Step 1: Radiation dose is in steady decline.
  - Step 2: Release of radioactive materials is under control and radiation dose is being significantly held down.
  - (Note) Issues after Step 2 will be categorized as "Mid-term Issues".
- Target achievement dates are tentatively set as follows, although there will still be various uncertainties and risks:
  - Step 1: around 3 months
  - Step 2: around 3 to 6 months (after achieving Step 1)
  - (Note) Announcements will be made as soon as timing of stepwise target achievement or quantitative prospects are determined, as well as if revisions to the targets or achievement dates become necessary.

3. Immediate Actions

- In order to achieve the above targets, immediate actions were divided into 3 groups with targets set for each of the 5 issues. Various countermeasures will be implemented simultaneously. (see the table in right.)
- In order to achieve Step 1, overcoming the following two issues that are currently being addressed will be critical:

1) Prevention of hydrogen explosion inside the primary containment vessel (hereafter, PCV) (Units 1 to 3.)
- Cooling the reactor by injecting fresh water into the reactor increases the chance of steam condensation, leading to a concern of potentially triggering a hydrogen explosion.

→Nitrogen gas will be injected into the PCV of each unit to keep the concentration of hydrogen and oxygen below flammability limit.

2) Prevention of release of contaminated water with high radiation level outside of the site boundary (Unit 2.)
- While cooling the reactor by injecting fresh water, accumulation of contaminated water with high radiation level in the turbine building is increasing (possible release to outside of the site boundary.)

→Actions will be taken against accumulated water to (1) secure several storage places and (2) install facilities to process the contaminated water and reduce the radiation dose, among others.

Roadmap for Immediate Actions

Areas	Issues	Targets and Countermeasures: Step 1	Targets and Countermeasures: Step 2
I. Cooling	(1) Cooling the Reactors	① **Maintain stable cooling** • Nitrogen gas injection • Flooding up to top of active fuel • Examination and implementation of heat exchange function ② **(Unit 2) Cool the reactor while controlling the increase of accumulated water until the PCV is sealed**	③ **Achieve cold shutdown condition (sufficient cooling is achieved depending on the status of each unit.)** • Maintain and reinforce various countermeasures in Step 1
I. Cooling	(2) Cooling the Spent Fuel Pools	④ **Maintain stable cooling** • Enhance reliability of water injection • Restore coolant circulation system • (Unit 4) Install supporting structure	⑤ **Maintain more stable cooling function by keeping a certain level of water.** • Remote control of coolant injection operation • Examination and implementation of heat exchange function
II. Mitigation	(3) Containment, Storage, Processing, and Reuse of Water Contaminated by Radioactive Materials (Accumulated Water)	⑥ **Secure sufficient storage place to prevent water with high radiation level from being released out of the site boundary.** • Installation of storage/processing facilities ⑦ **Store and process water with low radiation level** • Installation of storage facilities/decontamination processing	⑧ **Decrease the total amount of contaminated water.** • Expansion of storage/processing facilities • Decontamination/Desalt processing (reuse), etc.
II. Mitigation	(4) Mitigation of Release of Radioactive Materials to Atmosphere and from Soil	⑧ **Prevent scattering of radioactive materials on buildings and ground** • Dispersion of inhibitor • Removal of debris • Installing reactor building cover	⑨ **Cover the entire buildings (as temporary measure).**
III. Monitoring/ Decontamination	(5) Measurement, Reduction and Announcement of Radiation Dose in Evacuation Order/Planned Evacuation/ Emergency Evacuation Preparation Areas	⑩ **Expand/enhance monitoring and inform of results fast and accurately** • Examination and implementation of monitoring methods	⑪ **Sufficiently reduce radiation dose in evacuation order / planned evacuation / emergency evacuation preparation areas** • Decontamination/monitoring of municipal residences.
		(Note) With regard to radiation dose monitoring and reduction measures in evacuation order/planned evacuation/emergency evacuation preparation areas, we will take every measure through thorough coordination with the national government and by consultation with the prefectural and municipal governments.	

Attachment ①

Roadmap towards Restoration from the Accident at Fukushima Daiichi Nuclear Power Station

Basic Policy: By bringing the reactors and spent fuel pools to a stable cooling condition and mitigating the release of radioactive materials, we will make every effort to enable evacuees to return to their homes and for all citizens to be able to secure a sound life.

Areas	Issues	Current Status (as of April 16th)	Targets, Countermeasures and Risks <Step 1 (around 3 months)> Radiation dose is in steady decline.	Targets, Countermeasures and Risks <Step 2 (around 3 to 6 months*)> Release of radioactive materials is under control and radiation dose is being significantly held down. * After achieving Step 1	Mid-term Issues
I. Cooling	(1) Cooling the Reactors	**Current Status [1] (Units 1 to 3) Cooling achieved by water injection while there is partial damage to fuel pellets.** ●Continued injection of fresh water and further cooling measures are required. Countermeasure [1]: Injecting fresh water into the RPV by pumps. [illegible] Countermeasure [2]: Injecting nitrogen gas into the PCV (start from Unit 1). Countermeasure [3]: Consideration of flooding the PCV up to the top of active fuel. **Current Status [2] (Units 1 to 3) High likelihood of small leakage of steam containing radioactive materials through the gap of PCV caused by high temperature.** ●Lowering the amount of steam through cooling and evidence of [illegible] required. Countermeasure [4]: [illegible] Countermeasure [5]: Consideration of [illegible] the leakage by covering the reactor building (coordinate with issue [4]). **Current Status [3] (Unit 2) Large amount of water leakage, indicating high likelihood of PCV damage.** ●Repairing the damaged location is required. ●Need to control the amount of water injection since leakage increases as injection increases. Countermeasure [6]: Consideration of sealing the damaged location (e.g., filling with grout [illegible]). Countermeasure [7]: Cooling at minimum water injection rate to control the leakage of contaminated water. Risk [1]: [illegible] (countermeasures [12] and [14]) **Current Status [4] Secured multiple off-site power (1 system each from TEPCO and Tohoku EPCO) and deployed backup power (generator cars / emergency generators)** Risk [2]: Possibility of (partial) loss of power [illegible] Countermeasure [8]: Install interconnecting lines of offsite power [illegible]	**Target [1] (Unit 1 to 3) Maintain stable cooling.** Countermeasure [9]: Flood the PCV up to the top of active fuel. Countermeasure [10]: Reduce the amount of radioactive materials [illegible] release of steam containing radioactive materials into the atmosphere. Countermeasure [11]: Continue preventing hydrogen explosion by injecting nitrogen into the PCV. Risk [2]: [illegible] Countermeasure [12]: Consideration and implementation of measures to hold down [illegible] the water leak [illegible] RPV [illegible] accumulated water in the reactor buildings. Countermeasure [13]: Consideration of recovering heat exchange function for the reactor (installing heat exchangers). Risk [3]: Possibility of prolonged work in high dose level areas (countermeasures [9] and [12]). **Target [2] (Unit 2) Cool the reactor while controlling the increase of accumulated water until PCV is sealed.** Countermeasure [14]: Continue cooling by current minimum injection rate. Countermeasure [15]: Continue prevention of hydrogen explosion by nitrogen injection into the PCV. Countermeasure [16]: Continue consideration and implementation of sealing measures at damaged location. Implement cooling measures similar to those for Units 1 and 3 once the damaged location is sealed. Risk [4]: [illegible] (countermeasures [15] and [16])	**Target [3] Achieve cold shutdown condition (sufficient cooling is achieved depending on the status of each unit.)** Countermeasure [17]: Maintain and enhance countermeasures in Step 1 if needed.	**Issue [1]** Prevention of breakage, clogging and water leakage of structural materials (reactor and pipes, etc.) due to corrosion caused by salt.

Note: Reactor pressure vessel is described as "RPV" and primary containment vessel is described as "PCV".

<table>
<tr><th rowspan="2">Areas</th><th rowspan="2">Issues</th><th rowspan="2">Current Status (as of April 16th)</th><th colspan="2">Targets, Countermeasures and Risks</th><th rowspan="2">Mid-term Issues</th></tr>
<tr><th><Step 1 (around 3 months)>
Radiation dose is in steady decline.</th><th><Step 2 (around 3 to 6 months*)>
Release of radioactive materials is under control and radiation dose is being significantly held down.
* After achieving Step 1</th></tr>
<tr><td>I. Cooling</td><td>(2) Cooling the Spent Fuel Pools</td><td>Current Status [5] Fresh water is injected from outside for Units 1, 3, 4 and through normal cooling line for Unit 2.
*Reduction of water exposure and countermeasures for aftershocks are required
Countermeasure [18]: Consideration/implementation of improving reliability of external water injection by concrete pumpers ("Giraffe", etc.)/switch to remote-controlled operation.
Current Status [6]: Confirmation of release of radioactive materials from the pool
Countermeasure [19]: Sampling and measurement of steam/pool water by "Giraffe", etc.
*Most fuels in Unit 4 have been confirmed intact according to the result of pool water analysis.
Current Status [7]: Walls of the building supporting the pool have been damaged.
*Tolerance evaluation is especially needed for Unit 4.
Countermeasure [20]: Seismic tolerance assessment of Unit 4.
*A certain level of seismic tolerance has been confirmed
Countermeasure [21]: Continue monitoring and examine necessary countermeasures. (→ countermeasure [26])</td><td>Target [4]: Maintain stable cooling.
Countermeasure [22]: Continuation of water injection by "Giraffe", etc. (reliability improvement (enhanced durability of hoses)/switch to remote-controlled operation.)
Countermeasure [23]: Add cooling function to normal Fuel Pool Cooling system and continue injecting water for Unit 2.
Countermeasure [24]: Examination and implementation of restoration of normal cooling system for Units 1, 3, and 4
Risk [8]: Possibility of inability to restore normal cooling function due to damages to the building
Countermeasure [25]: Examination and implementation of installing heat exchangers.
Countermeasure [26]: (Unit 4) Installation of supporting structure under the bottom of the pool</td><td>Target [5]: Maintain more stable cooling function by keeping a certain level of water.
Countermeasure [27]: Cooling by installation of heat exchangers
Countermeasure [28]: Expansion of remote-controlled operation areas of "Giraffe", etc.</td><td>Issue [2]: Removal of fuels (Including Units 5 & 6.)</td></tr>
<tr><td>II. Mitigation</td><td>(3) Containment, Storage, Processing, and Reuse of Water Contaminated by Radioactive Materials (Accumulated Water)</td><td>Current Status [8]: Leakage of high radiation-level contaminated water assumed to have originated from Unit 2 reactor occurred, but was subsequently stopped.
Countermeasure [29]: Identify leakage path and examine and implement preventive measures
- [illegible]
- Installing fences in the bay to prevent contamination from spreading (silt fence)
- Blockage between trenches and buildings, etc.
Current Status [9]: Leakage and accumulation of high radiation level contaminated water at Unit 2's turbine building, vertical shafts and trenchs.
Countermeasure [30]: Transferring accumulated water to facilities that can store it (condenser and Centralized Waste Treatment Facility).
Countermeasure [31]: Preparing decontamination and desalt of transferred accumulated water. (→Countermeasure [38])
Countermeasure [32]: Preparing to install tanks
Current Status [10]: Increase of storage volume of water with low radiation level.
Countermeasure [33]: Preparing to store with tanks and barges
Countermeasure [34]: Preparing for decontamination and desalt of contaminated water (→Countermeasure [41])
Countermeasure [35]: Preparing to install a reservoir.
Current Status [11]: High likelihood of underground water around the building (sub-drainage water) to be contaminated.
Countermeasure [36]: Preparing to decontaminate sub-drainage water after being pumped up</td><td>Target [6]: Secure sufficient storage place to prevent water with high radiation level from being released out of the site boundary.
Countermeasure [37]: Utilization of "Centralized Waste Treatment Facility", etc. to store water
Countermeasure [38]: Install water processing facilities; decontaminate and desalt highly contaminated water and store in tanks.
Risk [9]: Possibility of delay in installing water processing facilities or poor operating performance of the facilities.
Countermeasure [39]: Examination and implementation of backup measures (installment of additional tanks or pools or leakage prevention by coagulator, etc.)
Target [7]: Store and process water with low radiation level.
Countermeasure [40]: Increase storage capacity by adding tanks, barges, Megafloat, etc.
Countermeasure [41]: Decontaminating contaminated water using decontaminants to below acceptable criteria</td><td>Target [8]: Decrease the total amount of contaminated water.
Countermeasure [42]: Expansion of additional tanks to store high radiation-level contaminated water
Countermeasure [43]: Continuation and reinforcement of decontamination and desalt of high radiation level water.
Countermeasure [44]: Continuation and reinforcement of decontamination and desalt of low radiation-level water
Countermeasure [45]: Reuse of processed water in reactor coolant
Countermeasure [46]: Decontamination to the level below criteria level.</td><td>Issue [3] Installation of full-fledged water treatment facilities.</td></tr>
</table>

Areas	Issues	Current Status (as of April 16th)	Targets, Countermeasures and Risks <Step 1 (around 3 months)> Radiation dose is in steady decline.	<Step 2 (around 3 to 6 months*)> Release of radioactive materials is under control and radiation dose is being significantly held down. * After achieving Step 1	Mid-term Issues
II. Mitigation	(4) Mitigation of Release of Radioactive Materials to Atmosphere and from Soil	**Current Status [12]: Debris are scattered outside the buildings and radioactive materials are being scattered.** Countermeasure [47]: Inhibit [illegible] of radioactive materials by full-scale [illegible] of inhibitor after confirming its performance by test. Countermeasure [48]: Prevent rain water contamination by [illegible] of inhibitor. Countermeasure [49]: Removal of debris. Countermeasure [50]: Examination and implementation of basic design for reactor building cover and full-fledged measure (container with concrete roof and wall, etc.) Countermeasure [51]: Consideration of solidification, substitution and cleaning of contaminated soil (by [illegible])	**Target [9]: Prevent scattering of radioactive materials on buildings and ground.** Countermeasure [52]: Improvement of [illegible] by expanding application and dispersion of inhibitors to the ground and buildings. Countermeasure [53]: Continue removal of debris. Countermeasure [54]: Begin installing reactor building cover (with ventilator and filter.) ([illegible] considerable reduction of radiation [illegible] to launch [illegible] countermeasure [52] and [53].)	**Target [10]: Cover the entire buildings (as temporary measure).** Countermeasure [55]: Complete installing reactor building covers (Units 1, 3, 4.) ([illegible]) Countermeasure [56]: Begin detailed design of full-fledged measure (container with concrete roof and wall, etc.)	**Issue [4]: Cover the entire building (as full-fledged measure)** Issue [5]: Solidification, [illegible] and cleaning of contaminated soil.
III. Monitoring/ Decontamination	(5) Measurement, Reduction and Announcement of Radiation Dose in Evacuation Order/Planned Evacuation/Emergency Evacuation Preparation Areas	**Current status [13]: Monitoring of radiation dose in and out of the power station is carried out.** Countermeasure [57]: Monitoring sea water, soil and [illegible] within the site boundary ([illegible] locations.) Countermeasure [58]: Monitoring radiation dose at the site boundary ([illegible] locations.) Countermeasure [59]: Consideration of monitoring methods in [illegible] order/planned evacuation/emergency evacuation preparation areas. (countermeasure [60] to [62])	**Target [11]: Expand/enhance monitoring and inform of results fast and accurately.** Countermeasure [60]: Consideration and implementation of monitoring methods in evacuation order / planned evacuation / emergency evacuation preparation areas. (in cooperation and consultation with national/ prefectural/municipal governments.) Countermeasure [61]: Announce accurately monitoring results of long half-life residue radioactive materials such as cesium 137	**Target [12]: Sufficiently reduce radiation dose in evacuation order / planned evacuation / emergency evacuation preparation areas.** Countermeasure [62]: Monitoring of [illegible] residents (in cooperation and consultation with national / prefectural / municipal governments.) Countermeasure [63]: Examination and implementation of necessary measures to reduce radiation dose (decontamination of [illegible] and soil, etc.) (in cooperation and consultation with national/ prefectural/municipal governments.)	Issue [6]: Continue [illegible] and [illegible] environmental safety.

(Note) With regard to radiation dose monitoring and reduction measures in evacuation order/planned evacuation/emergency evacuation preparation areas, we will take every measure through thorough cooperation with the national government and by consultation with the prefectural and municipal governments.

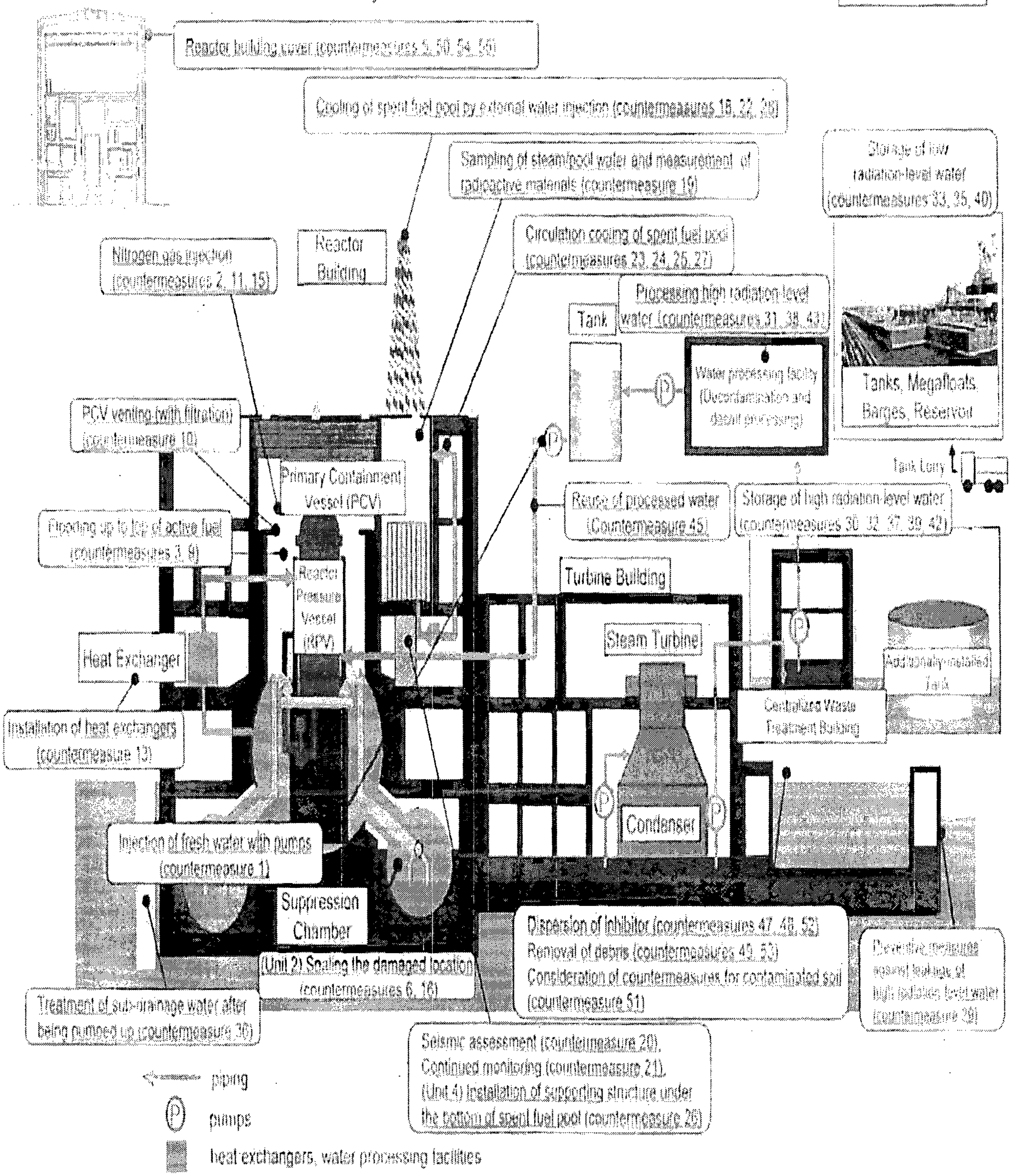
Roadmap for Immediate Actions (Issues / Targets / Major Countermeasures)

Reference 1

		Current Status	STEP1	STEP1 target	STEP2	STEP2 target	Mid-term Issues
I. Cooling	(1) Reactors	Injecting fresh water	Nitrogen gas injection (Unit1·3) Flooding up to top of active fuel Examination and implementation of heat exchange function (Unit 2) Sealing the damaged location	Stable cooling	Flooding up to top of active fuel	[illegible]	Prevention of breakage of structural materials, etc.
	(2) Spent Fuel Pools	Injecting fresh water	Enhance reliability of water injection Restore coolant circulation system (Unit 4) Install supporting structure	Stable cooling	Remote control of water injection Examination and implementation of heat exchange function	More stable cooling	Removal of fuels
II. Mitigation	(3) Accumulated Water	Transferring water with high radiation level Storing water with low radiation level	Installation of storage / processing facilities Installation of storage facilities / decontamination processing	Secure storage place	Expansion of storage / processing facilities Decontamination / Desalt processing (reuse), etc	Decrease contaminated water	Installation of full-fledged water treatment facilities
	(4) Atmosphere / Soil		Dispersion of inhibitor Removal of debris Installing reactor building cover		Dispersion of inhibitor Removal of debris Installing reactor building cover		Installation of reactor building cover (container with concrete) Solidification of contaminated soil, etc.
III. Monitoring / Decontamination	[illegible]	Monitoring of radiation dose in and out of the power station	Expand/enhance monitoring and inform of results fast and accurately		Sufficiently reduce radiation dose in evacuation order / planned evacuation / emergency evacuation preparation areas		Continue monitoring and informing environmental safety

Overview of Major Countermeasures in the Power Station

Reference 2



Wittick, Brian

From: Wittick, Brian
Sent: Monday, April 18, 2011 2 12 AM
To: Casto, Chuck
Cc: Reynolds, Steven
Subject: Cabinet cancellation

Met with Suzanne. She will get Econ to cancel and provide feedback

VR

Sent from NRC BlackBerry
Brian Wittick

(b)(6)

BBB\130

Wittick, Brian

From: Wittick, Brian
Sent: Monday, April 18, 2011 8:36 AM
To: Reynolds, Steven
Subject: Re: need an interpreter for meeting to discuss TEPCO Roadmap - Tuesday at noon

It is scheduled

Sent from NRC BlackBerry
Brian Wittick
(b)(6)

----- Original Message -----
From: Reynolds, Steven
To: Wittick, Brian
Sent: Mon Apr 18 07:43:32 2011
Subject: need an interpreter for meeting to discuss TEPCO Roadmap - Tuesday at noon

Brian,

Tomorrow (Tuesday, April 19th) there will be a meeting with NISA (and maybe TEPCO and others?) to discuss the TEPCO Roadmap. Chuck, Steve Garchow, and I will attend. The meeting is at noon in the TEPCO building in room 1230 (12th floor). Mr. Hosano will be running the meeting.

We will need an interpreter for this meeting.

thanks,
Steve

BBB/131

Wittick, Brian

From: Wittick, Brian
Sent: Monday, April 18, 2011 7:27 PM
To: Wittick, Brian; 'bannai-toshihiro@meti.go.jp', 'satoh takashi@tepco.co.jp'; 'nei-hisanori@meti.go.jp'; 'oshima-toshiyuki@meti.go.jp'; 'koyama-masaomi@meti.go.jp'
Cc: Casto, Chuck; Reynolds, Steven; 'y-uemura@simul.co.jp'
Subject: RE: NRC Meetings for 19 April 2011
Attachments: NRC Meetings 19-April-2011.docx

Dear Bannai-san and Satoh-san,

Please find the schedule for NRC meetings today (attached). If you have any questions or concerns, please let me know.

Best regards,

Brian Wittick
U.S. Nuclear Regulatory Commission
Japan Team International Liaison
Tel: 81-33-22-45-066
(b)(6)

B33/132

U.S. Nuclear Regulatory Commission Meetings
Tuesday, 19 April 2011

Time	Organization-Topic	Location
1100	NISA & TEPCO - Daily Status	TEPCO
1200	NISA – Senior Level	TEPCO
1600	NISA/JNES	METI

Huffert, Anthony

From: Huffert, Anthony
Sent: Monday, April 18, 2011 1:04 AM
To: Holahan, Vincent
Cc: Gepford, Heather; Meighan, Sean
Subject: RE: PACOM LNO

Hi Vince,

I'd like to call you when there is a free moment and compare notes – still working on making that time slot available – hopefully soon.
My cell phone number is correct. Thanks for providing yours.
The other NRC HPs here at the embassy are Heather Gepford (R2) and Sean Meighan (NRR).
It's currently 1400 Monday (0100 EDT).
Best,
Tony

From: Holahan, Vincent
Sent: Sunday, April 17, 2011 8:01 PM
To: Huffert, Anthony
Cc: Hoc, PMT12
Subject: PACOM LNO

Hi Tony,

I figure that you are probably checking your email and it would be easier to make contact this way rather than try to catch up with you between Monday morning meetings. Still Sunday afternoon in Honolulu.

Michelle Hart gave me your cell number (b)(6)

Mine is: (b)(6)

Let me know when you want to chat.

It is currently 1500 hrs HST (2100 hrs EDT)

Cheers,
Vince

888\133

Wittick, Brian

From: Wittick, Brian
Sent: Tuesday, April 19, 2011 7:33 AM
To: Emche, Danielle
Cc: Foggie, Kirk
Subject: RE: Lunch with Mr Mitsumata of METI

Thanks Danielle. Bannai said he was close to Nei's level.

-----Original Message-----
From: Emche, Danielle
Sent: Tuesday, April 19, 2011 7:31 AM
To: Wittick, Brian
Cc: Foggie, Kirk; Bloom, Steven
Subject: RE: Lunch with Mr.Mitsumata of METI

Under METI, he is in the Agency for Natural Resources and Energy, Department of Electricity and Gas Industry Department, Division Director of Nuclear Energy Planning.

My guess, although he isn't very high level, he will have a perspective about, and role in plans for, the future, i.e., roadmaps, updating their regulatory structure, etc. Another interesting "listening mode" opportunity.

Danielle

-----Original Message-----
From: Wittick, Brian
Sent: Tuesday, April 19, 2011 2:23 AM
To: Emche, Danielle; Foggie, Kirk; LIA02 Hoc; LIA08 Hoc
Subject: Fw: Lunch with Mr.Mitsumata of METI

Request assistance to identify who the below METI Dir is Thanks

Sent from NRC BlackBerry
Brian Wittick
(b)(6)

----- Original Message -----
From: 中川air <nakagawa@ruby.famille.ne.jp>
To: Wittick, Brian
Sent: Mon Apr 18 23:33:33 2011
Subject: Lunch with Mr.Mitsumata of METI

Brian san

Could you be so kind to try the lunch between Casto san, you and Mitumata san of Director of Nuclear Energy Policy Planning Division and me either on 25 (Mon) or 27 (Tue)?

Nakagawa

PBB\134

Wittick, Brian

From: Wittick, Brian
Sent: Tuesday, April 19, 2011 6:53 PM
To: Pace, Patti
Cc: Doane, Margaret; Casto, Chuck; 'AngelovBA@state.gov'; Reynolds, Steven; 'angelovba@state.gov'; 'BasallaSI@state.gov'
Subject: RE: Phone Call for Chairman and Ambassador Roos

Hi Patti,

It was good to speak with you. Bonnie's email address is Cc'd and her phone number is (b)(6)

Bonnie,

Please see Patti's request to set up a phone call with the Ambassador below, along with Patti's phone number.

Thanks
Brian

From: Pace, Patti
Sent: Tuesday, April 19, 2011 6:20 PM
To: Casto, Chuck
Cc: Doane, Margaret; Wittick, Brian
Subject: RE: Phone Call for Chairman and Ambassador Roos

Dear Chuck,

Thanks for your reply. Chairman Jaczko is available this evening and again tomorrow morning, our time. I have not worked with Ambassador Roos' office before. Could you or someone from your team reach out to the Ambassador's office to facilitate scheduling a call for the Chairman and Ambassador?

Many thanks,

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

From: Casto, Chuck
Sent: Tuesday, April 19, 2011 5:40 PM
To: Pace, Patti
Subject: Re: Phone Call for Chairman and Ambassador Roos

I mentioned it to bonnie angelov but nothing was arranged.

Chuck

From: Pace, Patti
To: Casto, Chuck
Cc: Monninger, John

BBB\135

Sent: Tue Apr 19 10:28:39 2011
Subject: Phone Call for Chairman and Ambassador Roos

Dear Mr. Casto,

During the Chairman's briefing call this morning, he asked for a call to be set up for him to speak with Ambassador Roos (for Tuesday evening our time, Wednesday morning your time). Do you know if steps have been taken to initiate the scheduling of this call? If not, I would be happy to take the lead in reaching out to the Ambassador's office through the State Department. I do not want to duplicate efforts if this call is already in the works. Please advise.

Many thanks,

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

Wittick, Brian

From: Wittick, Brian
Sent: Tuesday, April 19, 2011 7:39 AM
To: Bloom, Steven
Subject: RE: Lunch with Mr.Mitsumata of METI

Thanks Steve

-----Original Message-----
From: Bloom, Steven
Sent: Tuesday, April 19, 2011 7:38 AM
To: Wittick, Brian
Cc: Emche, Danielle; Foggie, Kirk
Subject: RE: Lunch with Mr.Mitsumata of METI

MITSUMATA Hiroki
Consulting Fellow (until June 30, 2009) Director, Nuclear Energy Policy Planning Division, Electricity and Gas Industry Department, Agency for Natural Resources and Energy (ANRE) Experience
2009.7 - Director, Nuclear Energy Policy Planning Division, Electricity and Gas Industry Department, Agency for Natural Resources and Energy (ANRE)

From the Rieti Website.

Steve
-----Original Message-----
From: Wittick, Brian
Sent: Tuesday, April 19, 2011 7:14 AM
To: Bloom, Steven
Subject: RE: Lunch with Mr.Mitsumata of METI

If you can find it easily. Otherwise we can make due.

-----Original Message-----
From: Bloom, Steven
Sent: Tuesday, April 19, 2011 7:13 AM
To: Wittick, Brian
Subject: RE: Lunch with Mr.Mitsumata of METI

Brian,

Are you asking for his bio, not sure what you are asking for.

Steve

-----Original Message-----
From: LIA02 Hoc
Sent: Tuesday, April 19, 2011 2:23 AM
To: Bloom, Steven
Subject: FW: Lunch with Mr.Mitsumata of METI

B88/136

From: Wittick, Brian
Sent: Tuesday, April 19, 2011 2:22:48 AM
To: Emche, Danielle; Foggie, Kirk; LIA02 Hoc; LIA08 Hoc
Subject: Fw: Lunch with Mr.Mitsumata of METI
Auto forwarded by a Rule

Request assistance to identify who the below METI Dir is
Thanks

Sent from NRC BlackBerry
Brian Wittick

(b)(6)

---- Original Message ----
From: 中川air <nakagawa@ruby.famille.ne.jp>
To: Wittick, Brian
Sent: Mon Apr 18 23:33:33 2011
Subject: Lunch with Mr.Mitsumata of METI

Brian san

Could you be so kind to try the lunch between Casto san. you and Mitumata san of Director of Nuclear Energy Policy Planning Division and me either on 25 (Mon) or 27 (Tue)?

Nakagawa

Wittick, Brian

From: Wittick, Brian
Sent: Tuesday, April 19, 2011 8:36 AM
To: 'nakagawa@ruby famille.ne.jp'
Subject: Re: Fwd: RE: Lunch with Mr.Mitsumata of METI

Dear Nakagawa-san,

I will inform Chuck Casto tomorrow. Any information you can provide on Mr Mitsumata's discussion interests is greatly appreciated.

Best regards

Sent from NRC BlackBerry
Brian Wittick
(b)(6)

From: nakagawa <nakagawa@ruby.famille.ne.jp>
To: Wittick, Brian
Sent: Tue Apr 19 08:26:30 2011
Subject: Fwd: RE: Lunch with Mr.Mitsumata of METI

Brian san

Let's agree on 25th. 12:15 at the lobby of Okura hotel.

Nakagawa

-------- Original Message --------
Subject:RE: Lunch with Mr.Mitsumata of METI
Date: Tue, 19 Apr 2011 06:18:01 -0400
From: Wittick, Brian <Brian.Wittick@nrc.gov>
To:'??air' <nakagawa@ruby.famille.ne.jp>

Dear Nakagawa-san,

It is always a pleasure to hear from you. I spoke to Chuck Casto and he will be honored to attend lunch with Mitsumata-san. Request clarification of which days are acceptable.

We look forward to our visit.

Best regards,
Brian Wittick

-----Original Message-----
From: 中川air [mailto:nakagawa@ruby.famille.ne.jp]
Sent: Monday, April 18, 2011 11:34 PM
To: Wittick, Brian
Subject: Lunch with Mr.Mitsumata of METI

Brian san

BBB/137

Could you be so kind to try the lunch between Casto san, you and Mitumata san of Director of Nuclear Energy Policy Planning Division and me either on 25 (Mon) or 27 (Tue)?

Nakagawa

Wittick, Brian

From: Wittick, Brian
Sent: Tuesday, April 19, 2011 8:24 PM
To: 'bannai-toshihiro@meti.go.jp'; 'satoh.takashi@tepco.co.jp'; 'nei-hisanori@meti.go.jp'; 'oshima-toshiyuki@meti.go.jp'; 'koyama-masaomi@meti.go.jp'
Cc: Casto, Chuck; Reynolds, Steven; 'y-uemura@simul.co.jp'
Subject: NRC Meetings for 20 April 2011

Dear Bannai-san and Satoh-san,

Due to computer difficulties I am listing the meeting schedule for today below:

Time	Activity	Location
1030	Radiological Monitoring Working Group	MEXT
1100	Daily Status	TEPCO
1500	Assist List Discussions	Kantei

If you have any questions or concerns, please let me know.

Best regards,

Brian Wittick
U.S. Nuclear Regulatory Commission
Japan Team International Liaison
Tel: 81-33-22-45-066

(b)(6)

BBB/138

51

Huffert, Anthony

From: Huffert, Anthony
Sent: Wednesday, April 20, 2011 8:27 PM
To: Gepford, Heather; Meighan, Sean; Reynolds, Steven
Subject: PACOM LNO

Heather, Sean and Steve,

Below is contact info for Dr. Vince Holahan (NRC staff) assigned to PACOM.

I recommend that we send Vince the agenda for the mtg at Yokota tomorrow, along with an answer to his question about the lead Fed agency.

With the time difference between here and Hawaii, could we respond to him this morning?

Tony

From: Holahan, Vincent
Sent: Sunday, April 17, 2011 9:01 PM
To: Huffert, Anthony
Cc: Hoc, PMT12
Subject: PACOM LNO

HI Tony,

I figure that you are probably checking your email and it would be easier to make contact this way rather than try to catch up with you between Monday morning meetings. Still Sunday afternoon in Honolulu.

Michelle Hart gave me your (b)(6)

Mine is (b)(6)

Let me know when you want to chat.

It is currently 1500 hrs HST (2100 hrs EDT)

Cheers,
Vince

888\139

Greenwood, Carol

From: Gibson, Kathy
Sent: Wednesday, April 20, 2011 6:46 PM
To: Flory, Shirley
Subject: RE: COMPARATIVE RISK ASSESSMENT: FUEL STORAGE IN SFP vs. DRY CASK

Isn't this supposed to be Monday, April 25 from 10-11?

Kathy Halvey Gibson
Director
Division of Systems Analysis

Kathy.Gibson@nrc.gov
(301) 251-7499 (Work)
(b)(6)

Kathy Halvey Gibson.vcf

-----Original Appointment-----
From: Flory, Shirley
Sent: Wednesday, April 20, 2011 5:39 PM
To: Sheron, Brian; Esmaili, Hossein; Helton, Donald; Murphy, Andrew; Lee, Richard; Hogan, Rosemary; Coyne, Kevin; Gibson, Kathy; Scott, Michael; Correia, Richard; Coe, Doug; Case, Michael; Richards, Stuart; Tinkler, Charles; Santiago, Patricia; Armstrong, Kenneth
Cc: Uhle, Jennifer; Hudson, Daniel; Stutzke, Martin
Subject: COMPARATIVE RISK ASSESSMENT: FUEL STORAGE IN SFP vs. DRY CASK
When: Wednesday, April 27, 2011 10:00 AM-11:00 AM (GMT-05:00) Eastern Time (US & Canada).
Where: C- 5C19

Hossein: If this date/time does not work for you, please let me know and I will try again, but I would probably have to re-schedule to the week of May 2. I was trying to accommodate Brian's and Kathy's schedule. Mike S. is on travel all next week.

Thanks – Shirley
301-251-7400

UPDATED per conversation with Pat. Saf 4/20

BBB\140

Huffert, Anthony

From: Huffert, Anthony
Sent: Wednesday, April 20, 2011 1:48 AM
To: Gepford, Heather; Meighan, Sean
Subject: FW: Nuclear contamination testing - U.S. company wants Embassy contact names

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From: Berger, Claire [mailto:BergerMC@state.gov]
Sent: Friday, April 15, 2011 12:41 AM
To: Howard, E. Bruce
Cc: Cherry, Ronald C; Duncan, Aleshia D; Huffert, Anthony; Gepford, Heather; Basalla, Suzanne I; Walcott, Naomi; Wiggin, Geoffrey W; Helen Peterson; Casto, Chuck; Spurlock, Kenneth CAPT USN MDAO; Cooper, Justin D; Berger, William
Subject: Nuclear contamination testing - U.S. company wants Embassy contact names

Bruce,

The Embassy Operator put through a call from Mr. Raymond Willis whose company, Summit Environmental Technologies, has been selected by JETRO to conduct nuclear contamination testing on Japan's food, waste oil, etc.

JETRO met with them in the U.S. this week, and will meet again there next week with them. Summit plans to start setting up labs in Japan w/in the next 30 days.

Mr. Willis would like to make contact w/ persons here at the Embassy, as well as other American companies/agencies in Japan, involved in this.

Best contacts for him are (b)(6) and personal email (b)(6)

Claire Berger
Economic Section OMS
Embassy Tokyo
(81-3) 3224-5022
BergerMC@state.gov

-----Original Message-----
From: Raymond Willis (b)(6)
Sent: Friday, April 15, 2011 1:05 PM
To: Berger, Claire
Subject: Initial contact for Summit Labs

Clair,
Thanks much. I look forward to hearing for you and others regarding Embassy or other Americans dealing with health, Environmental and other agencies regarding the nuclear contamination testing. As I indicated we are working with JETRO here and anticipate being in japan in the near future. I want to establish contact between you and other executives in Summit.

Please send return note indicating that you have received this.

Thanks much,

808\141

Ray Willis

[redacted]
(b)(6)

Raymond A. Willis

[redacted]
(b)(6)

SBU
This email is UNCLASSIFIED

Wittick, Brian

From: Wittick, Brian
Sent: Wednesday, April 20, 2011 6:33 AM
To: 'y-uemura@simul.co.jp'
Cc: 'smckenna@ofda.gov'
Subject: Re Interpreter for April 21st

Dear Yoriko-san,

Thank you for the information. We look forward to seeing the ladies as always.

Kind regards
Brian

Sent from NRC BlackBerry
Brian Wittick
(b)(6)

----- Original Message -----
From: 上村 依子 <y-uemura@simul.co.jp>
To: Wittick, Brian
Cc: 'McKenna, Surin (DCHA/OFDA)' <smckenna@ofda.gov>
Sent: Wed Apr 20 05:48:47 2011
Subject: RE: Interpreter for April 21st

Dear Brian-san,

Thank you for your call and email.

We have made an arrangement as below for tomorrow,

<Ms. Ohno>
15:00 Visit the Embassy
16:00 METI
19:00 Kantei Mtg.

As for Kantei Mtg., I have talked with Ms. Nagai.
She was worried about it because it will be the first meeting after the "operation schedule" has been released.
So, she would like to go there and support Ms. Ohno in the meeting.
You don't have to worry about the fee for that.
She really appreciate your support and is always willing to work for you.

I hope the arrangement above is okay with you.

Best regards,
Yoriko

BBB\142

==
上村（うえむら）依子／コミュニケーション事業部

(株)サイマル・インターナショナル
http://www.simul.co.jp <http://www.simul.co.jp/>
TEL: 03-3524-3177(直通)　FAX: 03-3524-3105
〒104-0045
東京都中央区築地1-12-6　築地えとビル5階

From: Wittick, Brian [mailto:Brian.Wittick@nrc.gov]
Sent: Wednesday, April 20, 2011 6:11 PM
To: 上村 依子
Cc: 'McKenna, Surin (DCHA/OFDA)'
Subject: RE: Interpreter for April 21st

Dear Yoriko-san,

To confirm our conversation, we do not need an interpreter for an 1100 meeting tomorrow. In the future, the 1100 meetings at TEPCO will only be Monday, Wednesday, and Friday. So, Thursday's meetings will include:

1600 METI

1900 Kantei

Thank you,

Kind regards,

Brian

From: 上村 依子 [mailto:y-uemura@simul.co.jp]
Sent: Wednesday, April 20, 2011 3:27 AM
To: Wittick, Brian
Subject: RE: Interpreter for April 21st

==

上村（うえむら）依子／コミュニケーション事業部
(株)サイマル・インターナショナル
http://www.simul.co.jp <http://www.simul.co.jp/>
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〒104-0045
東京都中央区築地1-12-6　築地えとビル5階

From: Wittick, Brian [mailto:Brian.Wittick@nrc.gov]
Sent: Tuesday, April 19, 2011 10:04 AM
To: 上村 依子
Subject: RE: Interpreter for April 19th & 20th

Dear Yoriko-san,

The 1900 has been cancelled for today.

For tomorrow, we have a conflict needing 2 interpreters in the morning.

The meeting schedule is

1030 MEXT

1100 TEPCO

1500 Kantei

Thanks

Brian

From: 上村 依子 [mailto:y-uemura@simul.co.jp]
Sent: Monday, April 18, 2011 8:58 PM
To: Wittick, Brian
Subject: RE: Interpreter for April 19th & 20th

Thank you

Brian

From: 上村 依子 [mailto:y-uemura@simul.co.jp]
Sent: Wednesday, April 20, 2011 3:02 AM
To: Wittick, Brian
Subject: RE: Interpreter for April 21st

Dear Brian-san,

Thank you for the information.

Do you know when the next 1900 Kantei meeting will take place?

If it's going to take place tomorrow night, I will adjust Ms. Nagai's schedule accordingly.

For tomorrow, we have assigned Ms. Ohno for working 9-17.

Please see the attached schedule for the latest arrangement.

Thank you!

Best regards,

Yoriko

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上村（うえむら）依子／コミュニケーション事業部
(株)サイマル・インターナショナル
http://www.simul.co.jp <http://www.simul.co.jp/>
TEL: 03-3524-3177(直通)　FAX: 03-3524-3105
〒104-0045
東京都中央区築地1-12-6　築地えとビル5階
————————————————————

From: Wittick, Brian [mailto:Brian.Wittick@nrc.gov]
Sent: Tuesday, April 19, 2011 7:25 PM
To: 上村 依子
Subject: RE: Interpreter for April 19th & 20th

The 1500 meeting tomorrow at the Kantei is the same as the meeting held last Wednesday at 1500, concerning review of assistance offers to Japan.

Kind regards,

Brian

From: 上村 依子 [mailto:y-uemura@simul.co.jp]
Sent: Monday, April 18, 2011 9:44 PM
To: Wittick, Brian
Subject: RE: Interpreter for April 19th & 20th

Dear Brian-san,

Thank you for the latest information.

I told Ms. Nagai about the cancellation of Kantei meeting tonight.

Is the 1500 meeting tomorrow the same "Kantei" meeting cancelled tonight?

As for tomorrow, I will assign an extra interpreter for 10:30 with MEXT.

She will visit the Embassy at 10:00.

Thank you.

Best regards,

Yoriko

==
上村（うえむら）依子／コミュニケーション事業部
(株)サイマル・インターナショナル
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東京都中央区築地1-12-6　築地えとビル5階

From: Wittick, Brian [mailto:Brian.Wittick@nrc.gov]
Sent: Tuesday, April 19, 2011 10:04 AM
To: 上村 依子
Subject: RE: Interpreter for April 19th & 20th

Dear Yoriko-san,

The 1900 has been cancelled for today.

For tomorrow, we have a conflict needing 2 interpreters in the morning.

The meeting schedule is

1030 MEXT

1100 TEPCO

1500 Kantei

Thanks

Brian

From: 上村 依子 [mailto:y-uemura@simul.co.jp]
Sent: Monday, April 18, 2011 8:58 PM
To: Wittick, Brian
Subject: RE: Interpreter for April 19th & 20th

Dear Brian,

Ohayo gozaimasu

Thank you for the information!

Best regards,

Yoriko

==
上村（うえむら）依子／コミュニケーション事業部
(株)サイマル・インターナショナル
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〒104-0045
東京都中央区築地1-12-6　築地えとビル5階

From: Wittick, Brian [mailto:Brian.Wittick@nrc.gov]
Sent: Monday, April 18, 2011 7.27 PM
To: 上村 依子
Subject: RE: Interpreter for April 19th & 20th

Dear Yoriko

Thank you for the update. We have a busy day scheduled for tomorrow. Wit meetings at:

1100 TEPCO/NISA

1230 TEPCO/NISA

1600 NISA

1900 KANTEI

Kind regards

Brian

From: 上村 依子 [mailto:y-uemura@simul.co.jp]
Sent: Monday, April 18, 2011 5:03 AM
To: Wittick, Brian
Cc: 'McKenna, Surin (DCHA/OFDA)'
Subject: Interpreter for April 19th & 20th

Dear Brian-san,

Thank you for your call and email regarding the cancellation.

We have assigned Ms. Morioka for 19th and Ms. Nagai for 20th.

Ms. Nagai will also work for Kantei meeting @19:00 tomorrow.

Please refer to the attached schedule.

Thank you!

Best regards,

Yoriko

==
上村（うえむら）依子／コミュニケーション事業部
(株)サイマル・インターナショナル
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〒104-0045
東京都中央区築地1-12-6　築地えとビル5階

From: Wittick, Brian [mailto:Brian.Wittick@nrc.gov]
Sent: Saturday, April 16, 2011 9:47 AM

To: 上村 依子
Cc: 'McKenna, Surin (DCHA/OFDA)'
Subject: RE: Interpreter for April 16th&17th

Dear Yoriko-san,

This is to confirm our conversation that we do not require interpreter services for the rest of the weekend. Interpreters will be needed again on Monday.

Kind regards,

Brian

From: 上村 依子 [mailto:y-uemura@simul.co.jp]
Sent: Friday, April 15, 2011 4:21 AM
To: Wittick, Brian
Subject: Interpreter for April 16th&17th

Dear Brian-san,

As I informed you before, we have assigned Ms. Sumita for 9-17 this weekend.

She will visit the Embassy @9:00.

If any change of the arrangement is required, please let me know.

I won't be able to check my office PC during weekend.

Please call my cell phone when you need an extra interpreter this weekend.

My number is (b)(6)

Thank you.

Best regards,

Yoriko

===
上村（うえむら）依子／コミュニケーション事業部
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From: Wittick, Brian [mailto:Brian.Wittick@nrc.gov]
Sent: Thursday, April 14, 2011 6:07 PM
To: 上村 依子
Subject: RE: Interpreter for April 15th

Thank you.

From: 上村 依子 [mailto:y-uemura@simul.co.jp]
Sent: Thursday, April 14, 2011 5:01 AM
To: Wittick, Brian
Cc: 'tanabeyx@state.gov'; 'smckenna@ofda.gov'
Subject: RE: Interpreter for April 15th

Dear Brian-san,

Thank you for your updated information.

I added the interpreters' name to each meeting.

1. Nagai

11:00- @ TEPCO

2. Nagai

13:30- @TEPCO

3. Ohno

14:00- @NISA

4. Nagai

15:00- Kantei Building

5. Ohno

16:00- with NISA

6. Nagai

17:30- with NISA

Ms. Nagai will visit the Embassy at 9:00 tomorrow like she did today.

Ms. Ohno will also visit the Embassy at 13:30.

I updated the schedule of interpreters as attached.

Thank you.

Best regards,

Yoriko

===
上村（うえむら）依子／コミュニケーション事業部
(株)サイマル・インターナショナル
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〒104-0045
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From: Wittick, Brian [mailto:Brian.Wittick@nrc.gov]
Sent: Thursday, April 14, 2011 5:35 PM
To: 上村 依子
Cc: 'tanabeyx@state.gov'; 'smckenna@ofda.gov'
Subject: RE: Interpreter for April 15th

Dear Yoriko,

This is correct that we need a second interpreter to cover the afternoon meetings tomorrow.

Please let me know what the plan will be for the interpreters to meet up for each of the groups.

If there are questions or issues during the day, my phone number is [redacted] (b)(6)

Thank you,

Brian Wittick

From: 上村 依子 [mailto:y-uemura@simul.co.jp]
Sent: Thursday, April 14, 2011 3:00 AM
To: Wittick, Brian
Cc: 'tanabeyx@state.gov'; Stahl, Eric; 'smckenna@ofda.gov'
Subject: Interpreter for April 15th

Dear Brian-san,

Ms. Nagai has just informed me of the schedule of 15th as below

1.

11:00- @ TEPCO

2.

13:30- @TEPCO

3.

14:00- @NISA

4.

15:00- Kantei Building

5.

16:00- with NISA

6.

17:30- with NISA

Can we assign an extra interpreter for 3 and 5?

Ms. Nagai will interpret at 1,2,4 and 6.

If this is okay with you, I will make an arrangement accordingly.

Thank you.

Best regards,

Yoriko

==
上村（うえむら）依子／コミュニケーション事業部
(株)サイマル・インターナショナル
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Wittick, Brian

From: Wittick, Brian
Sent: Wednesday, April 20, 2011 8:25 PM
To: LIA08 Hoc
Cc: LIA02 Hoc, Reynolds, Steven; Casto, Chuck
Subject: RE: addresses

Please address the package to:

Chuck Casto
U.S. Nuclear Regulatory Commission (NRC) site team

U.S. Embassy Japan
1-10-5 Akasaka
Minato-ku, Tokyo 107-8420 JAPAN

I have spoken with the mail room and they know who we are and how to route mail to us. Please use Fedex as we do not have U.S. mail set up yet.

Thanks
Brian

From: LIA08 Hoc
Sent: Wednesday, April 20, 2011 7:18 PM
To: Wittick, Brian
Subject: RE: addresses

Ok

One more question.

If we send it attn NRC site team or attn Chuck Casto, the concern is that it may be rejected once it arrives or tied up in an effort for the recipient to determine who or where the package should go. Is there a liaison or a point of contact there at the Embassy who we could address the package to that would be a familiar name to those who in the Embassy's mailroom who would receive the package?

Liaison Team Coordinator
US Nuclear Regulatory Commission
email: lia08.hoc@nrc.gov
Desk Ph: 301-816-5185

From: Wittick, Brian
Sent: Wednesday, April 20, 2011 6:58 PM
To: LIA08 Hoc
Subject: RE: addresses

You got it FYI, we do not currently have an DFO (same as APO for Japan) available to us, but I hope to get one set up as part of the transition from USAID to NRC logistics support.

Brian

BBB\143

From: LIA08 Hoc
Sent: Wednesday, April 20, 2011 6:40 PM
To: Wittick, Brian
Subject: RE: addresses

Brian

Here is what it says on the website for the US Embassy in Japan:

1-10-5 Akasaka
Minato-ku, Tokyo 107-8420 JAPAN

Could you confirm whether or not this is the right address when you get in?

There is an APO box also listed. However, Fed Ex will not ship to PO or APO boxes

Thanks

Liaison Team Coordinator
US Nuclear Regulatory Commission
email: lia08.hoc@nrc.gov
Desk Ph: 301-816-5185

From: Wittick, Brian
Sent: Wednesday, April 20, 2011 4:52 PM
To: LIA08 Hoc; Liaison Japan
Subject: Re: addresses

Hotel is:
2-10-4 Toranomon Minato-ku
Tokyo 105-0001
Japan

Embassy I will get you when I get to work, but you can get it from the embassy website

Sent from NRC BlackBerry
Brian Wittick
(b)(6)

From: LIA08 Hoc
To: Liaison Japan
Sent: Wed Apr 20 13:35:27 2011
Subject: FW: addresses

Can anyone help with the address of the embassy and the hotel you all are staying at? Thanks

Jeff Temple
Liaison Team Coordinator
US Nuclear Regulatory Commission
email: lia08.hoc@nrc.gov
Desk Ph: 301-816-5185

From: Marshall, Jane
Sent: Wednesday, April 20, 2011 1:31 PM
To: Temple, Jeffrey; LIA08 Hoc
Subject: addresses
Importance: High

Jeff
Please remember the Tokyo embassy and hotel address for Chuck so that RII can get a replacement card to him.

Wittick, Brian

From: Wittick, Brian
Sent: Wednesday, April 20, 2011 11:15 PM
To: 'ses-o@state.gov'
Subject: 20Km No Go zone

Please see the link, page 2, for discussion of the changed characterization of the 20Km zone around the plant.

http://www.jaif.or.jp/english/news_images/pdf/ENGNEWS01_1303298461P.pdf

The JAIF and TEPCO websites are good resources that we get much of our information from.

Let us know if you have additional questions.

Thanks
Brian Wittick
U.S. NRC Japan Site Team

(b)(6)

Wittick, Brian

From: Wittick, Brian
Sent: Wednesday, April 20, 2011 11:21 PM
To: 'ses-o@state.gov'
Subject: 20Km evacuation zone characterization

Please see the following link, page 2, for discussion of the changed characterization of the 20Km zone:

http://www.jaif.or.jp/english/news_images/pdf/ENGNEWS01_1303298461P.pdf

The JAIF and TEPCO websites are where we get much of our information, pictures, videos, etc from.

Let us know if you have additional questions.

Thanks
Brian Wittick
Executive Technical Assistant
U.S. NRC Japan Liaison Team
(b)(6)

BBB/145

Greenwood, Carol

From: Gibson, Kathy
Sent: Wednesday, April 20, 2011 4:54 PM
To: Tinkler, Charles
Subject: FW: Useful presentation from http://allthingsnuclear.org of April 14, and a SUGGESTION for improving our BWRs
Attachments: image001.png; image002.gif; image003.gif; Kathy Halvey Gibson.vcf; image004.jpg

Fyi – anything SOARCA can add to this discussion?

Kathy Halvey Gibson
Director
Division of Systems Analysis

Kathy.Gibson@nrc.gov
(301) 251-7499 Work
(b)(6)

US Nuclear Regulatory Commission
Office of Nuclear Regulatory Research
Protecting People and the Environment

From: Sheron, Brian
Sent: Wednesday, April 20, 2011 4:19 PM
To: Beasley, Benjamin
Cc: Uhle, Jennifer; Correia, Richard; Case, Michael; Gibson, Kathy; Coe, Doug; Kauffman, John
Subject: Re: Useful presentation from http://allthingsnuclear.org of April 14, and a SUGGESTION for improving our BWRs

Thanks. Good insights and assessment.

From: Beasley, Benjamin
To: Sheron, Brian
Cc: Uhle, Jennifer; Correia, Richard; Case, Michael; Gibson, Kathy; Coe, Doug; Kauffman, John
Sent: Wed Apr 20 16:08:52 2011
Subject: RE: Useful presentation from http://allthingsnuclear.org of April 14, and a SUGGESTION for improving our BWRs

Brian,

I understand your question to be about the regulatory feasibility of the suggestion to have a "magneto" on the RCIC shaft, like that on a piston-driven aircraft engine, so that whenever the pump is running there is electrical power generated for the RCIC valves and other emergency loads. The electrical power might also be used to charge the batteries and operate control room indicators and lights. Before addressing your backfit question, there are some system implications associated with the suggestion. (John Kauffman drafted these thoughts and they reflect comments from Rich and Doug.)

<u>System Implications</u>

In a LOOP event, RCIC typically runs (along with HPCI/HPCS to restore/maintain reactor water level). However, these systems have more capacity than is needed and either trip on high level or require operator intervention to throttle them back. The point is that RCIC only runs intermittently. It also does not run at constant speed, which would be problematic for making stable, useable AC.

BBB\146

Connecting a magneto to the RCIC shaft would create a "load," so RCIC would either need to draw more steam to produce the same injection flow or be de-rated. If the RCIC turbine were run continuously, it could depressurize the RCS, causing a loss of motive force. A separate turbine or a generator connected to the RCIC turbine only when RCIC is not injecting would address the de-rating issue but not the depressurization issue. Either of these would likely be more costly than alternatives.

In summary; this idea would present challenging implementation hurdles. A more straight-forward approach would be to have pre-arranged temporary AC sources, e.g. skid mounted EDGs, and ways to connect them to the station's emergency/vital buses.

Backfit discussion

The probability of a LOOP followed by failure of the onsite EPS (a station blackout) is, at most, on the order of 3E-5 per year. This is based on simply multiplying LOOP initiating event frequency data and onsite EPS failure probability (8 hour mission time). To calculate a CDF frequency from this SBO probability, credit would need to be given for recovery actions (such as grid restoration) and alternate AC capabilities (SBO or B5B diesels). Plants also take action when expecting severe weather (hurricanes) that can affect the grid, such as shutting down the reactor and pre-positioning skid-mounted EDGs. Based on the above, the CDF due to station blackout is less than 1E-05 Under the agency's Regulatory Analysis Guidelines (page 14), with a delta CDF below E-5, we are in the zone of "Management decision whether to proceed." We could well be below E-6 and in the "No action" zone altogether (see figure below).

The Regulatory Analysis Guidelines (page 13) discuss the uncertainties associated with extreme external events:

> However, the uncertainties associated with certain external event risk contributions (especially seismic) can be relatively large. Therefore, to supplement any available quantitative information, qualitative insights should be used for issues involving external events.

This is just a quick consideration. The numbers and discussion above indicate that the answer is not a definitive "no," but, that it will be difficult to impose substantial additional protection (cost-justified) backfits on station blackout.

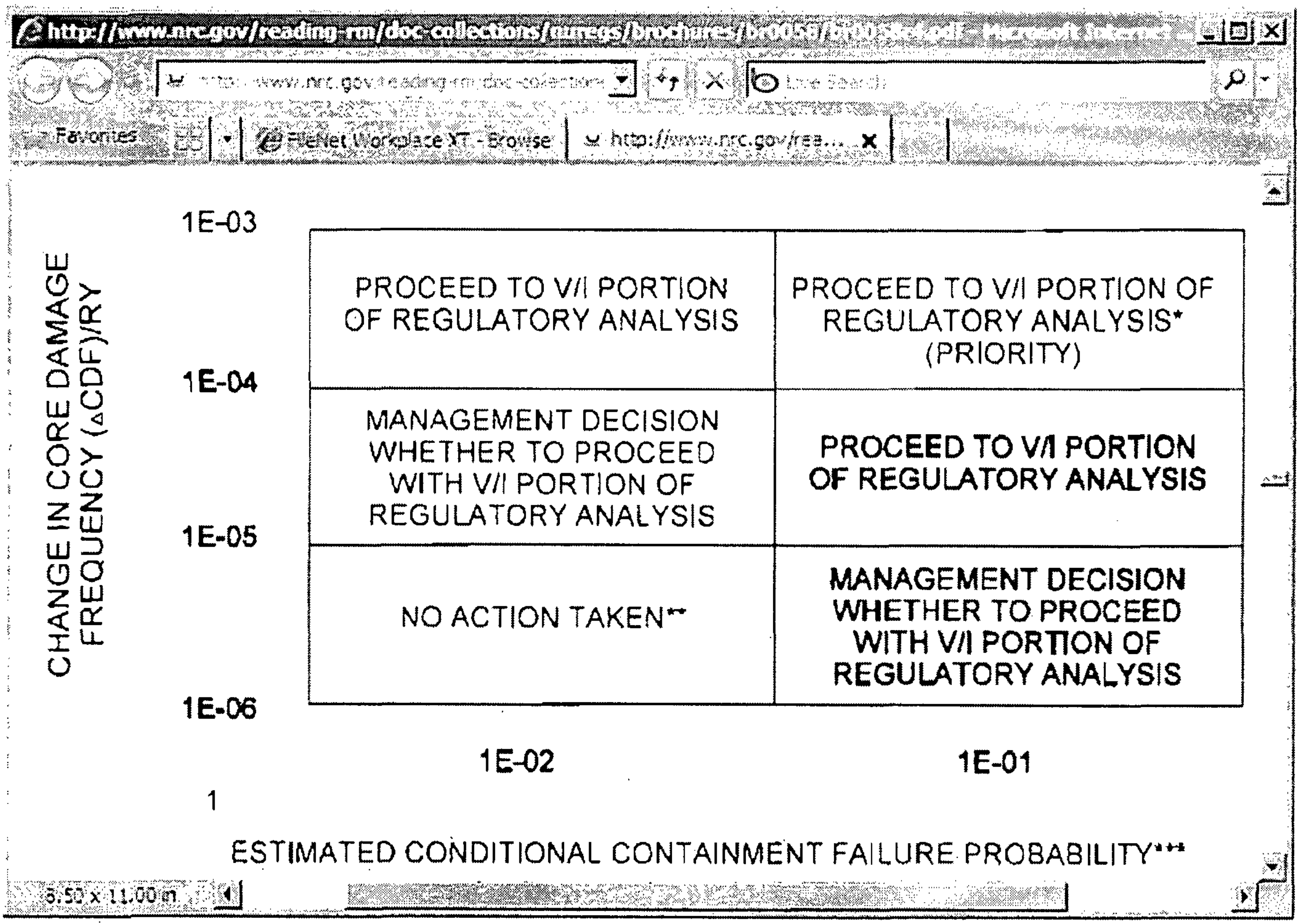
Regards,
Ben

Additional comments from Doug

1. You need to do the analysis and shouldn't SWAG this. As I read the discussion, it is focused on core damage, whereas the regulatory analysis must consider consequences (i.e. person-rem avoided). The core damage piece doesn't apparently consider SBO coping equipment/procedures (I'm not sure why) and the regulatory analysis guidelines do not (I believe) address multi-unit severe external events. So.... back to 'you shouldn't SWAG this.'

2. Second, I would resist zeroing in on specific 'solutions' without a full and integrated review of how any/all 'solutions' would impact the overall reactor plant system and its risk profile. Adding any new backfit carries the potential for creating new vulnerabilities even as you are attempting to resolve known vulnerabilities. I would advocate continuing to collect ideas such as this one, but not to do any 'cost-benefit' or similar analysis until we can look at them in an integrated manner.

Figure 3.2 from NUREG/BR-0058



From: Sheron, Brian
Sent: Monday, April 18, 2011 11:20 AM
To: Beasley, Benjamin
Cc: Correia, Richard; Coe, Doug
Subject: FW: Useful presentation from http://allthingsnuclear.org of April 14, and a SUGGESTION for improving our BWRs

See below. Would this likely pass a cost-benefit backfit test?

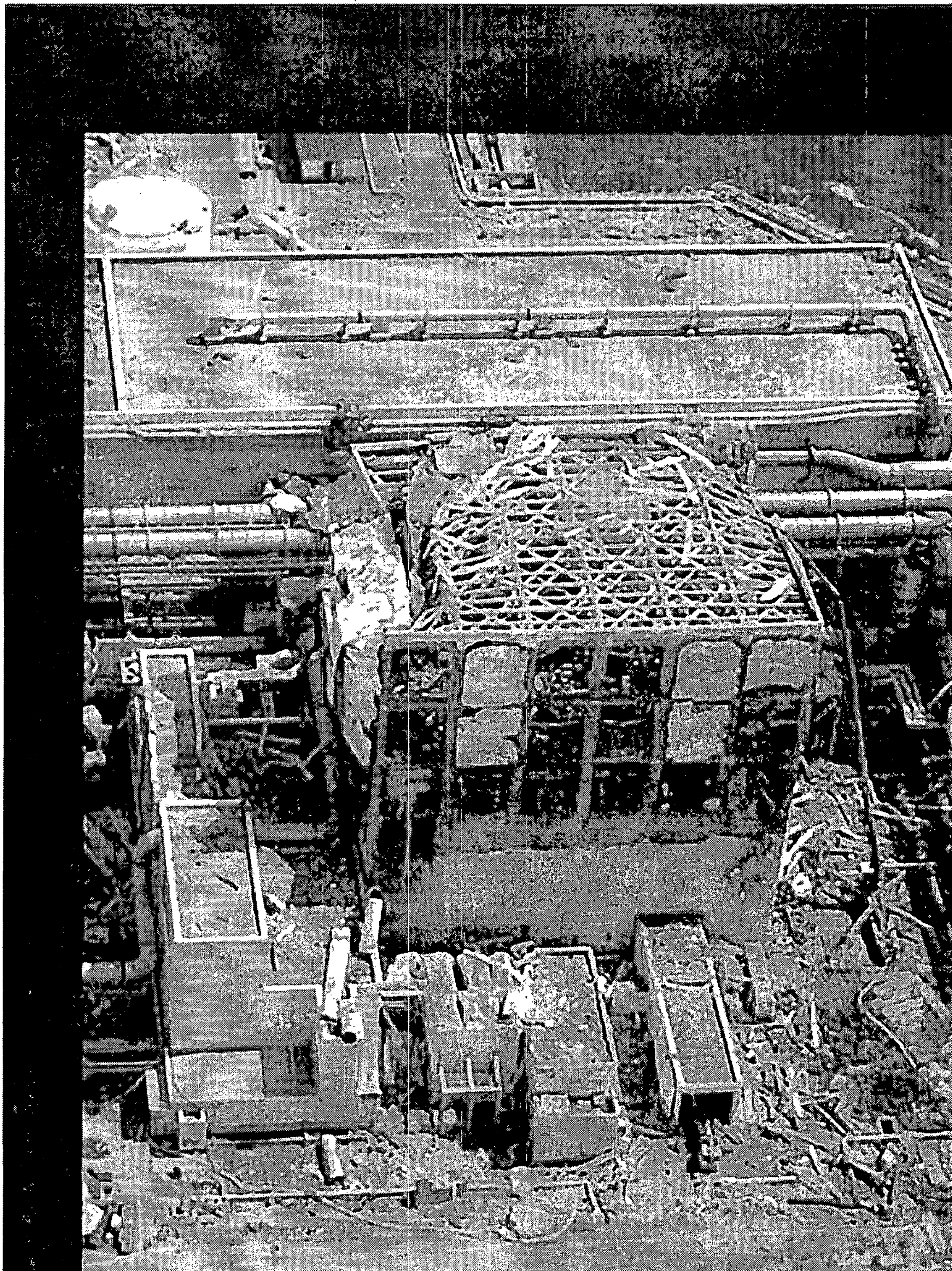
From: Richard L Garwin [mailto:rlg2@us.ibm.com]
Sent: Sunday, April 17, 2011 4:25 PM
To: Larzelere, Alex
Cc: Caponiti, Alice; Busby, Jeremy T; DL-NITsolutions; Schneider, Steve
Subject: Useful presentation from http://allthingsnuclear.org of April 14, and a SUGGESTION for improving our BWRs

Dear Colleagues,

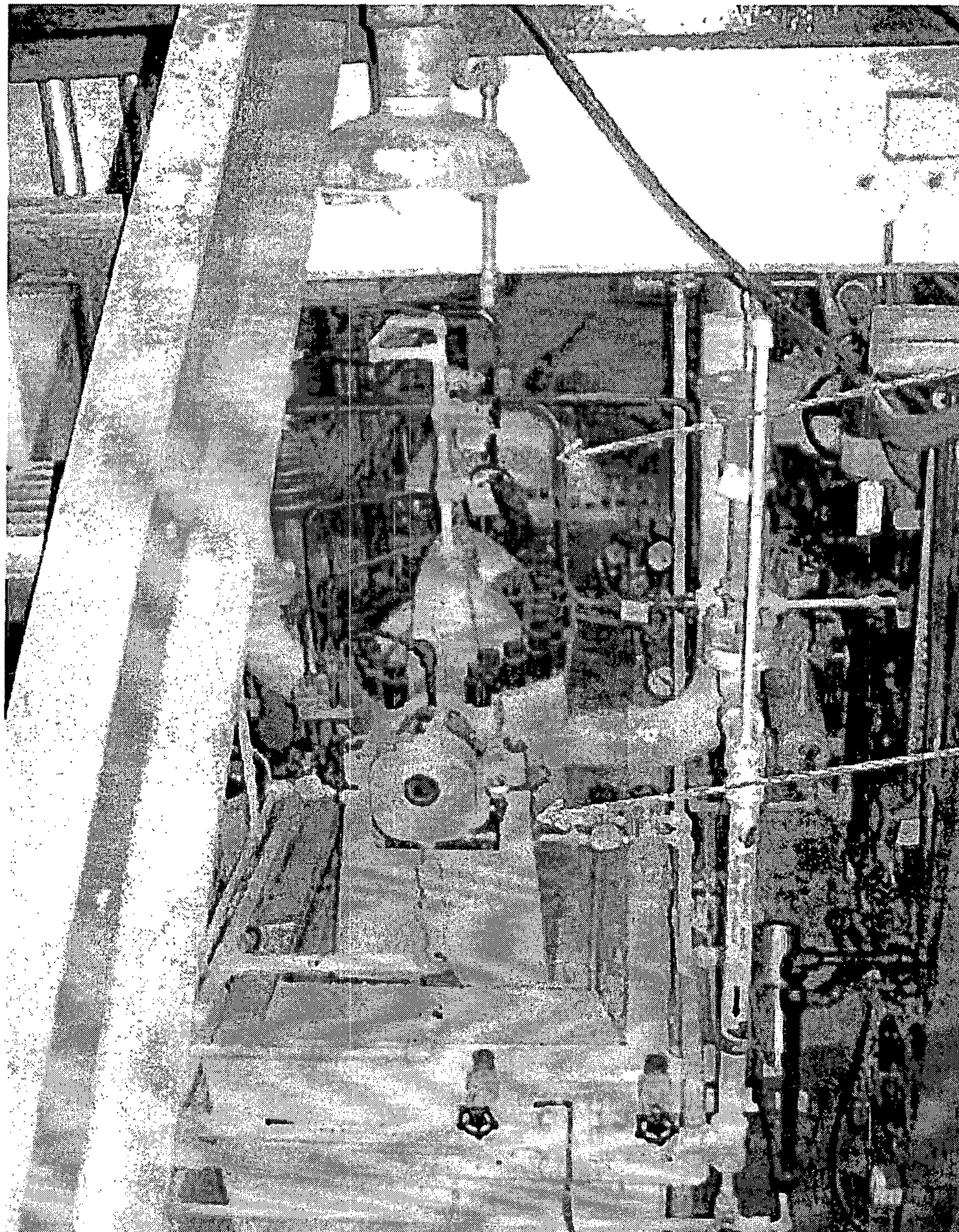
http://allthingsnuclear.org of April 14 has a very useful presentation of the Fukushima Dai-ichi problem.

I attach the first slide and also a detail of the steam-driven "isolation turbine and pump," and provide also

a SUGGESTION by Bill Press.



Reactor Core Isolation Co



Bill Press (William H. Press, University of Texas at Austin, and LANL) asks why the RCIC turbine/pump does not have a "magneto" on the shaft, like that on a piston-driven aircraft engine, so that whenever the pump is running there is electrical power generated for the RCIC valves and other emergency loads. This might well be used to charge the batteries, too, and operate the control room indicators and lights.

This seems to me an eminently practical suggestion, which I am passing on for communication to NE and NRC.

Dick Garwin

Huffert, Anthony

From: Huffert, Anthony
Sent: Thursday, April 21, 2011 12:44 AM
To: (b)(6)
Cc: Reynolds, Steven; Gepford, Heather; Meighan, Sean; Wittick, Brian (b)(6) (b)(6) (b)(6) (b)(6) DARTDOELiaison1@ofda.gov'; 'Smith, (b)(6)
Subject: NRC staff visit to Yokota

LT CDR Burke:

Below is the agenda for the NRC staff visit to Yokota tomorrow, March 22nd.

Please contact Dr. Heather Gepford (heather.gepfored@nrc.gov (b)(6) for additional information regarding this trip.

We look forward to our visit.

PMT Embassy
Heather Gepford, Tony Huffert, Sean Meighan

**** AGENDA ***

1000 - Depart AMEMB via USFJ supplied vehicle
1100-1130 - Arrive Yokota AFB -
1130 - 1300 Lunch on base at the exchange/Shopping if desired.
1300 - 1700 Meeting with Dr Michaud/Dr Harvis and DTRA
1700 Depart Yokota
1800-1830 Arrive back at AMEMB

Dr Michaud and Dr Harvis will introduce you to the DOE sensor guys and also show you the modeling that DTRA is doing and the Air Force Radiation Assessment Team (AFRAT) and will be your host from 1300-1700.

PMT Embassy
Heather Gepford, Tony Huffert, Sean Meighan

885/147

Huffert, Anthony

From: Smith, Christopher L [Christopher.Smith@nnsa.doe.gov]
Sent: Thursday, April 21, 2011 12:06 AM
To: (b)(6) Huffert, Anthony
Cc: Reynolds, Steven; Gepford, Heather; Meighan, Sean; Wittick, Brian; (b)(6) (b)(6) (b)(6) 'DARTDOELiaison1@ofda.gov'
Subject: Re: NRC Visit to Yokota on Friday

If someone could forward the schedule, I will ensure the DOE personnel at Yokota are ready to receive when you arrive.

Thanks,
Chris

-----Original Message-----
From: Tanaka, Reid CAPT USN
To: Huffert, Anthony
Cc: Reynolds, Steven
Cc: Gepford, Heather
Cc: Smith, Christopher L
Cc: Meighan, Sean
Cc: Wittick, Brian
Cc: Michaud, Mark CAPT USN
Cc: Harvis, Lee Col USAF
Cc: Capria, Frederick CAPT
Cc: Powers, Jeffrey CAPT USN
Cc: Bacon, Jeffrey B MAJ USA
Cc: Hawkins, Leslie LTCOL USA USFJ
Cc: Wilde, Jacob H Capt USMC
Cc: Beavers, Shane L LT USN
Cc: Livingston, Brian E Capt USAF
Subject: RE: NRC Visit to Yokota on Friday
Sent: Apr 20, 2011 2:25 PM

Tony, OK, thanks.

Dirk and team. To help focus the Friday visit.

v/r reid

-----Original Message-----
From: Huffert, Anthony [mailto:Anthony.Huffert@nrc.gov]
Sent: Wednesday, April 20, 2011 12:23 PM
To: Tanaka, Reid CAPT USN
Cc: Reynolds, Steven; Gepford, Heather; Meighan, Sean; Wittick, Brian; 'christopher.smith@nnsa.doe.gov'
Subject: Visit to Yokota base

CAPT. Tanaka,

388\148

As you requested, I'm sending you this email to summarize the purpose of the NRC staff visit at the Yokota base later this week. Our goal is to meet with other US Government (DOE and USAF) counterparts that have been collecting, analyzing, and interpreting radiological data in response to the Fukushima Daichi incident. We're seeking information on both ongoing and planned measurements, the process DOE used for developing PAGs based on DOE measurement methods, and an understanding of environmental monitoring methods at the base.

We understand that Friday, April 22nd, is proposed for this trip. NRC staff participants will bring their HSPD-12 security badges - please let us know if additional security or other information is needed in support of this trip.

We look forward to hearing from you.

PMT Embassy

Heather Gepford, Tony Huffert, Sean Meighan

Huffert, Anthony

From: Huffert, Anthony
Sent: Thursday, April 21, 2011 3:19 AM
To: (b)(6)
Attachments: Q&As for food monitori ...ocx

888/149

NRC Staff Proposed Questions on Food Monitoring

Draft: 04/22/2011

Japan Regulatory Infrastructure

1. Which GOJ agencies are responsible for food monitoring after a nuclear incident?
    - Fisheries Research Agency
    - MHLW Japanese Ministry of Health
    - Institutes of Food Hygiene in each prefecture
    - Japan Food Research Laboratories.

2. Is there an overarching document that describes the Japanese regulatory infrastructure for monitoring seafood from "catch" to "plate".

3. Has there been an expansion of GOJ resources for monitoring radioactive contamination? Which additional GOJ agencies are now involved in monitoring food?

4. What other Japanese monitoring resources are available (academic, non- rx industrial, etc)

5. What are the licensees' (TEPCO) responsibilities for offsite monitoring during an incident?

Food Monitoring Protocols

6. Where are the monitoring points in the food processing chain?

7. Are there sufficient monitoring resources applied now in the food processing chain to ensure public health?

8. Where does sampling for radioactive contamination in food and animal feed take place? For example, are foods monitored for radioactive contamination at the port of entry, food distribution center, markets, etc)?

9. Are there established procedures for "screening" food for the presence of radioactive contamination? If radioactive contamination is detected, are there procedures established for conducting more in-depth radiological analysis, such as radioassays, in a mobile or central laboratory?

10. What fraction of a "catch" (boat load) of seafood is sampled ? Is each "catch" (boat load) screened for radioactive contamination, or are there established sampling criteria for taking representatives food samples from one or more lots of seafood? Is sampling of "catches" determined for a given location or time?

11. What quality control procedures are used for the analysis of radioactivity in food samples and animal feed? Is an international standard, such as International Standards Organization, used for quality control purposes? What are the established procedures for sample collection and analysis; instrument calibration and performance; and formal training of personnel conducting the analysis? What are the types of radiation detection and measurement systems used to monitor food? How

many of each detector type are used by each prefecture? · For foods other than seafood, what are the designated locations for sampling ? For example, where is meat sampled – at the farm, collection area, etc? What fraction of produce / milk/ water sampled?

12. Has the sampling frequency of food increased since March 11, 2011?

13. Do Japanese nuclear power plants have requirements for radiological environmental sampling similar to the United States? If yes, what are the typical requirements?

14. Is there evidence that food monitoring for radioactive contamination can be bypassed by local growers of foods or foodstuffs?

15. How do Japanese Derived Intervention Levels correlate to those established by international organizations, such as the World Health Organization?

16. What are the future plans for monitoring foods for radioactive contamination? Will monitoring continue for the next few months or years? What is the schedule for it to decrease or end?

17. **What analytical methods are currently being used to generate the test sampling data you have been providing over the last few days? (A link or reference to an existing document would be fine and, if in English, fantastic.)**

Here is the link to the "Manual for Measuring Radioactivity of Foods in Case of Emergency" dated May 9, 2002. This is written in Japanese and no English translation exists.

http://www.mhlw.go.jp/stf/houdou/2r9852000001558e-img/2r98520000015cf6.pdf
http://www.mhlw.go.jp/stf/houdou/2r9852000001558e-img/2r98520000015cfn.pdf

This manual has around 40 pages elaborating on various methods to measure radioactivity including:

- Method for measuring radioactive iodine through NaI(Tl) scintillation survey meter.
- Method for nuclides analysis of gamma-ray energy spectrometry using germanium semiconductor detector.
- Method for uranium analysis and rapid method for plutonium analysis in an emergency.
- Rapid method for Sr-90 analysis in an emergency and method for radiostrontium analysis through fuming nitric acid method in an emergency.

MHLW understands testis are being conducted according to this manual, however what analytical methods are being currently used actually depends on each examination body.

18. **How many samples have been collected and what is the variability in the findings?**

MHLW made public all the test results regardless of whether it is above or below the provisional regulatory standards.

Other information resources for food monitoring include:

- World Health Organization
- IAEA
- ....

19. **Is there a document describing the basis/rationale for Japan's regulatory limits for radionuclide levels that could be supplied (or a link)?**

Yes, *http://www.MHLW.go.jp/stf/houdou/2r9852000001558e-img/2r98520000015av4.pdf*

20. **What data/criteria have been used to established the area where production and/or shipment are now restricted?**

This instruction was made by Prime Minister Mr. Kan, who is Director-General of the Nuclear Emergency Response Headquarters.

Chief Cabinet Secretary Mr. Edano told at the press conference that the scope of food products and geographic area was decided based on the available date, considering figures of food products, stretch of the places where exceeding level of radioactive contaminants in foods were reported, and the practice that labeling of origin is put by prefecture basis, consulting with the Nuclear Safety Commission of Japan

13. **Where is scanning/testing currently being conducted?**

The laboratories which are conducting tests includes Institutes of Food Hygiene in each prefecture and Japan Food Research Laboratories

6) What has been the response when levels found were above Japan's limits? A product embargo or hold? Destruction?
Each prefecture withdraws the products of the same lot from the market and discard them.

7) Are there any health concerns or what types of controls are in place for fresh water fish, aquacultured seafood, shellfish, other sea products like sea cucumber, sea urchin, etc.?
Please see the attachment "220311 Radioactive Contaminants in Seawater (English)"

Notes: sea farming and free catch methods are used. Where is location of plant in view of these activities

21. For US incidents, what are the US FDA requirements for food sampling?

22. For US incidents, what are the US Dept Agriculture requirements for food sampling?

23. For US Incidents, what other US Federal resources are applied for food sampling?

24. For international incidents, what US govt assets are planned?

Greenwood, Carol

From:	Gibson, Kathy
Sent:	Thursday, April 21, 2011 4:13 PM
To:	Sheron, Brian; Uhle, Jennifer
Subject:	FW: Briefing for Brian on comparative risk assessment for SFP
Attachments:	SFP Risk Talking Points - Briefing for RES FO - April 2011.pdf; Kathy Halvey Gibson.vcf; image001.jpg

fyi

Kathy Halvey Gibson
Director
Division of Systems Analysis

Kathy.Gibson@nrc.gov
(301) 251-7499 Work
(b)(6)

From: Esmaili, Hossein
Sent: Thursday, April 21, 2011 4:04 PM
To: Gibson, Kathy; Correia, Richard; Case, Michael; Scott, Michael; Coe, Doug; Richards, Stuart; Lee, Richard; Coyne, Kevin; Santiago, Patricia; Hogan, Rosemary; Tinkler, Charles; Armstrong, Kenneth; Stutzke, Martin; Hudson, Daniel; Helton, Donald; Murphy, Andrew; Esmaili, Hossein
Subject: Briefing for Brian on comparative risk assessment for SFP

Hi All,

I have attached the talking points for the Monday morning briefing for Brian. Don Helton will be the primary speaker since he is most familiar with the issues/analysis because of his past involvement. I will be out of the office tomorrow.

Thanks

hossein

888/158

April 21, 2011

Comparative Spent Fuel Risk/Consequence Study

Background & Past Studies:	Not a new issue – elements studied in the past Generic Issue-82 (SFP Beyond-DBA Events) 1989 Value/Impact Study to Rsolve GI-82 Mid-90s AEOD Report and NRR SFP Action Plan NUREG-1738 Decommissioning Risk Study for Relaxing EP Alvarez Paper & NRC Response on moving fuel to casks National Academies Study & Response on safety/security of spent fuel RES Post 9/11 SFP Security Assessments NUREG-1864 Pilot Dry Cask PRA 2008 PRM Response & 2009 Draft License Renewal GEIS Update
Objective:	Assess the effect on risk of removing older fuel from the SFP with a focus on more realistic analysis
Internal/External Forcing Functions:	Congressional interest Short-term & Long-term Fukushima Task Force New Site Level 3 PRA SECY Omission of SFP analysis in SOARCA
Stated & Implicit Constraints:	Short term horizon (~ 1 year) Cannot interfere with the completion of SOARCA Contract placement lag time (~ 2-6 months) Necessarily need to focus on one site to manage scope and promote realism
Potential Approaches:	Full SFP Risk Assessment (cannot meet stated schedule) Cost/Benefit Analysis (cannot meet objective of realism) Mitigation Alternative Analysis (cannot meet stated schedule) <u>Limited Scope SFP Risk Assessment</u>
Technical Approach:	A limited-scope risk assessment for one site to quantify the consequences and risk associated with SFP storage from specified initiators (over one fuel cycle), relying as much as practical on readily available information. Two options and configurations will be considered: (i) "as is" – high-density racking with current regulatory requirements and (ii) low-density racking with current applicable regulatory requirements. Limited treatment of initiators (seismic, cask drop) [DRA] Simplified accident progression event trees for scenario definition [DRA] Decay heat/inventory analysis; criticality (if needed) [DSA] MELCOR accident progression analysis [DSA] MACCS2 analysis confined to current best practices/outputs [DSA] Seismic analysis for quantification of fragilities/damage states [DE] Structural analysis for quantification of boundary conditions [DE] Screening HEP quantification [DRA] Review (ACRS & other Offices) Preliminary Documentation

Key Tech./Info Challenges:	Seismic damage assessments (only legacy information available) Structural damage assessments (including probability distributions) Human Reliability Analysis approach General design specifications for a modern low-density rack configuration Site information (e.g., structural details, current SFP loading) Site practices (e.g., fuel reconfiguring practice, mitigation procedures) Handling InfoSec issues of B5b mitigative measures in a safety study Availability of reliability data
Near-term staffing:	DSA lead: Hossein Esmaili (Overall lead) DE lead: Andrew Murphy DRA lead: Don Helton
Internal stakeholders:	NMSS DSFST - (Dry cask) NSIR DPR, DSP - (EP, B5b) NRR DPR, DRA, DSS,DROL - (cost benefit, DBA, SAMA, Plant PM) NRO DSRA – (DBA, SAMDA)
Deferred Items:	New seismic hazard infromation Treatment of risk beyond a single, postulated fuel cycle Treatment of cask risk, fuel movement risk Treatment of economic costs and cost/benefit in general Treatment of other initiators (e.g., LOSFPC, reactor-related, etc.) Consideration of uncertainty via risk-informed safety-margins Refined HEP quantification Extension to other sites (either via additional studies or extrapolation) NUREG development & issuance
Resource Estimates:	Will provide once a work breakdown structure has been formulated – expect that it will approach the 4 FTE/$500K limit
Resource Impacts:	Will provide resource impacts once a work breakdown structure has been formulated – expect that multiple User Need activities will be affected
Immediate Actions: (next few weeks)	Update 2008 6-page project discussion plan Create work breakdown structure (including projected $/FTE and impacts) Develop points of contact in NSIR, NMSS, NRR

Lee, Richard

From: Powers, Dana A [dapower@sandia.gov]
Sent: Thursday, April 21, 2011 5:33 PM
To: Lee, Richard
Subject: FW: bugs, Fukushima and the like

Richard, Sud did the trick! We got this reply from Natesan. Should we just pass the information on to Kelly and let him track down details? Dana

-----Original Message-----
From: Natesan, K. [mailto:natesan@anl.gov]
Sent: Thursday, April 21, 2011 3:30 PM
To: Bill Shack
Cc: Powers, Dana A; Basu, Sudhamay
Subject: Re: bugs, Fukushima and the like

Bill

Regret the delay in replying to you. We currently have limited expertise in the area of microbial corrosion/fouling at ANL. However, there is some expertise in this area of corrosion (in particular, ongoing work in ocean thermal energy systems in Hawaii).

The person to contact at ANL is C. B. Panchal, ES Division, Tel # 410 531 0880. He is an STA.

Another person who has substantial experience is an Ex-Nalco employee by name Mike Enzien. He is currently a Principal Research Scientist at The Dow Chemical Company and is Lead R&D Specialist at Dow Microbial Control - Dow Chemicals. He has done a lot of work in this area.

Hope this helps.

Ken Natesan

On 4/18/11 2:28 PM, "Bill Shack [redacted] (b)(6) wrote:

>Ken,
>
>You can see Dana's concern below. Microbially-induced corrosion (MIC)
>is major industry, probably bigger for the oil folks than nukies. Can
>you suggest an expert with some perspective.
>
>Begin forwarded message:
>>
>> From: "Powers, Dana A" <dapower@sandia.gov>
>> Date: April 18, 2011 2:19:15 PM CDT
>> To: [redacted] (b)(6)

>> Subject: bugs, Fukushima and the like
>>
>> Bill, the boys have been pumping raw seawater into the reactors and
>>pools at Fukushima. Right now, within the vessels conditions probably
>>are not too conducive to biological growth. Eventually things will
>>cool down and one will have to worry about such things. Certainly at
>>TMI, a little hydraulic fluid in the water after head removal was
>>enough to spawn an entire ecosystem. Do you know anyone that knows
>>about such things? The reason I ask is that I remember you mentioning
>>that there was a biologically assisted stress corrosion cracking.
>>Maybe experts in that can point to experts in bugs that will devour
>>Fukushima. Dana
>>
>
>

Huffert, Anthony

From: Huffert, Anthony
Sent: Thursday, April 21, 2011 1:42 AM
To: (b)(6)
Cc: Reynolds, Steven; Meighan, Sean; Gepford, Heather
Subject: Names of visitors to Yokota (4/22/11)

LT CDR Burke,

Here are the names of the NRC and US Embassy staff who will participate in the visit at Yokota tomorrow:

Steve Reynolds (NRC Site Team Leader)
Heather Gepford (NRC Protective Measures Team Leader / heather.gepford@nrc.gov) Tony Huffert (NRC Protective Measures Team) Naomi Walcott (US Embassy) Ron Petri (US Embassy)

From,
NRC PMT Embassy
Heather Gepford, Tony Huffert, Sean Meighan

---Original Message-----
From: Huffert, Anthony
Sent: Thursday, April 21, 2011 12:44 AM
To: (b)(6)
Cc: Reynolds, Steven; Gepford, Heather; Meighan, Sean; Wittick, Brian; (b)(6)
(b)(6)
'DARTDOELiaison1@ofda.gov'; (b)(6)
Subject: NRC staff visit to Yokota

LT CDR Burke:

Below is the agenda for the NRC staff visit to Yokota tomorrow, March 22nd.

Please contact Dr. Heather Gepford (heather.gepford@nrc.gov (b)(6) for additional information regarding this trip.

We look forward to our visit.

PMT Embassy
Heather Gepford, Tony Huffert, Sean Meighan

**** AGENDA ***

1000 - Depart AMEMB via USFJ supplied vehicle
1100-1130 - Arrive Yokota AFB -
1130 - 1300 Lunch on base at the exchange/Shopping if desired.
1300 - 1700 Meeting with Dr Michaud/Dr Harvis and DTRA
1700 Depart Yokota
1800-1830 Arrive back at AMEMB

8BB\152

Dr Michaud and Dr Harvis will introduce you to the DOE sensor guys and also show you the modeling that DTRA is doing and the Air Force Radiation Assessment Team (AFRAT) and will be your host from 1300-1700.

PMT Embassy
Heather Gepford, Tony Huffert, Sean Meighan

Greenwood, Carol

From: Gibson, Kathy
Sent: Friday, April 22, 2011 10:22 AM
To: Scott, Michael
Subject: RE: Briefing for Brian on comparative risk assessment for SFP
Attachments: Kathy Halvey Gibson.vcf; image001.jpg

Yes, but it will require some contractor support likely for all 3 divisions. I reiterated with Richard and Hossein yesterday that I want as much done in-house as possible.

Kathy Halvey Gibson
Director
Division of Systems Analysis

Kathy.Gibson@nrc.gov
(301) 251-7499 Work
(b)(6)

US Nuclear Regulatory Commission
Office of Nuclear Regulatory Research
Protecting People and the Environment

From: Scott, Michael
Sent: Friday, April 22, 2011 9:39 AM
To: Gibson, Kathy
Subject: FW: Briefing for Brian on comparative risk assessment for SFP

Thought you wanted this done in-house?

From: Esmaili, Hossein
Sent: Thursday, April 21, 2011 4:04 PM
To: Gibson, Kathy; Correia, Richard; Case, Michael; Scott, Michael; Coe, Doug; Richards, Stuart; Lee, Richard; Coyne, Kevin; Santiago, Patricia; Hogan, Rosemary; Tinkler, Charles; Armstrong, Kenneth; Stutzke, Martin; Hudson, Daniel; Helton, Donald; Murphy, Andrew; Esmaili, Hossein
Subject: Briefing for Brian on comparative risk assessment for SFP

Hi All,

I have attached the talking points for the Monday morning briefing for Brian. Don Helton will be the primary speaker since he is most familiar with the issues/analysis because of his past involvement. I will be out of the office tomorrow.

Thanks

hossein

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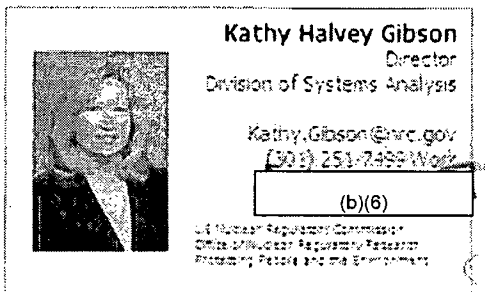
Greenwood, Carol

From: Gibson, Kathy
Sent: Friday, April 22, 2011 2:19 PM
To: Holahan, Patricia
Subject: RE: ET director schedule
Attachments: Kathy Halvey Gibson.vcf

Trish,
I am not available in May. Ray is on travel two of the weeks and Shannon is still in school.

Maybe in June if we go on staffing that long.

Kathy



From: Holahan, Patricia
Sent: Friday, April 22, 2011 1:46 PM
To: Correia, Richard; Sheron, Brian; Case, Michael; Coe, Doug; Gibson, Kathy; Richards, Stuart; Scott, Michael; Uhle, Jennifer; Valentin, Andrea
Subject: RE: ET director schedule

Rich

We believe that we could use your skills more on the ET rather than the LT. So if you're amenable to doing that, I'd put you and Doug on the list (obviously on different days and shifts).

Thanks, Trish

From: Correia, Richard
Sent: Friday, April 22, 2011 7:05 AM
To: Sheron, Brian; Case, Michael; Coe, Doug; Gibson, Kathy; Richards, Stuart; Scott, Michael; Uhle, Jennifer; Valentin, Andrea
Cc: Holahan, Patricia
Subject: RE: ET director schedule

Brian,
The NSIR LT coordinator has reached out to me and others asking for continued support. I'm working with them on dates and shifts.

Rich Correia, PE
Director
Division of Risk Analysis
RES
US NRC

BBG\154

From: Sheron, Brian
Sent: Friday, April 22, 2011 6:53 AM
To: Case, Michael; Coe, Doug; Correia, Richard; Gibson, Kathy; Richards, Stuart; Scott, Michael; Uhle, Jennifer; Valentin, Andrea
Subject: FW: ET director schedule

I do not see this as restricted to division directors. If you are available, please respond to Trish.

From: Holahan, Patricia
Sent: Thursday, April 21, 2011 5:54 PM
To: Johnson, Michael; Flanders, Scott; Leeds, Eric; Ruland, William; Haney, Catherine; Kokajko, Lawrence; Lewis, Robert; Moore, Scott; Sheron, Brian; Uhle, Jennifer
Cc: Evans, Michele; Marshall, Jane; Layton, Michael; McDermott, Brian
Subject: ET director schedule

We are asking the offices to identify Division directors that could serve as possible candidates for future schedules of the reduced scope ET beginning ~May 2. We would ask the larger offices (NRR, NRO) to identify 3-4 candidates that could possibly fill this role and other offices to identify 1-2 individuals. They should have worked in the Op Center as either Liaison Team, PMT, or RST directors through the Japan event.

Thanks very much in advance,
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)
patricia.holahan@nrc.gov

Huffert, Anthony

From: Gabor, Robert R [GaborRR@state.gov]
Sent: Wednesday, April 27, 2011 11:23 PM
To: Riesland, Nicholas J
Cc: Basalla, Suzanne I; Clever, Thomas S (Scott); Deshpande, Gautam A; Foster, Dirk, Gabor, Robert R; Gepford, Heather; Howard, E. Bruce; Huffert, Anthony; Jiggens, Tim; Johnstone, Gregg M; Kerstner, Anthony D (TDY/RSO); Martyn, Thomas G; Meighan, Sean; Morimura, Stephanie (TDY/PAS); Peterson, Joyce D; Petrie, Ronald C; Roos, Susan H; Sano, Mikako; Simmers, Keith; Smith, Chris; Tanaka, Reid; Vyas, Rajesh (Manila); Walcott, Naomi; Washburn, Lisa L; Wiggin, Geoffrey W
Subject: MED re Food and Radiation. GOJ practices.

Nick -- Thanks for attending the call and offering the feedback below. I'm cc'ing the whole working group, as this will be helpful for our discussion today.

Regards,
Robert

Robert Gabor
Economic Affairs
American Embassy Tokyo
1-10-5 Akasaka, Minato-Ku, Tokyo
Tel: +81 (3) 3224-5024; Fax. +81 (3) 3224-5229
Email: GaborRR@state.gov

SBU
This email is UNCLASSIFIED.

From: Riesland, Nicholas J
Sent: Thursday, April 28, 2011 9:39 AM
To: Gabor, Robert R
Cc: Petrie, Ronald C; McCoy, Gretchen A (MED)
Subject: FW: Food and Radiation. GOJ practices.

SBU
This email is UNCLASSIFIED.

From: Nick Riesland (b)(6)
Sent: Wednesday, April 27, 2011 5:37 PM
To: Riesland, Nicholas J
Subject: Food and Radiation. GOJ practices.

Robert

I am no longer in Tokyo, but back in Bangkok. Was on the call this morning for the presentation until about 1150a Tokyo time. I then had to scoot off to another appointment. However, reviewing the slides from the presentation and from what I did hear of the f/u Q&A, I have a few comments/observations to offer as a medical doctor without training as a radiation health physicist:

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- This morning underscored to me that we are dealing with a technologically advanced country with health concerns that parallel our own. It didn't feel that way for those dealing with the Chernobyl aftermath. Although information sharing has been criticized, it is difficult for me to see how we would do much better in our country if a similar nuclear accident were to occur.
- While there may be minor differences in exposure standards and methodology between the GOJ agencies and our own EPA, DOE and FDA+, these are unlikely to result in a significant health impact.
- Based on compared with my other experience with similar issues in the 1990s out of our Embassy in Minsk (directly in the Chernobyl plume) and the soil and food contamination aftermath, the resources and expertise brought to bear in dealing with Fukushima is staggering. In the Chernobyl-contaminated region, an FDA lab in Pennsylvania agreed to do some limited testing of samples that we collected and split between them and the Kremlin Radiologic Laboratory in Moscow. We did a few spot tests, did some extrapolations in constructing a rough exposure model and then left it at that with some consequent general guidance. Admittedly, Belarus is/was a small player on the world stage, not a heavyweight like Japan which is a global crossroads. I think that your Ambassador and the WG are being appropriately vigilant and giving realistic reassurance to all stakeholders.
- If you read the UN reports on Chernobyl, one gets a sense that the consequences of what we see in Japan are going to be just about nil, even if there are occasional lapses in monitoring and some further venting of contaminated material into the atmosphere.
- While the US military with all of their resources is making a valiant effort to replicate GOJ surveillance and constructing detailed personal exposure models, the USG civilian side isn't finding a need for similar measures.

Not sure what's involved with the student presentations that you refer to. You've got some good TDYers there who might be willing/able to put something together.

Hope that helps.

I continue to follow as closely as I can, from a distance.

Best regards,
Nick

Lee, Richard

From: Joy L Rempe [Joy.Rempe@inl.gov]
Sent: Friday, April 29, 2011 5:03 PM
To: Brown, Michael, Lee, Richard; Salay, Michael, Hossein.Esmaili
Cc: Harold Finley McFarlane; Douglas E Burns; Peko, Damian
Subject: Distribution of Plant Parameter Plots
Attachments: ATT00003 .jpg; ATT00004..jpg

Hi,

I spoke with Damian today about the distribution of these plots and associated information. I am allowed to distribute within the federal family because federal employees have certain restrictions placed on them if they release it beyond the government. He looked at the distribution list associated with RST01, and it appears that there are non-feds on it. He said that until he can learn the exact answer, we should just send to some folks at NRC and let them decide about distribution.

I will continue to send to the nrc.gov folks on my list, but refrain from RST01 unless I know otherwise. Damian did say that if you have a list of federal folks, including NRC, Bettis and KAPL, that you'd like me to include, I could also do it. Frankly, it wasn't clear to me that the RST01 address was working for me anyhow.

Joy

Joy Rempe · Idaho National Laboratory
Phone: (208) 526-2897 (b)(6) Fax: (208) 526-2930 •
Email: Joy.Rempe@inl.gov

----- Forwarded by Joy L Rempe/YOJ/CC01/INEEL/US on 04/29/2011 02:56 PM -----

"Marksberry, Don" <Don.Marksberry@nrc.gov>

04/29/2011 10:15 AM

To RST01 Hoc <RST01.Hoc@nrc.gov>, "Brown, Michael" <Michael.Brown@nrc.gov>
cc "Lee, Richard" <Richard.Lee@nrc.gov>, Joy L Rempe <Joy.Rempe@inl.gov>, "Salay, Michael" <Michael.Salay@nrc.gov>, "Esmaili, Hossein" <Hossein.Esmaili@nrc.gov>
Subject DOE Trend Plots and plant Data From TEPCO

Dave, Mike, RST01

Joy added RST01 to the distribution of the INL-DOE charts (see att 1). The INL charts are largely based on the 2-page table of "...major parameters of the plant..." from the NISA press releases (see att 2). The same 2-page table in Japanese can be found on the NISA Japanese webpage (see att 3). I have been sending Joy the full set of the TEPCO data table and charts (in Japanese) whenever someone in RES receives them and uploads to our 1F SharePoint page. Jeff Mitman hooked us up with Carl Moore to add Joy and myself to the daily distribution of the full TEPCO data set (see att 4 for an example of the full TEPCO data set).

Joy's staff at INL can add additional trend charts using the larger scope data from the TEPCO data set, if she can get on a regular distribution. We received a TEPCO data set yesterday, but not today (maybe because of the holiday).

With regards to the Excel spreadsheets, maybe Joy can share her spreadsheets with the NRC and Consortium.

One observation: The INL-DOE charts are marked OUO. I don't know what this means when they are sent to INPO and GEH.

BBB\156

Don

Don Marksberry

Division of Risk Analysis
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
21 Church Street
Rockville, Maryland 20850-4207

Phone: 301-251-7593
E-mail: Don.Marksberry@nrc.gov

USPS & Express Mail Address:
Mail Stop: C-4C07M
Washington, D.C. 20555-0001

----- Message from Joy L Rempe <Joy.Rempe@inl.gov> on Thu, 28 Apr 2011 21:42:24 -0400 -----

To: "Caponiti, Alice" <Alice.Caponiti@nuclear.energy.gov>, "Bari, Robert A" <bari@bnl.gov>, "Bill.McCaughey@nuclear.energy.gov" <Bill.McCaughey@nuclear.energy.gov>, "binderjl@ornl.gov" <binderjl@ornl.gov>, "busbyjt@ornl.gov" <busbyjt@ornl.gov>, "cgrandy@anl.gov" <cgrandy@anl.gov>, Christine E White <Christine.White@inl.gov>, "Peko, Damian" <Damian.Peko@nuclear.energy.gov>, "dddixon@lanl.gov" <dddixon@lanl.gov>, "Marksberry, Don" <Don.Marksberry@nrc.gov>, Douglas E Burns <Douglas.Burns@inl.gov>, "Hackett, Edwin" <Edwin.Hackett@nrc.gov>, Elizabeth A Connell <Elizabeth.Connell@inl.gov>, "farmer@anl.gov" <farmer@anl.gov>, "flanagangf@ornl.gov" <flanagangf@ornl.gov>, "gehinjc@ornl.gov" <gehinjc@ornl.gov>, Harold Finley McFarlane <Harold.McFarlane@inl.gov>, "horak@bnl.gov" <horak@bnl.gov>, "james.buelt@pnl.gov" <james.buelt@pnl.gov>, "JohnE.Kelly@nuclear.energy.gov" <JohnE.Kelly@nuclear.energy.gov>, "Flack, John" <John.Flack@nrc.gov>, "kbsoren@sandia.gov" <kbsoren@sandia.gov>, "Kellar, Kenneth" <Kenneth.Kellar@nuclear.energy.gov>, "ks@bnl.gov" <ks@bnl.gov>, Kurt L Davis <Kurt.Davis@inl.gov>, "patrick.schwab@nuclear.energy.gov" <patrick.schwab@nuclear.energy.gov>, "Lee, Richard" <Richard.Lee@nrc.gov>, "Richard.Reister@nuclear.energy.gov" <Richard.Reister@nuclear.energy.gov>, "RobertP.Martin@inl.gov" <RobertP.Martin@inl.gov>, "Robert.Youngblood@inl.gov" <Robert.Youngblood@inl.gov>, "ROB.VERSLUIS@nuclear.energy.gov" <ROB.VERSLUIS@nuclear.energy.gov>, "Rogaunt@sandia.gov" <Rogaunt@sandia.gov>, RST01 Hoc <RST01.Hoc@nrc.gov>, "spburns@sandia.gov" <spburns@sandia.gov>, "tom.miller@nuclear.energy.gov" <tom.miller@nuclear.energy.gov>, "trevor.cook@nuclear.energy.gov" <trevor.cook@nuclear.energy.gov>, "wagnerjc@ornl.gov" <wagnerjc@ornl.gov>, William C Phoenix <William.Phoenix@inl.gov>

Subject: Updated Plots and Timeline

Hi,

Here's the latest set of plots. We are continuing to add more data that we've been receiving from TEPCO. Because of the behavior that we are seeing at earlier time periods (e.g., negative temperature values), we are also starting to label some

of the data as 'suspect', such as the feedwater nozzle temperatures reported on Unit 3 (slide 15). We also have generated a sketch (Slide 12) that illustrates the location of various sensors.

Joy

[attachment "Fukushima Chart 28 April 2011.pdf" deleted by Joy L Rempe/YOJ/CC01/INEEL/US] [attachment "2 Fukushima Dai-ichi Nuclear Power Station Major Parameters of the Plant (As of 0600, April 28th.pdf" deleted by Joy L Rempe/YOJ/CC01/INEEL/US] [attachment "3 - Parameter Table in Japanese (see last page).pdf" deleted by Joy L Rempe/YOJ/CC01/INEEL/US]

Joy Rempe · Idaho National Laboratory
Phone: (208) 526-2897 (b)(6) Fax: (208) 526-2930 •
Email: Joy.Rempe@inl.gov

----- Message from "Moore, Carl" <Carl.Moore@nrc.gov> on Wed, 27 Apr 2011 22:26:32 -0400 -----

To: "Garchow, Steve" <Steve.Garchow@nrc.gov>, "Lupold, Timothy" <Timothy.Lupold@nrc.gov>, "Mitman, Jeffrey" <Jeffrey.Mitman@nrc.gov>, "Norwood, Donald" <Donald.Norwood@nrc.gov>, "Marksberry, Don" <Don.Marksberry@nrc.gov>, "Rempe, Joy" <Joy.Rempe@nrc.gov>

Subject: FW: 1F Plant DATA (4 /28/2011)

-----Original Message-----
From: 遠藤 秀和 [mailto:endou.hidekazu@tepco.co.jp]
Sent: Wednesday, April 27, 2011 10:14 PM
To: Reynolds, Steven; Moore, Carl; GardLA@INPO.org; nei-hisanori@meti.go.jp; oshima-toshiyuki@meti.go.jp; Aleshia D. Duncan
Cc: 堀川 健; 高階 悟志; 白石 哲博; nakamura.mihoko@tepco.co.jp; 横尾 智之; 氏田 修二郎; 佐藤 隆; 二宮 豊; 中野 浩; 伊藤 正裕; 石井 武生; 溝島 康二
Subject: 1F Plant DATA (4/28/2011)

Dear all.

Please find attached plant status of Fukushima Daiichi NPS.

We appreciate your support.

Best regards.

Hidekazu Endou
TEPCO
[attachment "福島第一プラントパラメータ0428_06時00分.pdf" deleted by Joy L Rempe/YOJ/CC01/INEEL/US]
[attachment "作業予定・現状0428_0800Fix.pdf" deleted by Joy L Rempe/YOJ/CC01/INEEL/US]

Subject: EDO Pre-brief for 4/28 CM re: Japanese Earthquake Status - Focus on Station Black-Out

Location: Bridgeline: 1-888-790-6563 (b)(6) O-17B4 (Region I calling in)

Start: Thu 4/14/2011 1:00 PM
End: Thu 4/14/2011 2:00 PM

Recurrence: (none)

Meeting Status: Accepted

Organizer: Borchardt, Bill
Required Attendees: Virgilio, Martin; Weber, Michael; Ash, Darren; Muessle, Mary; ConferenceRoomO17B4 Resource

Categories: Business

When: Thursday, April 14, 2011 1:00 PM-2:00 PM (GMT-05:00) Eastern Time (US & Canada).
Where: Bridgeline: 1-888-790-6563 (b)(6) O-17B4 (Region I calling in)

Note: The GMT offset above does not reflect daylight saving time adjustments.

~~*~*~*~*~*~*~*~*

[redacted]

Rct 2/21

BBB\157

Coyne, Kevin

From: Coyne, Kevin
Sent: Friday, April 29, 2011 12:41 PM
To: Siu, Nathan
Subject: Re: Action: Briefing for June CSNI Meeting

Works for me Nathan. Can you ask Shirley to set it up or shall I?

Thanks!

Sent from an NRC Blackberry
Kevin Coyne

(b)(6)

From: Siu, Nathan
To: Coyne, Kevin
Sent: Fri Apr 29 12:35:12 2011
Subject: RE: Action: Briefing for June CSNI Meeting

Kevin –

How about Tuesday the 24th? 1:30?

Nathan

From: Sangimino, Donna-Marie
Sent: Thursday, April 28, 2011 5:30 PM
To: Siu, Nathan; Coyne, Kevin; Kuritzky, Alan; Bajorek, Stephen; Barnes, Valerie; Tregoning, Robert; Uhle, Jennifer; Ali, Syed; Murphy, Andrew; Voglewede, John; Csontos, Aladar; Gibson, Kathy; Salley, MarkHenry; Richards, Stuart; Burke, John; Carpenter, Gene; Taylor, Gabriel
Cc: Veltri, Debra; Flory, Shirley; Eisenberg, Wendy; Armstrong, Kenneth; Rini, Brett; Ibarra, Jose; Dehn, Jeff; Rivera-Lugo, Richard; Ramirez, Annie
Subject: Action: Briefing for June CSNI Meeting

Good afternoon,

In preparation for the semi-annual Committee on the Safety of Nuclear Installations (CSNI) Meeting June 9-10, we are requesting that Working Group (WG) representatives schedule a 30 minute meeting with Brian on May 20, 23, 24 or 25. The purpose of the meeting is to brief Brian on recent activities within the groups – particularly on any documents that will be up for approval at the CSNI meeting, and on issues that may be

BBB/158

raised, or that you think should be raised. If there has been any discussion within your WG about how to approach Fukushima, or if there has been any coordination with CNRA Working groups, that would be helpful context to have. When we see the final agenda, we will forward it on.

For reference, the CSNI Working Groups include:

- CSNI Program Review Group (PRG) – S. Richards
- WG on Risk Assessment (WGRISK, includes digital I&C sub-group activities) – N. Siu, K. Coyne, A. Kuritzky
- WG on Analysis and Management of Accidents (WGAMA) – S. Bajorek
- WG on Human and Organizational Factors (WGHOF) – V Barnes
- WG on Integrity and Aging of Components and Structures (WGIAGE, includes concrete/seismic sub-group activities as well as CODAP) – R. Tregoning, S. Ali, A. Murphy, A. Csontos
- WG on Fuel Safety – J. Voglewede
- Task Group on Advanced Reactor Experimental Facilities (TAREF) – K. Gibson

Additionally, if status updates are available for these topics, please schedule a meeting or otherwise provide input:

- International Forum on Long Term Operations – R. Tregoning, G. Carpenter
- Sump Clogging Task Group – J. Burke
- High Energy Arcing Faults (HEAF) – M. Salley, G. Taylor

Thanks

Donna-Marie

International Programs Team Leader
US Nuclear Regulatory Commission
Office of Nuclear Regulatory Research (RES)

Donna-Marie.Sangimino@nrc.gov
(+1) 301-251-7673