

**Ross, Robin**

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**From:** Wertz, Trent on behalf of Leeds, Eric  
**Sent:** Thursday, April 14, 2011 11:01 AM  
**To:** Wertz, Trent  
**Subject:** FW: Statement on the implications of the Fukushima nuclear accident.htm

REF

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**From:** Wiggins, Jim  
**Sent:** Monday, April 04, 2011 7:11 AM  
**To:** ET05 Hoc; ET07 Hoc; LIA01 Hoc; RST01 Hoc; Hoc, PMT12  
**Cc:** Leeds, Eric; Johnson, Michael; Miller, Charles; FOIA Response.hoc Resource  
**Subject:** FYI:Statement on the implications of the Fukushima nuclear accident.htm

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## Statement from HM Chief Inspector of Nuclear Installations on the implications of the Fukushima nuclear accident

29 March 2011

On 12 March 2011, the Secretary of State for Energy and Climate Change, Chris Huhne, requested Mike Weightman, HM Chief Inspector of Nuclear Installations, to produce a report on the implications for the UK nuclear industry of the accident that took place at the Fukushima Dai-ichi nuclear power station in Japan. The purpose of the report is to identify any lessons to be learnt, taking forward this work in co-operation and co-ordination with national stakeholders and international colleagues. The Secretary of State asked for an interim report by the middle of May 2011, with a final report in September.

The Secretary of State's request has made clear that Mike Weightman has full independence to determine the scope of the report and the arrangements for conducting it. The Chief Inspector has since indicated that the reports would be:

- comprehensive and wide in scope;
- based on firm evidence and facts using the best independent scientific and technical advice available;
- informed by stakeholders with access to relevant information; and
- produced in an open and transparent way.

The reports will not address nuclear or energy policy issues as these are outside the role and responsibilities of the nuclear regulator.

It is not possible to define the final scope of the report at this stage. The events in Japan are not yet clear and relevant issues may emerge over the coming days or weeks that Mike Weightman would need to take into account in the final report. It is also possible that, once defined, the scope of the full report will need to be refined as further information becomes available. However, we can confirm that the scope for the final report will include the following broad areas:

## General

- General background on nuclear power technology and the approach to nuclear safety and security regulation in the UK, internationally and in Japan.

## Events in Japan

- A high-level description of the nuclear power station at Fukushima;
- Design provisions for resilience against natural hazards;
- The events at site, including timeline and impact and actions taken to protect people;
- Key on-site factors, including operator actions, contributing to the events; and
- Key off-site factors, including emergency response provisions, affecting the control and mitigation of events;

## Lessons for the UK

- A comparison of UK nuclear power station designs with those at Fukushima;
- Natural hazards and other potential threats to UK nuclear facilities;
- Potential lessons for the UK; and
- Any recommendations regarding the lessons learnt.

Given the timing, and the fact that there is likely to be only limited information available, the scope for the interim report will necessarily be less comprehensive than the final report. It will focus on any immediate lessons to be learnt for existing nuclear power stations in the UK and for any prospective nuclear power stations, based on the information available up to the middle of April.

Mike Weightman is setting up an independent expert technical advisory panel to assist in the report. He would also like to receive submissions from all those with technical information about the accident or thoughts about any lessons from it that can be learnt to enhance nuclear safety in the UK. We will send out further information on this in the coming days.



Ross, Robin

**From:** Wertz, Trent on behalf of Leeds, Eric  
**Sent:** Thursday, April 14, 2011 11:20 AM  
**To:** Wertz, Trent  
**Subject:** FW: The Lessons of Fukushima Daiichi, April 26, 2011

**From:** EUCI Events [<mailto:events@eucievents.com>]  
**Sent:** Tuesday, March 29, 2011 10:22 AM  
**To:** Leeds, Eric  
**Subject:** The Lessons of Fukushima Daiichi, April 26, 2011



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

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

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

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

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

[PDF Brochure](#) | [Pricing and Registration](#)

### Topics Include

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

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Ross, Robin

**From:** Wertz, Trent on behalf of Leeds, Eric  
**Sent:** Thursday, April 14, 2011 11:11 AM  
**To:** Wertz, Trent  
**Subject:** FW: FYI - HOMELAND SECURITY NEWS WIRE ARTICLE ON CORE MELT IN UNIT 2 AT FUKUSHIMA-DAIICHI

REL

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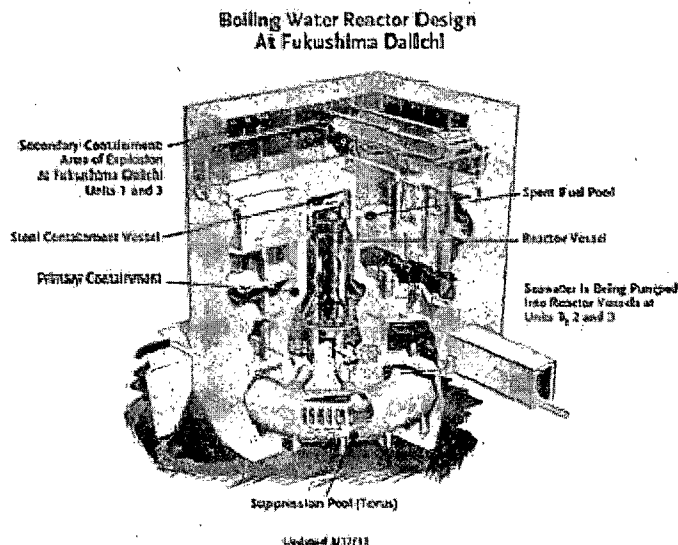
**From:** Weber, Michael  
**Sent:** Wednesday, March 30, 2011 6:56 PM  
**To:** LIA06 Hoc; LIA08 Hoc; Brenner, Eliot; Hayden, Elizabeth; Zimmerman, Roy; McDermott, Brian; Wiggins, Jim; Sheron, Brian  
**Cc:** RST01 Hoc; Leeds, Eric; Borchardt, Bill; Virgilio, Martin  
**Subject:** FYI - HOMELAND SECURITY NEWS WIRE ARTICLE ON CORE MELT IN UNIT 2 AT FUKUSHIMA-DAIICHI

The article below cites statements from the former head of GE nuclear research regarding the probable exvessel melt through of the core at unit 2. I had not previously seen references to this in the general press.

## Fukushima Daiichi nuclear plant lost

Published 30 March 2011

The radioactive core in the Unit 2 reactor at the Fukushima Daiichi nuclear plant appears to have melted through the bottom of its containment vessel and is now resting on a concrete floor; officials are now struggling with two crucial but contradictory efforts: pumping in water to keep the fuel rods cool and pumping out contaminated water; an investigation found that Tokyo Electric Power Co. officials had dismissed scientific evidence and geological history that indicated that a massive earthquake -- and subsequent tsunami -- was far more likely than they believed; more than 11,000 bodies have been recovered, but officials say the final death toll is expected to exceed 18,000. Hundreds of thousands of people remain homeless, their homes and livelihoods destroyed. Damage could amount to \$310 billion -- the most expensive natural disaster on record



Design schematic of the Fukushima reactor // Source: [instituteeforenergyresearch.org](http://instituteeforenergyresearch.org)



Workers at the crippled Fukushima Daiichi nuclear plant appeared to have “lost the race” to save one of the reactors, a U.S. expert told the *Guardian*.

Richard Lahey, who was head of safety research for boiling water reactors at General Electric when the company installed the units at the Japan plant, says the radioactive core in the Unit 2 reactor appears to have melted through the bottom of its containment vessel and on a concrete floor.

“The indications we have, from the reactor to radiation readings and the materials they are seeing, suggest that the core has melted through the bottom of the pressure vessel in unit two, and at least some of it is down on the floor of the drywell,” Lahey told the paper.

Lahey did add there was no danger of a Chernobyl-style catastrophe.

Japan was hit by another earthquake Wednesday after a magnitude-5.5 earthquake struck off the east coast of Honshu, according to the U.S. Geological Survey.

Fox News reports that Japan’s government vowed Tuesday to overhaul nuclear safety standards once its radiation-leaking reactor complex is under control, admitting that its safeguards were insufficient to protect the plant against the 11 March tsunami.

The struggle to contain radiation at the complex has unfolded with near-constant missteps — including two workers drenched Tuesday with radioactive water despite wearing supposedly waterproof suits. The unfolding drama has drawn increasing criticism of the utility that owns the plant as well as scrutiny of Japan’s preparedness for nuclear crises.

“Our preparedness was not sufficient,” Edano told reporters. “When the current crisis is over, we must examine the accident closely and thoroughly review” safety standards.

An AP investigation found that Tokyo Electric Power Co. officials had dismissed scientific evidence and geological history that indicated that a massive earthquake — and subsequent tsunami — was far more likely than they believed.

That left the complex with nowhere near enough protection against the 11 March tsunami.

A massive offshore earthquake triggered the tsunami that slammed into Japan’s northeast, wiping out towns, killing thousands of people and knocking out power and backup systems at the coastal nuclear power plant.

More than 11,000 bodies have been recovered, but officials say the final death toll is expected to exceed 18,000. Hundreds of thousands of people remain homeless, their homes and livelihoods destroyed. Damage could amount to \$310 billion — the most expensive natural disaster on record.

The mission to stabilize the power plant has been fraught with setbacks, as emergency crews have dealt with fires, explosions and radiation scares in the frantic bid to prevent a complete meltdown.

The plant has been leaking radiation that has made its way into vegetables, raw milk and tap water as far away as Tokyo. Residents within twelve miles of the plant have been ordered to leave and some nations have banned the imports of food products from the Fukushima region.

Highly toxic plutonium was the latest contaminant found seeping into the soil outside the plant, TEPCO said Monday.

Safety officials said the amounts did not pose a risk to humans, but the finding supports suspicions that dangerously radioactive water is leaking from damaged nuclear fuel rods.

"The situation is very grave," Edano told reporters Tuesday.

Fox News reports that workers succeeded last week in reconnecting some parts of the plant to the power grid. As they pumped in water to cool the reactors and nuclear fuel, however, they discovered numerous pools of radioactive water, including in the basements of several buildings and in trenches outside of them.

The contaminated water has been emitting four times as much radiation as the government considers safe for workers. It must be pumped out before electricity can be restored and the regular cooling systems powered up.

That has left officials struggling with two crucial but contradictory efforts: pumping in water to keep the fuel rods cool and pumping out contaminated water.

Officials are hoping tanks at the complex will be able to hold the water, or that new tanks can be trucked in. On Tuesday, officials from the Nuclear Safety Commission, an expert panel of nuclear watchdogs, said other possibilities include digging a storage pit for the contaminated water, recycling it back into the reactors or even pumping it to an offshore tanker.

The latest mishap came Tuesday, when three workers trying to connect a pump outside the Unit 3 reactor were splashed by radioactive water that gushed from a pipe. Though they were wearing suits meant to be waterproof and protect against high levels of radiation, nuclear safety official Hidehiko Nishiyama said the men were soaked to their underwear with the contaminated water.

They quickly washed it off and were not injured, officials said.

*Mike*

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

301-415-1705  
Mail Stop O16E15

**Ross, Robin**

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**From:** Wertz, Trent on behalf of Leeds, Eric *nr*  
**Sent:** Thursday, April 14, 2011 10:36 AM  
**To:** Wertz, Trent  
**Subject:** FW: RESPONSE - CSIS INVITATION: Nuclear Safety After Fukushima

*REL*

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**From:** Weber, Michael *W*  
**Sent:** Monday, April 04, 2011 10:45 AM  
**To:** Mamish, Nader  
**Cc:** Dembek, Stephen; LIA06 Hoc; LIA08 Hoc; Williams, Shawn; Virgilio, Martin; Miller, Charles; Sanfilippo, Nathan; Leeds, Eric; Wiggins, Jim; Johnson, Michael; Haney, Catherine; Sheron, Brian; Droggitis, Spiros; Schmidt, Rebecca; Powell, Amy; Brenner, Eliot; Hayden, Elizabeth  
**Subject:** RESPONSE - CSIS INVITATION: Nuclear Safety After Fukushima

Great. Thanks, Nader

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**From:** Mamish, Nader *W*  
**Sent:** Monday, April 04, 2011 8:37 AM  
**To:** Weber, Michael  
**Subject:** FW: QUERY - CSIS INVITATION: Nuclear Safety After Fukushima

Steve Dembek will participate and share insights w/the team.

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**From:** Weber, Michael *W*  
**Sent:** Friday, April 01, 2011 4:49 PM  
**To:** Doane, Margaret; Mamish, Nader  
**Cc:** LIA06 Hoc; LIA08 Hoc; Brenner, Eliot; Schmidt, Rebecca; Boger, Bruce; Thaggard, Mark; Muessle, Mary; Andersen, James; Leeds, Eric; Haney, Catherine; Sheron, Brian; Johnson, Michael; Virgilio, Martin  
**Subject:** QUERY - CSIS INVITATION: Nuclear Safety After Fukushima

Does OIP want to take the lead in participating in this seminar for NRC? Someone should attend, listen, and share highlights back here to the rest of our team. If OIP cannot support, please advise.

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**From:** CSIS Proliferation Prevention Program [<mailto:tsplitzer-hobeika@csis.org>]  
**Sent:** Friday, April 01, 2011 4:11 PM  
**To:** Weber, Michael  
**Subject:** CSIS INVITATION: Nuclear Safety After Fukushima

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<b>CSIS</b>	<b>CENTER FOR STRATEGIC &amp; INTERNATIONAL STUDIES</b>	<b>Proliferation Prevention Program</b>
<b>INVITATION</b>		
<i>The CSIS Proliferation Prevention Program invites you to a timely</i>		



*discussion on:*

## **Nuclear Safety After Fukushima**

The March 11, 2011 earthquake and tsunami have had a devastating effect on Japan. The impact has been magnified by the crisis at the Fukushima Daiichi nuclear power plant, where efforts continue to contain radiation from damaged reactors and spent fuel pools. Beyond the inevitable questions posed by the media in the midst of the crisis, national and international authorities will be reviewing safety regulations and their implementation. The U.S. Congress has already held several hearings and the International Atomic Energy Agency Director Yukiya Amano has called for a nuclear safety summit in June.

The CSIS Proliferation Prevention Program is pleased to bring two expert panels together to analyze the current situation and its impact on U.S. and international nuclear safety.

**Thursday, April 7, 2011**

**from 2:00pm to 5:00pm**

**B1 Conference Center**

**CSIS, 1800 K Street NW, Washington, DC 20006**

### **Speakers:**

Opening Remarks: Dr. John Hamre, President, Center for Strategic and International Studies

Moderator: Ms. Sharon Squassoni, Director, CSIS Proliferation Prevention Program

#### 2:15-3:45: National Responses

Mr. Alex Flint, Senior Vice President for Governmental Affairs, Nuclear Energy Institute (Invited)

Ms. Ellen Vancko, Nuclear Energy and Climate Change Project Manager, Union of Concerned Scientists

Mr. Mark Holt, Specialist in Energy Policy, Congressional Research Service

#### 3:45-5:00: International Responses

Dr. Olli Heinonen, Senior Fellow, Belfer Center for Science and International Affairs, Harvard Kennedy School

Mr. Carlton Stoiber, Chair of the Nuclear Security Working Group, International Nuclear Law Association

Ms. Carol Kessler, Chair of the Nonproliferation and National Security Department, Brookhaven National Laboratory

Please **RSVP** to Ms. Tamara Spitzer-Hobeika at [tspitzer-hobeika@csis.org](mailto:tspitzer-hobeika@csis.org) or 202.775.3239.

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**Ross, Robin**

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**From:** Wertz, Trent on behalf of Leeds, Eric  
**Sent:** Thursday, April 14, 2011 11:09 AM  
**To:** Wertz, Trent  
**Subject:** FW: you might have seen those high resolution images already

REL

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

From: Sheron, Brian  
Sent: Friday, April 01, 2011 8:26 AM  
To: Borchardt, Bill; Weber, Michael; Virgilio, Martin  
Subject: FW: you might have seen those high resolution images already

FYI.

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

From: Per F. Peterson [mailto:[peterf@nuc.berkeley.edu](mailto:peterf@nuc.berkeley.edu)]  
Sent: Thursday, March 31, 2011 11:45 PM  
To: Kelly, John E (NE); Adams, Ian; Aoki, Steven; Binkley, Steve; Brinkman, Bill; Budnitz, Bob; Butnitz, Bob (pacbell.net); Finck, Phillip; Garwin, Dick (EOP); Garwin, Dick (IBM); Grossenbacher, John (INL); Hurlbut, Brandon; Lee, Richard; Lyons, Peter; McFarlane, Harold; Miller, Neile; Mustin, Tracy; Peterson, Per; Sheron, Brian; Steve Fetter; Szilard, Ronaldo; Owens, Missy  
Cc: Smith, Haley; Chambers, Megan (S4); Narendra, Blake; Fitzgerald, Paige; Pitzer, Karrie S.  
Subject: Fwd: you might have seen those high resolution images already

If you've not had a chance to look at high-resolution photos of the Unit 1-4 reactors at Fukushima, I recommend reviewing these photos.

They provide a better understanding of the scale and logistical challenges of working at the site, and make it pretty clear why remotely operated heavy construction equipment will be needed for the remediation effort. Clearing debris at ground level will be important to get space for setting up cranes that can clear debris from the tops of the reactor buildings. There is a massive amount of material that will need to be moved. This is an area where advice from experts in building demolition is needed soon.

-Per

>Date: Thu, 31 Mar 2011 18:18:58 -0700  
>From: Peter Hosemann <[peterh@berkeley.edu](mailto:peterh@berkeley.edu)>  
>To: faculty <[NE-faculty@nuc.berkeley.edu](mailto:NE-faculty@nuc.berkeley.edu)>  
>Subject: you might have seen those high resolution images already  
>  
>but in case you did not:  
>  
><http://cryptome.org/eyeball/daiichi-npp/daiichi-photos.htm?>  
>  
>Peter  
>  
>--  
>Dr. Peter Hosemann  
>Assistant Professor  
>Nuclear Engineering  
>University of California Berkeley

Y/ 286



>phone: (c) 510 717 5752

>[peterh@berkeley.edu](mailto:peterh@berkeley.edu)

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Per F. Peterson  
Professor and Chair  
Department of Nuclear Engineering  
University of California  
4153 Etcheverry Hall  
Berkeley, California 94720-1730  
[peterh@nuc.berkeley.edu](mailto:peterh@nuc.berkeley.edu)  
Office: (510) 643-7749      Fax: (510) 643-9685  
[http://www.nuc.berkeley.edu/People/Per\\_Peterson](http://www.nuc.berkeley.edu/People/Per_Peterson)

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## Ross, Robin

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**From:** Wertz, Trent on behalf of Leeds, Eric  
**Sent:** Thursday, April 14, 2011 10:20 AM  
**To:** Wertz, Trent  
**Subject:** FW: NRC Blog Post - From Japan: A First Person Account and NRC Reporter Video

RFL

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**From:** Steger (Tucci), Christine  
**Sent:** Friday, April 08, 2011 11:22 AM  
**To:** NRR\_PMDA Distribution; Leeds, Eric; Boger, Bruce; Grobe, Jack; Ruland, William; Wertz, Trent; Nguyen, Quynh; Cohen, Shari; Schwarz, Sherry; Ross, Robin  
**Subject:** FYI: NRC Blog Post - From Japan: A First Person Account and NRC Reporter Video

In case you haven't seen the most recent post to the NRC Blog – I thought you may find it interesting. See below post from Dan Dorman (NRC) who is on the ground in Japan.  
The NRC Blog is located at: <http://public-blog.nrc-gateway.gov/>

In addition, there was a recorded interview in the NRC Reporter of Tony Ulses (NRR) and Jim Trapp (EDO) about their experiences while they were in Japan.  
<http://www.internal.nrc.gov/news/nrcreporter/2011/articles/04/02.html>

Christine

**Christine A. Steger**  
Communications Analyst  
Program Management, Policy Development  
and Analysis Staff  
Office of Nuclear Reactor Regulation  
Direct: 301-415-2008  
[christine.steger@nrc.gov](mailto:christine.steger@nrc.gov)

---

**Feed:** U.S. NRC Blog  
**Posted on:** Thursday, April 07, 2011 11:10 AM  
**Author:** Moderator  
**Subject:** From Japan: A First Person Account

Within about 16 hours after the massive earthquake and tsunami struck the Fukushima Dai'ichi nuclear power complex on the northeastern coast of Japan, two NRC reactor experts were throwing a few changes of clothing into suitcases and racing for the airport. They hit the ground in Tokyo with a single purpose – provide key technical support and advice to the U.S. Embassy.

Just over two days later, the vanguard of what has become a revolving team of more than 30 staff were on their way, including Chuck Casto, deputy regional administrator out of our Region II office. They were part of a U.S. Agency for International Development (USAID) assistance mission launched in response to a request for help from the Japanese government.

Now, over three weeks into this terrible tragedy for the Japanese people, the team of NRC experts is working closely with our counterparts in the Japanese government, as well as the power plant operator – TEPCO –

other U.S. government agencies, and even the U.S. private sector.

We have received tremendous support from the embassy and USAID staff as we've taken over a chunk of the embassy's space as a base of operations and demand all manner of IT support, but we never seem to spend long there. Every day we are off in small groups to various locations around Tokyo to meet with our Japanese counterparts, gathering information on the most current understanding of conditions at the plant and the actions being taken by the Japanese.

When we get back to the embassy, we get on the phone to experts back in the states and obtain their best consensus view of the actions needed to stabilize the plants. Then we are off around Tokyo again to share and discuss our advice and recommendations. In addition to this, we are supporting project teams established by the Japanese government to develop long-term plans for clean-up and decommissioning of the site after it is stabilized. In this latter effort, we are receiving tremendous support from colleagues in the Department of Energy and the national labs.

When we are at the embassy, we are also working closely with the embassy staff, USAID, and other federal agencies to respond to the specific requests for assistance from the Japanese government. For example, we have supported them with provision of a back-up supply of freshwater and pumping capacity to ensure that stable and sustainable cooling will be available at the plant. Through the generosity of the U.S. nuclear industry, we have been able to supply thousands of sets of protective clothing, radiation dosimeters and radiation monitoring equipment that will be important to ensuring protection of the workers at the site.

What has impressed all of us on the NRC team is the commitment of our Japanese counterparts to bring this very serious situation under control. Japan has long used nuclear power as a mainstay of its electrical generation system, so they have lots of experience.

This is a near overwhelming event that would challenge any nation, and I have been impressed at the effort being exerted by those most affected by this tragedy.

The nuclear community around the world is, in relative terms, small, and our thoughts are with the Japanese people and, in particular, with the workers at the site. Many of them have already suffered grievous loss of family and property from the earthquake and tsunami. They labor on in difficult conditions. The world has rallied to their aid, contributing protective clothing and equipment.

Our team in Japan continues to work with the Japanese government to ensure they have the resources to support and protect these workers. These are the true heroes of Fukushima Dai'ichi and they deserve our utmost respect, our fervent prayers and our continued support.

Thanks to Chuck Casto who contributed to this post.

*Dan Dorman*  
*NRC Japan Team Member*

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**Ross, Robin**

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**From:** Wertz, Trent on behalf of Leeds, Eric  
**Sent:** Thursday, April 14, 2011 10:19 AM  
**To:** Wertz, Trent  
**Subject:** FW: FYI: Spoke with Marty

RFL

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**From:** Moore, Scott *NSIR*  
**Sent:** Friday, April 08, 2011 4:52 PM  
**To:** Leeds, Eric  
**Subject:** RE: FYI: Spoke with Marty

Thanks, Eric. I agree that defining stability is an essential step (i.e., stability of the event at the plant). Various exit strategies .... for the site team, for the Ops Center, etc., all included stability of the event at the plant as an essential criteria. But I've heard different opinions among senior leadership on whether or not the plant situation is stable. Further defining the term should be a step in the right direction. Thanks for following up with Marty!

Scott

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**From:** Leeds, Eric  
**Sent:** Friday, April 08, 2011 1:53 PM  
**To:** Johnson, Michael; Sheron, Brian; Wiggins, Jim; Moore, Scott; Mamish, Nader; McCree, Victor; Lew, David; Satorius, Mark; Howell, Art; Kokajko, Lawrence  
**Subject:** FYI: Spoke with Marty

I just spoke with Marty about the concerns we discussed this am. Marty plans to send an email to all of us describing an "exit strategy" for the Op Center and Tokyo. He is working with the Chairman and seems confident that we will be able to down-power our efforts once a definition of stability is agreed upon and reached. Certainly, we'll work the issue through this weekend and the beginning of next week, but there is hope going forward.

Enjoy the weekend!

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

**Ross, Robin**

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**From:** Wertz, Trent on behalf of Leeds, Eric  
**Sent:** Thursday, April 14, 2011 10:36 AM  
**To:** Wertz, Trent  
**Subject:** FW: Best Video of the Wave that hit Japan

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**From:** Bittinger, Misty [<mailto:Misty.Bittinger@serco-na.com>]  
**Sent:** Monday, April 04, 2011 11:31 AM  
**Subject:** FW: Best Video of the Wave that hit Japan

*RFL* This is soo sad

**Subject: Fw: Best Video of the Wave that hit Japan**

<http://freevideocoding.com/flvplayer.swf?file=http://flash.vx.roo.com/streamingVX/63>

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No virus found in this message.

Checked by AVG - [www.avg.com](http://www.avg.com)

Version: 10.0.1209 / Virus Database: 1500/3543 - Release Date: 03/31/11

## Ross, Robin

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**From:** Wertz, Trent on behalf of Leeds, Eric  
**Sent:** Thursday, April 14, 2011 11:04 AM  
**To:** Wertz, Trent  
**Subject:** FW: message from Ambassador Roos

NEC  

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**From:** Blount, Tom  
**Sent:** Saturday, April 02, 2011 9:19 AM  
**To:** ET05 Hoc; Leeds, Eric  
**Subject:** FW: message from Ambassador Roos

fyi

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**From:** Morris, Scott  
**Sent:** Saturday, April 02, 2011 5:46 AM  
**To:** Blount, Tom  
**Subject:** FW: message from Ambassador Roos

fyi

---

**From:** Carpenter, Cynthia JOE  
**Sent:** Saturday, April 02, 2011 5:44 AM  
**To:** Borchardt, Bill; Weber, Michael; Virgilio, Martin; ET07 Hoc; Jaczko, Gregory  
**Cc:** Morris, Scott; Casto, Chuck  
**Subject:** message from Ambassador Roos

Chairman,

Chuck Casto called this morning. Ambassador Roos asked Chuck to pass along the Ambassador's sincere appreciation and gratitude to the NRC staff for the wonderful job the entire team back here has been doing. He added, "The Ambassador has received feedback from credible sources that believe this has been the US Embassy's finest hour since the Embassy has been there."

Chuck Casto asked that we pass this along, and also, he will craft some additional words directly from the Ambassador for either the Chairman or Bill to send to the staff.

**Ross, Robin**

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**From:** Wertz, Trent on behalf of Leeds, Eric  
**Sent:** Thursday, April 14, 2011 11:30 AM  
**To:** Wertz, Trent  
**Subject:** FW: WENRA Statement Regarding Japan

REL

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**From:** Holahan, Gary  
**Sent:** Thursday, March 24, 2011 6:14 PM  
**To:** Doane, Margaret; Borchardt, Bill  
**Cc:** Mamish, Nader; Leeds, Eric; Johnson, Michael; Miller, Charles; Weber, Michael; Virgilio, Martin  
**Subject:** RE: WENRA Statement Regarding Japan

Margie,

Thanks, we have these already. The area that we will really need help is on what the rest of the world (beyond WENRA) is planning to do for their **operating reactors**.

We have pretty good communications already established for **new reactors** (at least for MDEP members ... and that's most new reactor regulators).

We would really like CNRA to be more proactive in getting and sharing info on what other regulators are planning (and eventually finding) for **operating reactors**.

International cooperation will be a small but important part of the NCR Task Force effort.

Gary

---

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

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

## WENRA statement on the Fukushima NPP accident

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

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

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

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

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

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

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

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Published: 2011-03-23 20:38

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[News archive](#)

## **First proposal about European “stress tests” on nuclear power plants**

### **Definition and objective**

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

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

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

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

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

#### Technical scope

The scope takes into account the issues that have been directly highlighted by the events that occurred in Fukushima and the possibility for combination of initiating events. The following situations will be envisaged:

#### Initiating events

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

#### Consequential loss of safety functions

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

#### Accident management issues

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

#### Consideration should be given to:

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

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

#### Methodology and timeframe

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

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

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

The licensees could be given 6 months to perform the reassessments as described above and to send the results

and related documentation to their national regulator.

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

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

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Published: 2011-03-23 20:16

**Ross, Robin**

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**From:** Wertz, Trent on behalf of Leeds, Eric  
**Sent:** Thursday, April 14, 2011 10:21 AM  
**To:** Wertz, Trent  
**Subject:** FW: Dai-ichi

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

**From:** Ruland, William  
**Sent:** Friday, April 08, 2011 10:04 AM  
**To:** Grobe, Jack; Leeds, Eric  
**Subject:** RE: Dai-ichi

Depends what is meant by "know."

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

**From:** Grobe, Jack *mg*  
**Sent:** Friday, April 08, 2011 7:29 AM  
**To:** Leeds, Eric; Ruland, William  
**Cc:** Virgilio, Martin; Miller, Charles  
**Subject:** Re: Dai-ichi

I now have heard that the explosion in Unt 4 was not hydrogen but possibly welding gas.

The bottom line is we are all speculating and we need the data/log books/interviews, etc.  
Jack Grobe, Deputy Director, NRR

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

**From:** Leeds, Eric *mg*  
**To:** Grobe, Jack; Ruland, William  
**Cc:** Virgilio, Martin  
**Sent:** Thu Apr 07 18:52:50 2011  
**Subject:** RE: Dai-ichi

I did not. Was the RST/PMT aware?

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

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

**From:** Grobe, Jack *mg*  
**Sent:** Wednesday, April 06, 2011 1:05 PM  
**To:** Ruland, William; Leeds, Eric  
**Subject:** Dai-ichi

Japan just said ther was a zirc fire in Unit 4 SFP. Did we know this??  
Jack Grobe, Deputy Director, NRR



## Ross, Robin

---

**From:** Wertz, Trent on behalf of Leeds, Eric  
**Sent:** Thursday, April 14, 2011 11:06 AM  
**To:** Wertz, Trent  
**Subject:** FW: Areva pps presentation on Japan event  
**Attachments:** Fukuchima\_eng.pps

OCF

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**From:** Jones, Cynthia  
**Sent:** Friday, April 01, 2011 1:51 PM  
**To:** Jones, Cynthia; Wiggins, Jim; Evans, Michele; Rothschild, Trip; Brenner, Eliot; Hayden, Elizabeth; Leeds, Eric; Boger, Bruce; Uhle, Jennifer; Sheron, Brian; Droggitis, Spiros; Merzke, Daniel; Virgilio, Martin; Weber, Michael; Burnell, Scott; McDermott, Brian; Morris, Scott; Rothschild, Trip; Young, Mitzi  
**Subject:** Areva pps presentation on Japan event

Please see attached Areva presentation on Japan event (received from CRS). Very good.

Cyndi

---

**From:** Jones, Cynthia  
**Sent:** Friday, April 01, 2011 1:00 PM  
**To:** Wiggins, Jim; Evans, Michele; Rothschild, Trip; Brenner, Eliot; Hayden, Elizabeth; Leeds, Eric; Boger, Bruce; Uhle, Jennifer; Sheron, Brian; Droggitis, Spiros; Merzke, Daniel; Virgilio, Martin; Weber, Michael; Burnell, Scott; McDermott, Brian; Morris, Scott  
**Subject:** CRS draft document on Japanese event - for your awareness

FYI-

Last weekend amongst all the other requests, we (PMT and myself) were requested to review and assist the Congressional Research Service (CRS) on their draft document on the Japanese event. I just rec'd a copy from them, for your awareness.

The RST (Rx Safety Team) had no comments, but we had a lot, and I think it showed an improved production in this version. Please share with your staff (I already passed along to RST & PMT).

I expect that CRS will share with Congress shortly.

Cyndi

---

**From:** Jonathan Medalia [<mailto:JMEDALIA@crs.loc.gov>]  
**Sent:** Friday, April 01, 2011 12:01 PM  
**To:** Jones, Cynthia  
**Subject:** RE: your phone message on CRS draft document

I'm updating the report to add an appendix with useful links, and of course have included a couple from NRC. Thanks again for your good work.  
Jon

>>> "Jones, Cynthia" <[Cynthia.Jones@nrc.gov](mailto:Cynthia.Jones@nrc.gov)> 4/1/2011 11:59 AM >>>  
Thanks Jon

---

**From:** Jonathan Medalia [<mailto:JMEDALIA@crs.loc.gov>]  
**Sent:** Thursday, March 31, 2011 6:31 PM  
**To:** Jones, Cynthia  
**Cc:** Sun, Casper; LIA06 Hoc; Hoc, PMT12  
**Subject:** Re: your phone message on CRS draft document

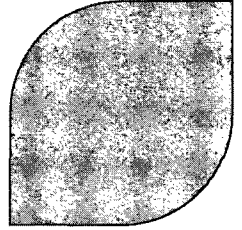
Hi Cyndi, Casper, et al.,

Thanks for your comments on my report, Cyndi. I have worked through them and now have the report in good shape. I'll be in touch if I have further questions, but for now I think I'm ok. I've attached the report. You will notice that I acknowledge assistance from NRC, which I greatly appreciate. I will update the report from time to time, so let me know if you have any thoughts, esp. things to add.

Best,  
Jon

Jonathan Medalia, Ph.D.  
Specialist in Nuclear Weapons Policy  
Congressional Research Service  
202-707-7632  
[jmedalia@crs.loc.gov](mailto:jmedalia@crs.loc.gov)





# The Fukushima Daiichi Incident

1. Plant Design
2. Accident Progression
3. Radiological releases
4. Spent fuel pools
5. Sources of Information

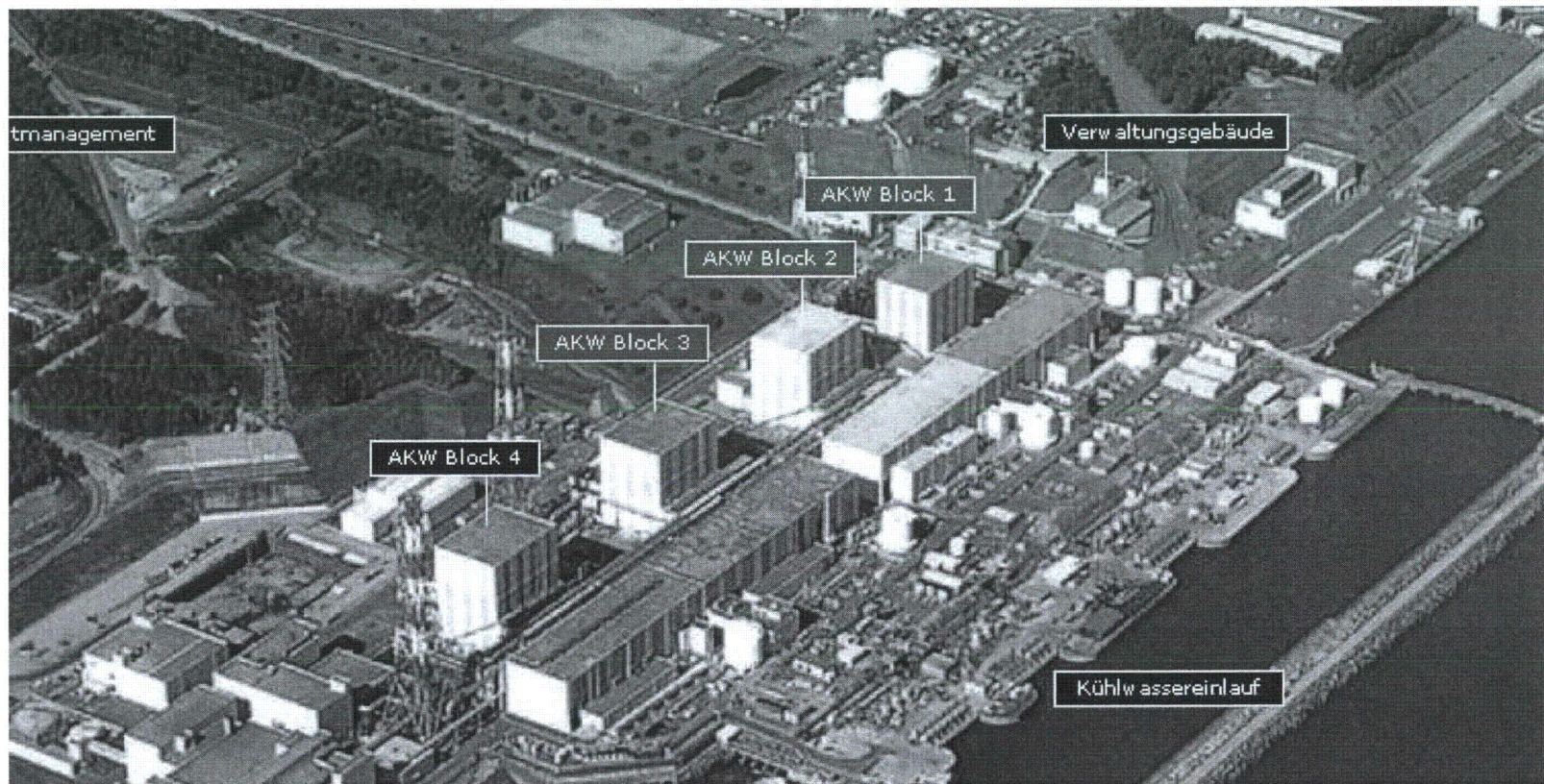
Matthias Braun  
PEPA4-G, AREVA-NP GmbH  
[Matthias.Braun@AREVA.com](mailto:Matthias.Braun@AREVA.com)

# The Fukushima Daiichi Incident

## 1. Plant Design

### ► Fukushima Daiichi (Plant I)

- ◆ Unit I - GE Mark I BWR (439 MW), Operating since 1971
- ◆ Unit II-IV - GE Mark I BWR (760 MW), Operating since 1974



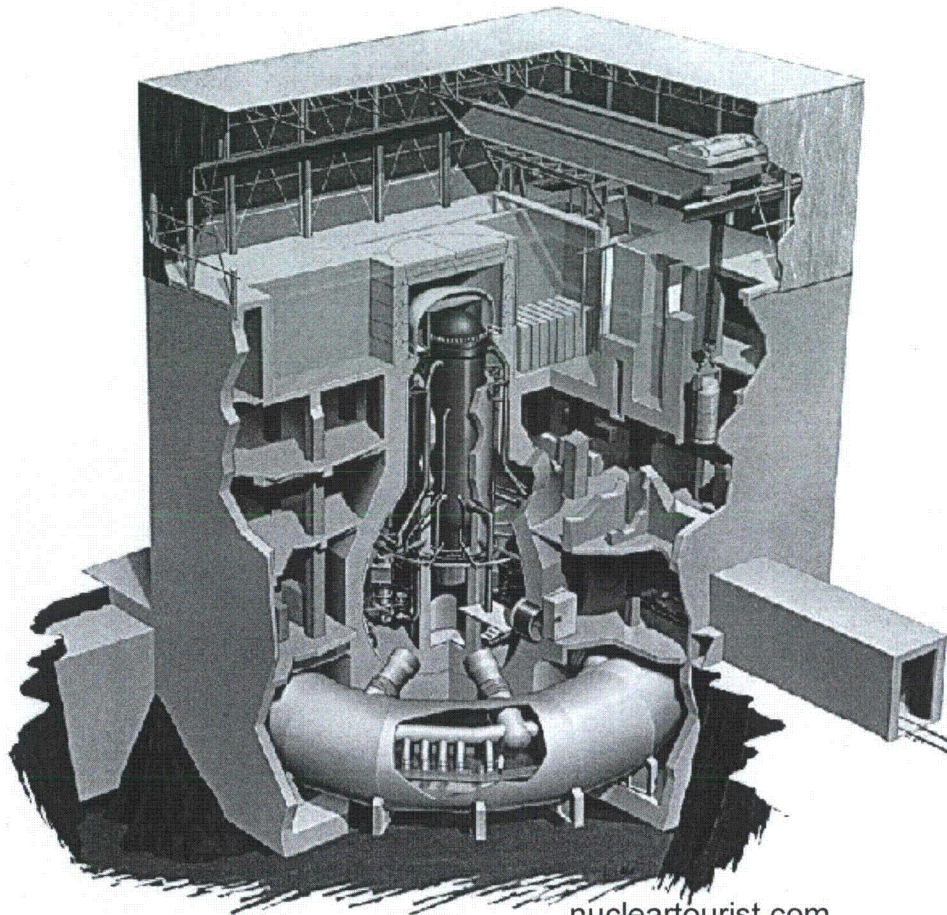


# The Fukushima Daiichi Incident

## 1. Plant Design

### ► Building structure

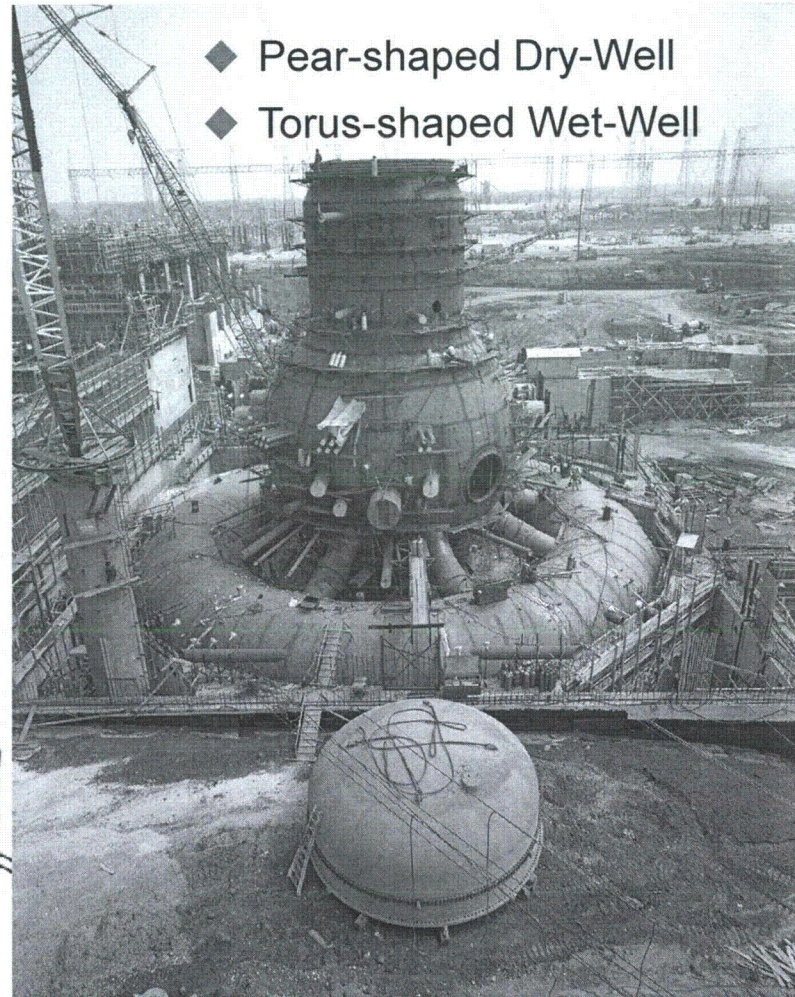
- ◆ Concrete Building
- ◆ Steel-framed Service Floor



nucleartourist.com

### ► Containment

- ◆ Pear-shaped Dry-Well
- ◆ Torus-shaped Wet-Well



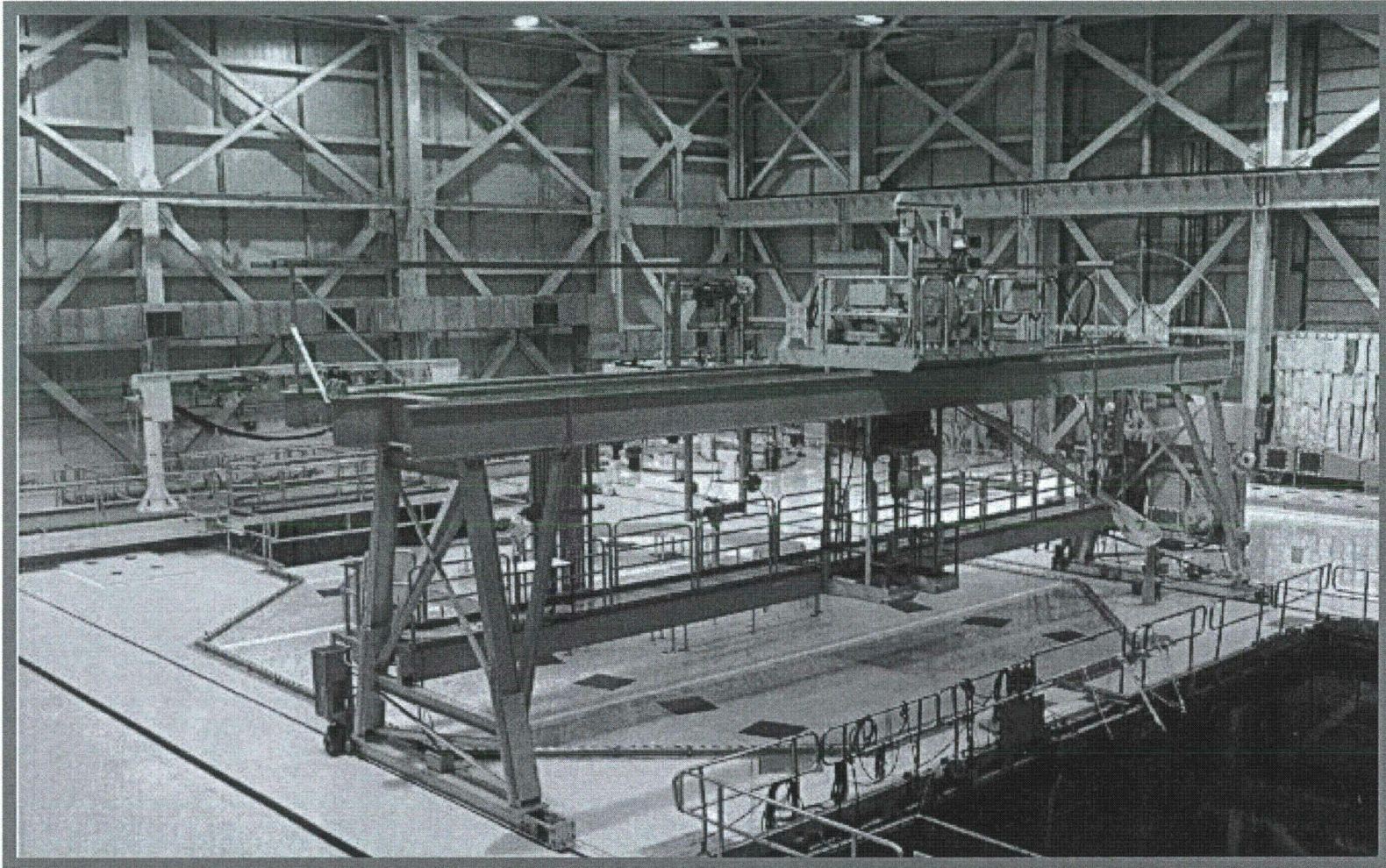
en.wikipedia.org/wiki/Browns\_Ferry\_Nuclear\_Power\_Plant



# The Fukushima Daiichi Incident

## 1. Plant Design

### ► Service Floor

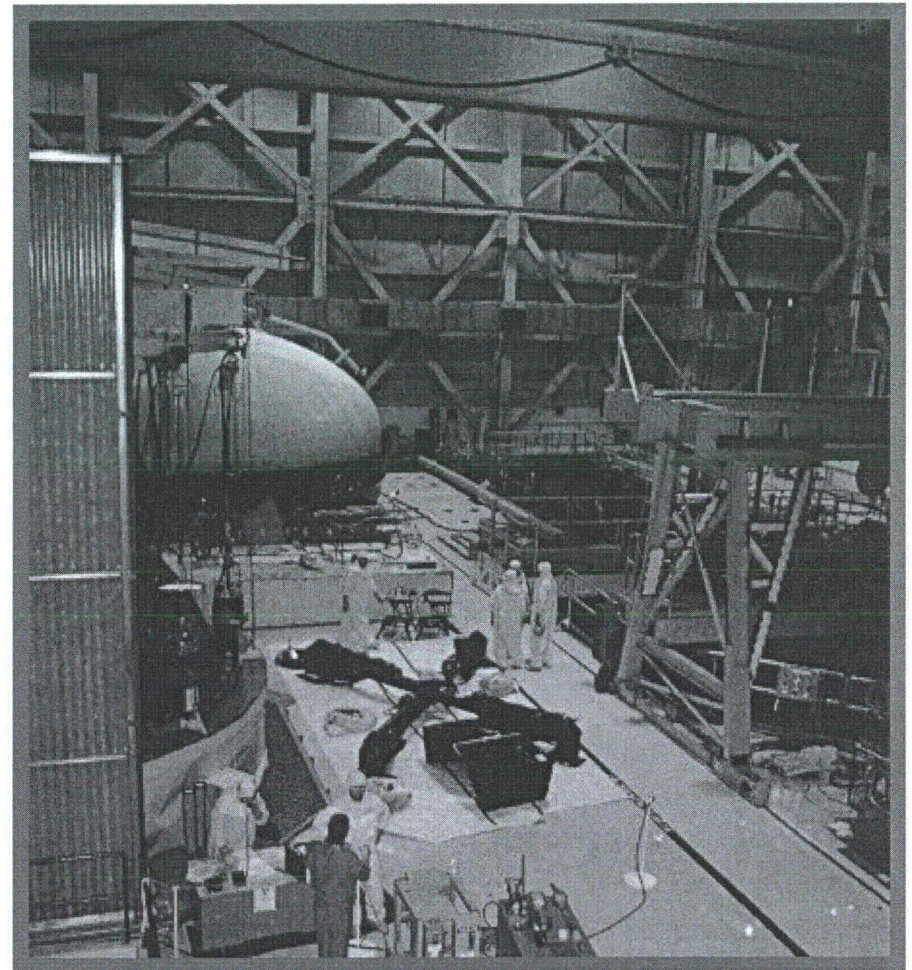
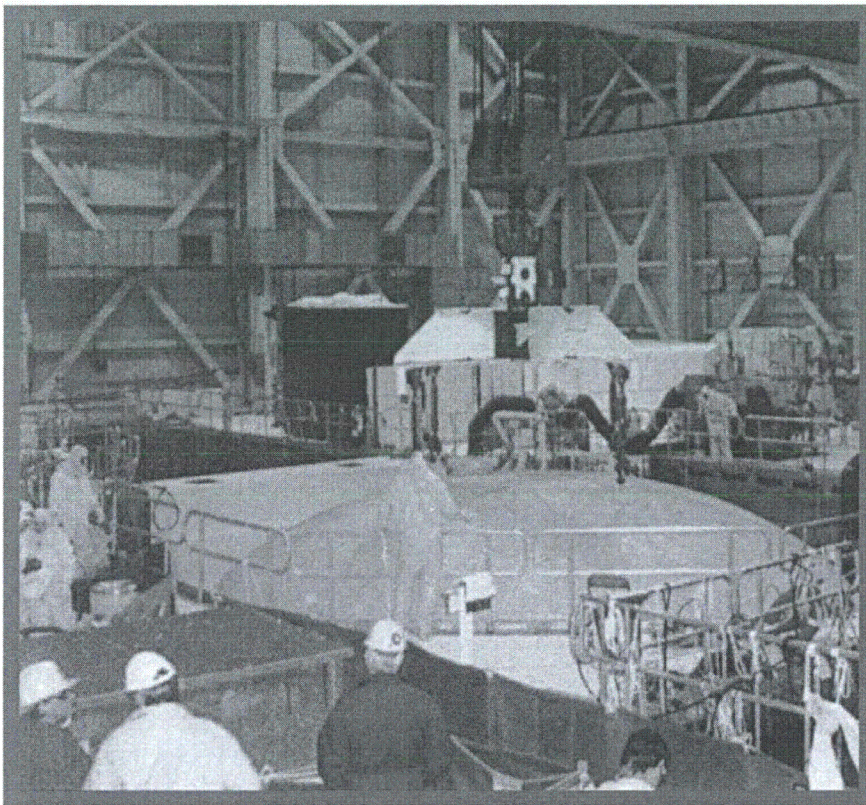




# The Fukushima Daiichi Incident

## 1. Plant Design

- ▶ Lifting the Containment closure head





# The Fukushima Daiichi Incident

## 1. Plant Design

► Reactor Service Floor  
(Steel Construction)

► Concrete Reactor Building  
(secondary Containment)

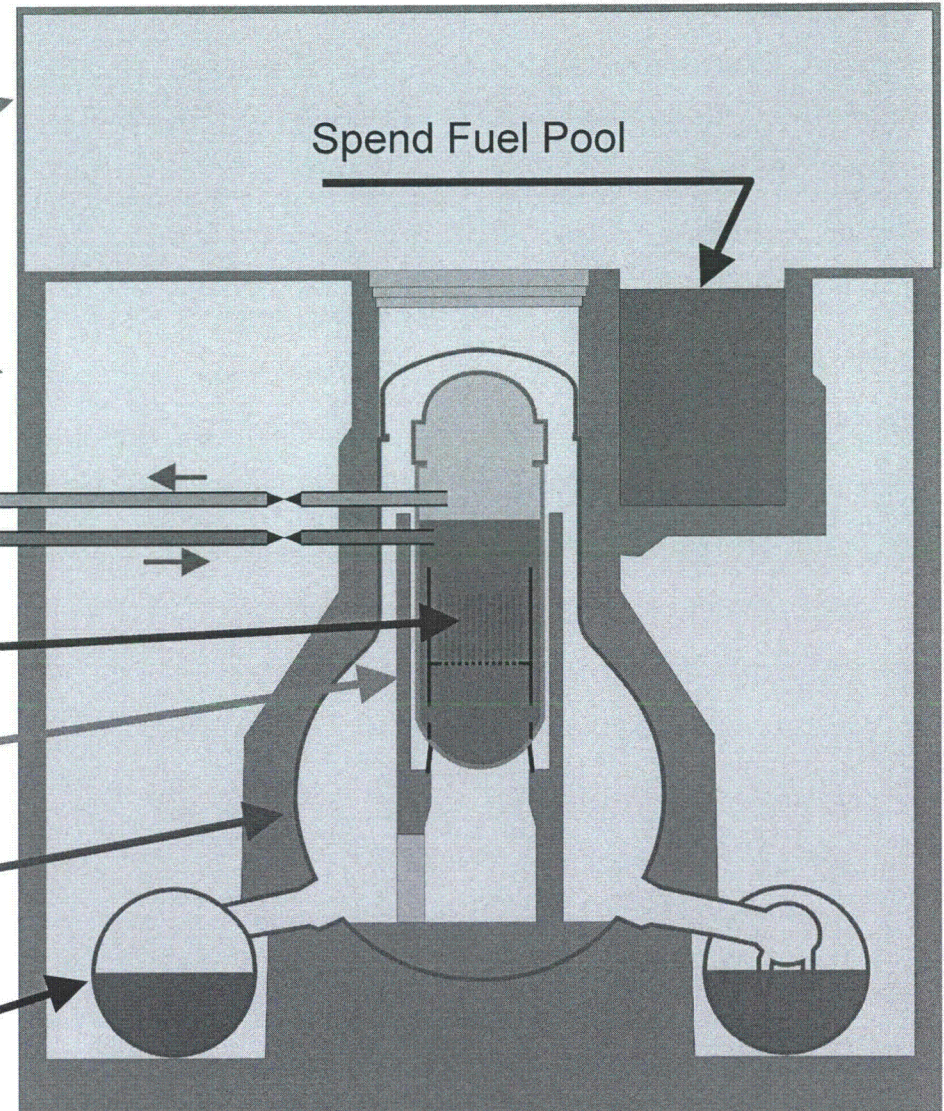
Fresh Steam line  
Main Feedwater

► Reactor Core

► Reactor Pressure Vessel

► Containment (Dry well)

► Containment (Wet Well) /  
Condensation Chamber





# The Fukushima Daiichi Incident

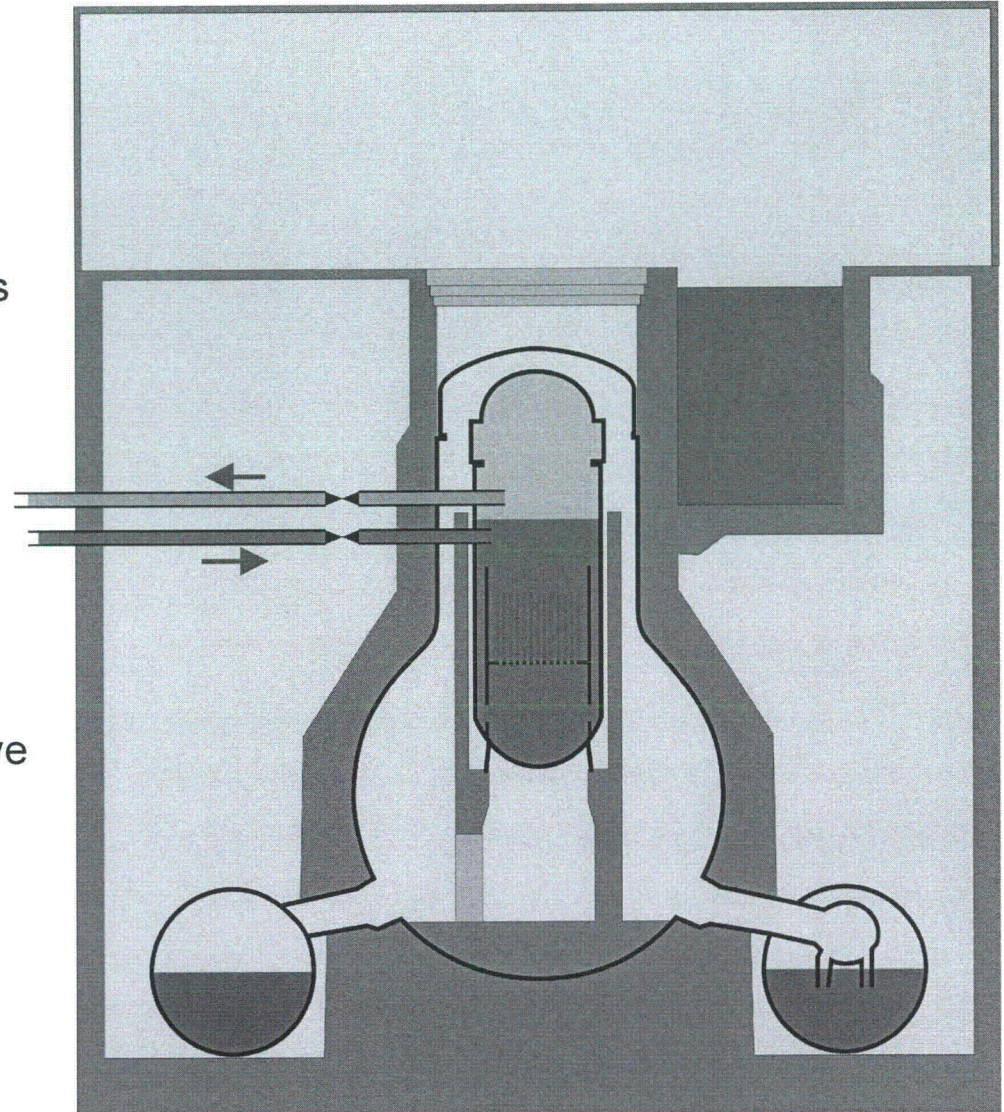
## 2. Accident progression

### ► 11.3.2011 14:46 - Earthquake

- ◆ Magnitude 9
- ◆ Power grid in northern Japan fails
- ◆ Reactors itself are mainly undamaged

### ► SCRAM

- ◆ Power generation due to Fission of Uranium stops
- ◆ Heat generation due to radioactive Decay of Fission Products
  - After Scram ~6%
  - After 1 Day ~1%
  - After 5 Days ~0.5%

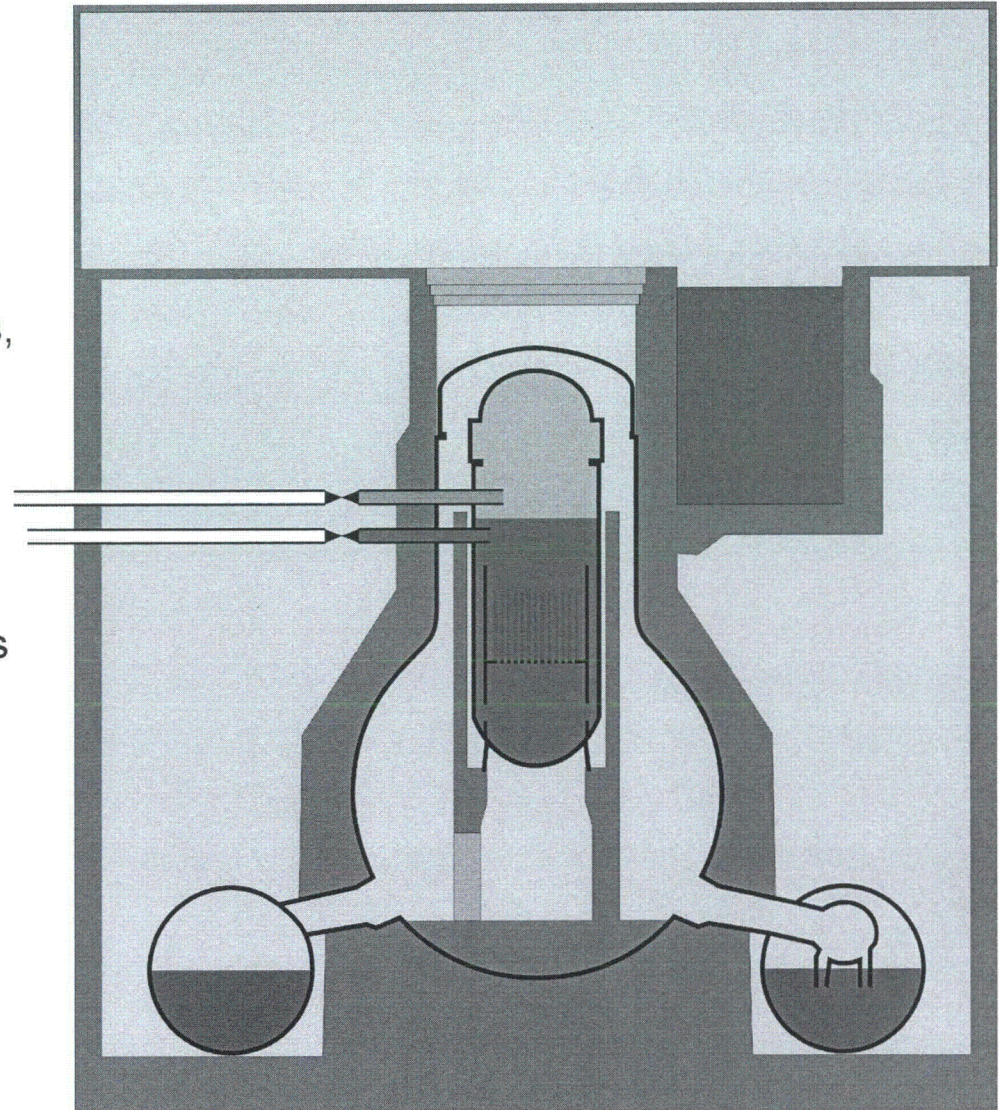




# The Fukushima Daiichi Incident

## 2. Accident progression

- ▶ Containment Isolation
  - ◆ Closing of all non-safety related Penetrations of the containment
  - ◆ Cuts off Machine hall
  - ◆ If containment isolation succeeds, a large early release of fission products is highly unlikely
- ▶ Diesel generators start
  - ◆ Emergency Core cooling systems are supplied
- ▶ Plant is in a stable save state

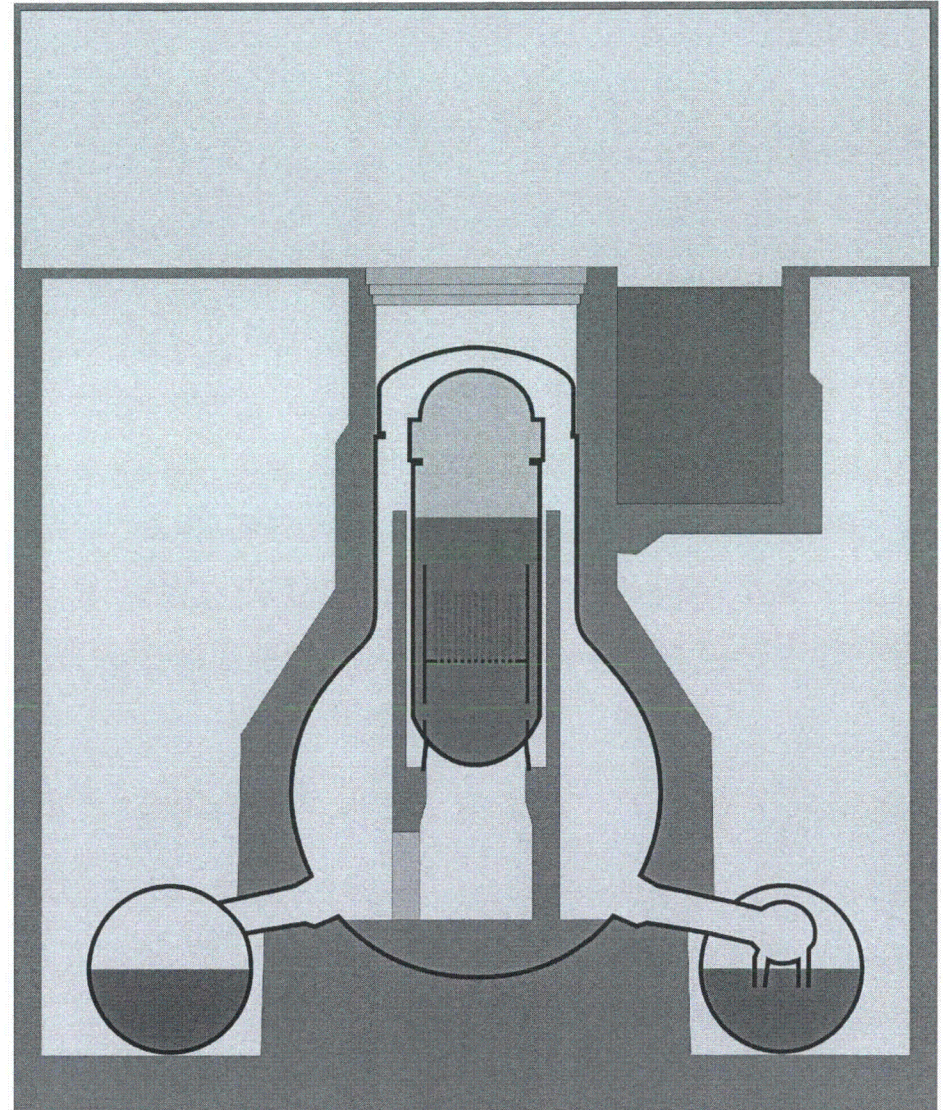




# The Fukushima Daiichi Incident

## 2. Accident progression

- ▶ 11.3. 15:41 Tsunami hits the plant
  - ◆ Plant Design for Tsunami height of up to 6.5m
  - ◆ Actual Tsunami height >7m
  - ◆ Flooding of
    - Diesel Generators and/or
    - Essential service water building cooling the generators
- ▶ Station Blackout
  - ◆ Common cause failure of the power supply
  - ◆ Only Batteries are still available
  - ◆ Failure of all but one Emergency core cooling systems

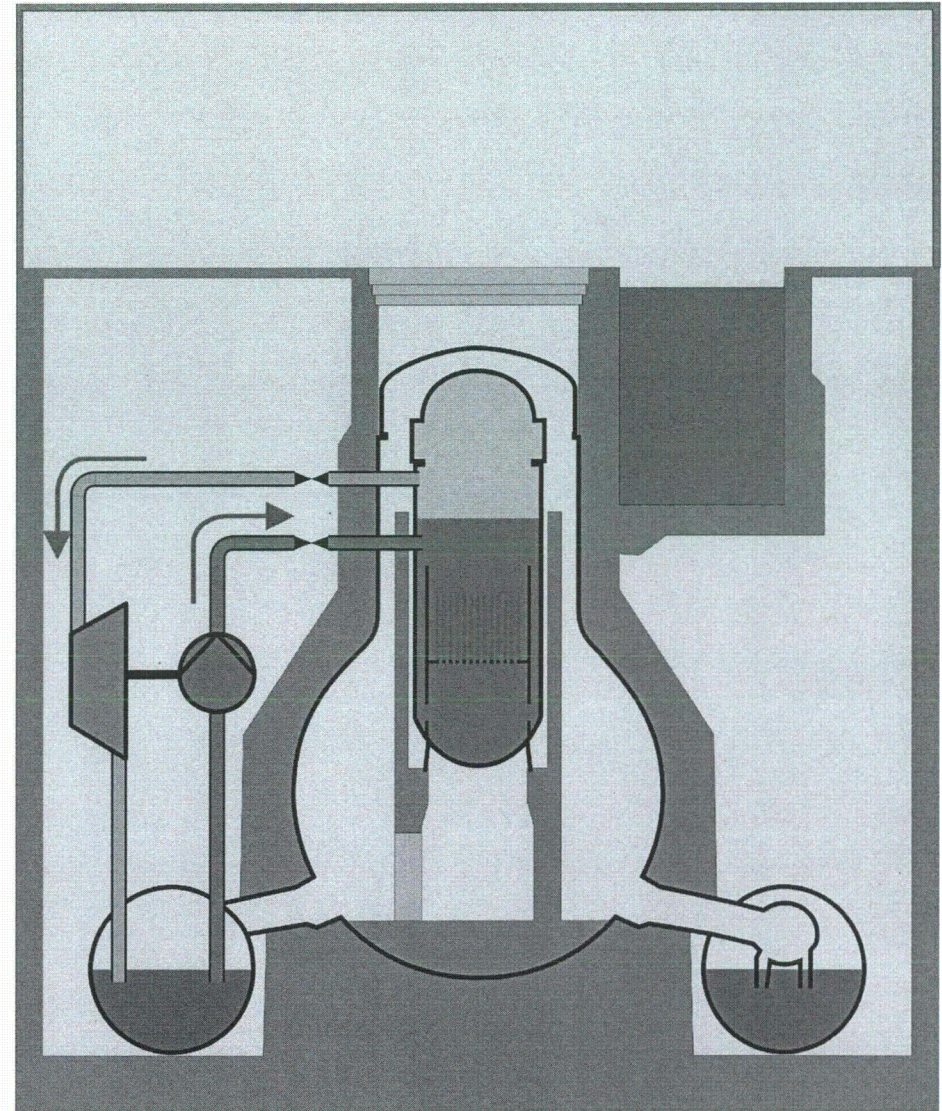




# The Fukushima Daiichi Incident

## 2. Accident progression

- ▶ Reactor Core Isolation Pump still available
  - ◆ Steam from the Reactor drives a Turbine
  - ◆ Steam gets condensed in the Wet-Well
  - ◆ Turbine drives a Pump
  - ◆ Water from the Wet-Well gets pumped in Reactor
  - ◆ Necessary:
    - Battery power
    - Temperature in the wet-well must be below 100°C
- ▶ As there is no heat removal from the building, the Core isolation pump cant work infinitely

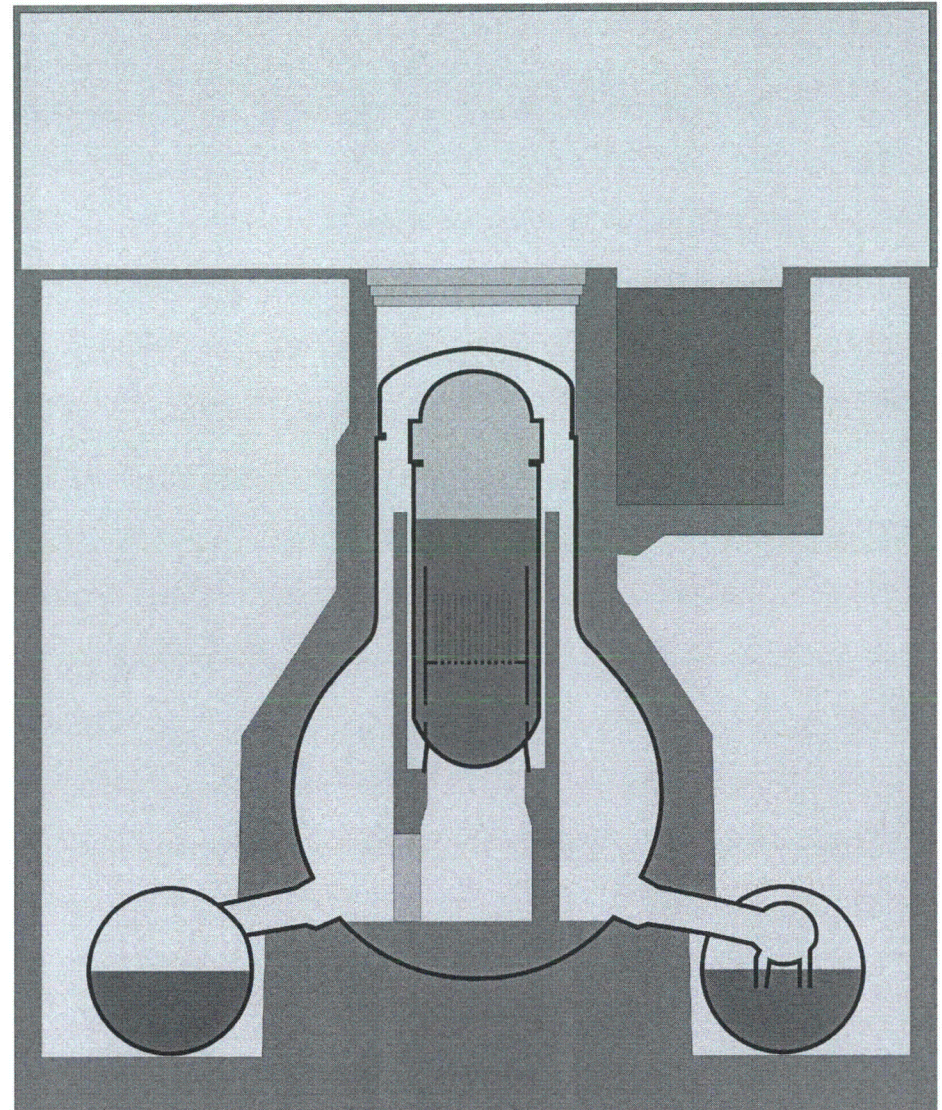




# The Fukushima Daiichi Incident

## 2. Accident progression

- ▶ Reactor Isolation pump stops
  - ◆ 11.3. 16:36 in Unit 1  
(Batteries empty)
  - ◆ 14.3. 13:25 in Unit 2  
(Pump failure)
  - ◆ 13.3. 2:44 in Unit 3  
(Batteries empty)
- ▶ Decay Heat produces still steam in Reactor pressure Vessel
  - ◆ Pressure rising
- ▶ Opening the steam relieve valves
  - ◆ Discharge Steam into the Wet-Well
- ▶ Descending of the Liquid Level in the Reactor pressure vessel

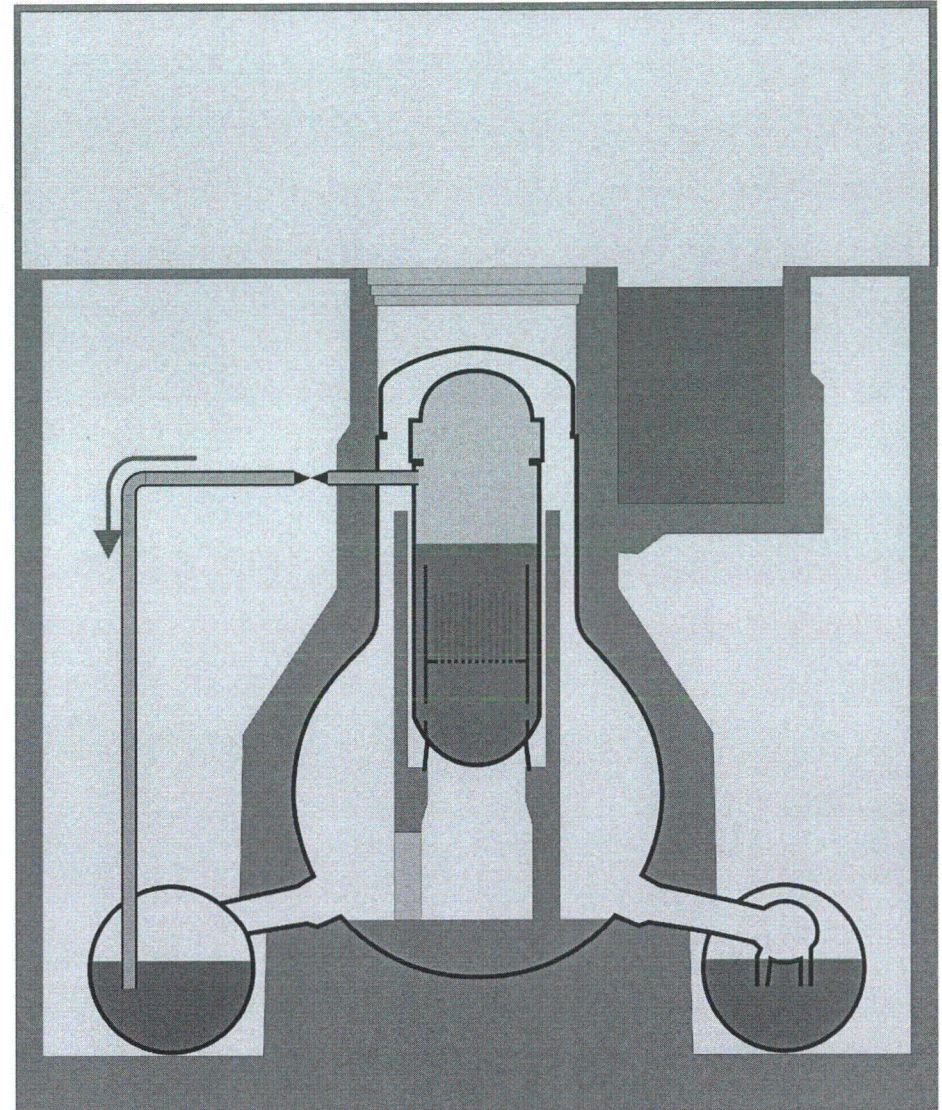




# The Fukushima Daiichi Incident

## 2. Accident progression

- ▶ Reactor Isolation pump stops
  - ◆ 11.3. 16:36 in Unit 1  
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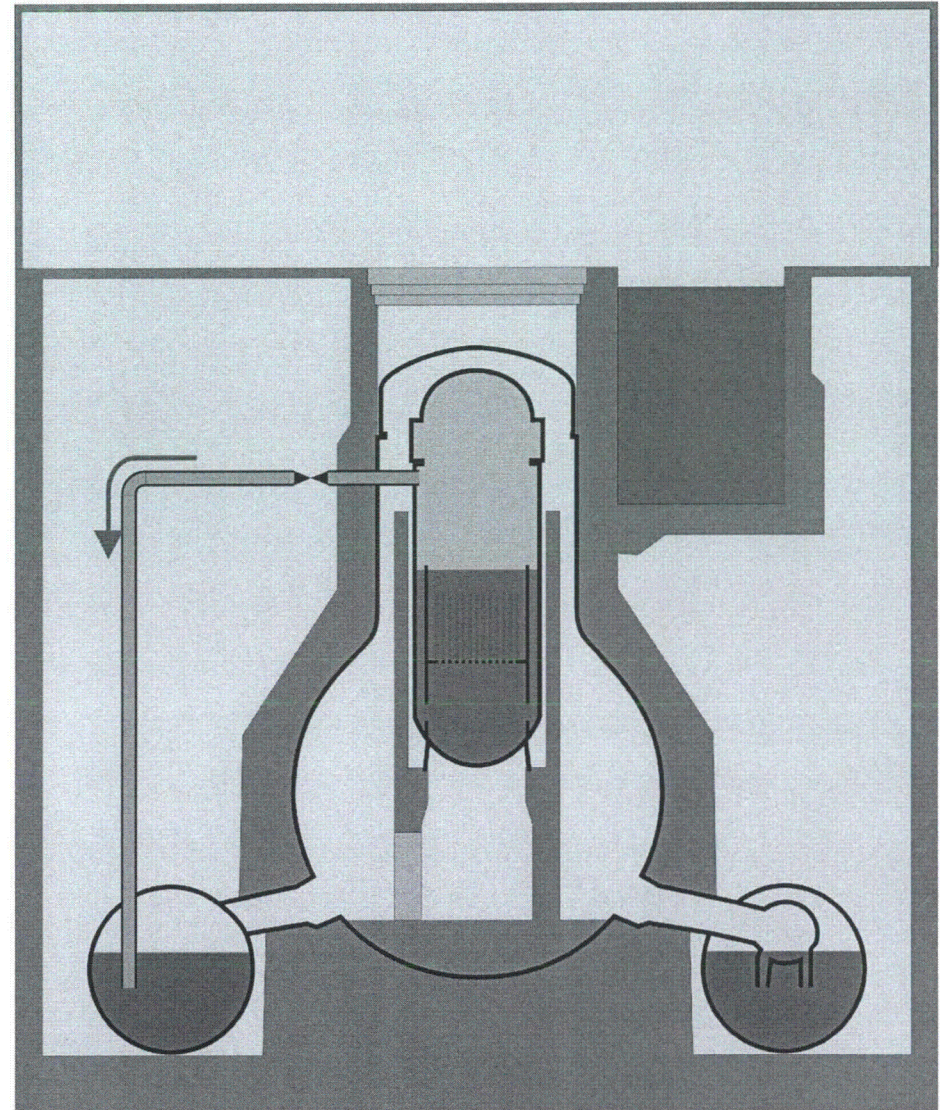




# The Fukushima Daiichi Incident

## 2. Accident progression

- ▶ Reactor Isolation pump stops
  - ◆ 11.3. 16:36 in Unit 1  
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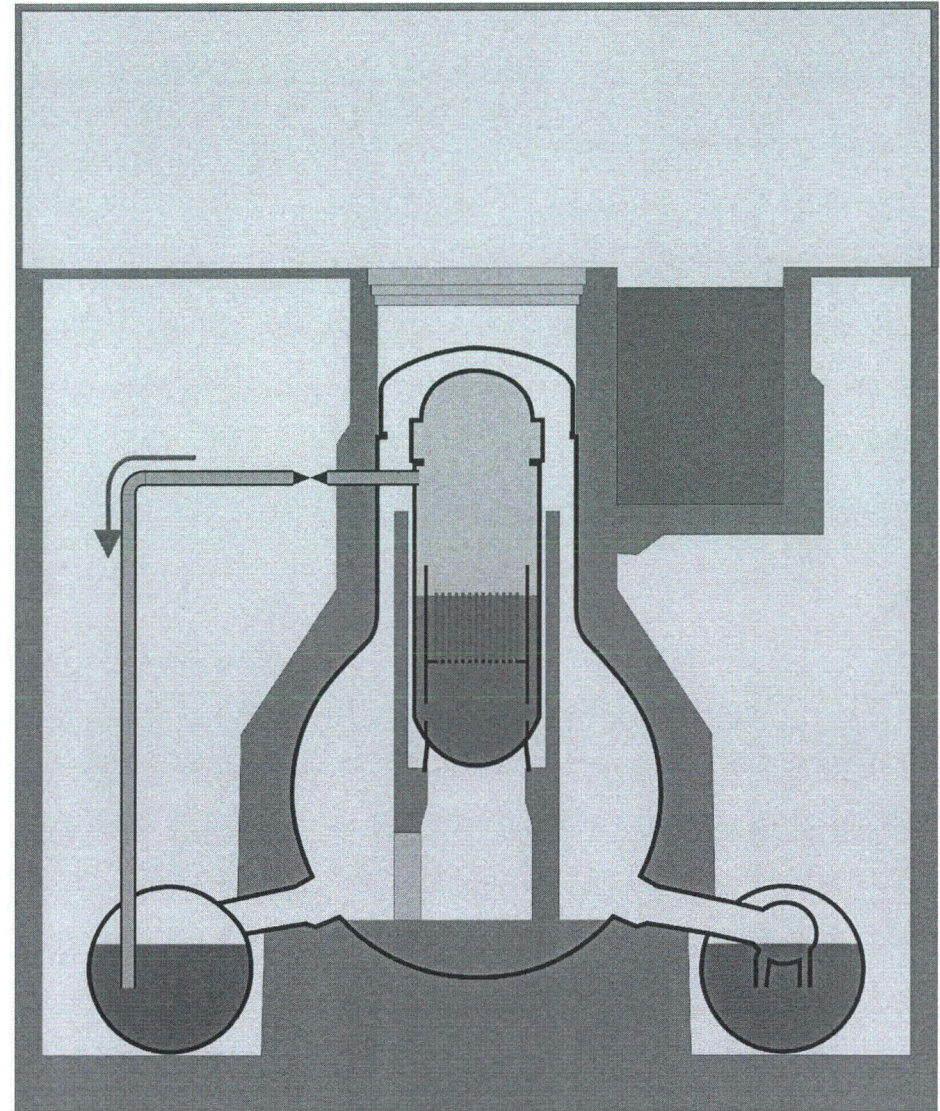




# The Fukushima Daiichi Incident

## 2. Accident progression

- ▶ Reactor Isolation pump stops
  - ◆ 11.3. 16:36 in Unit 1  
(Batteries empty)
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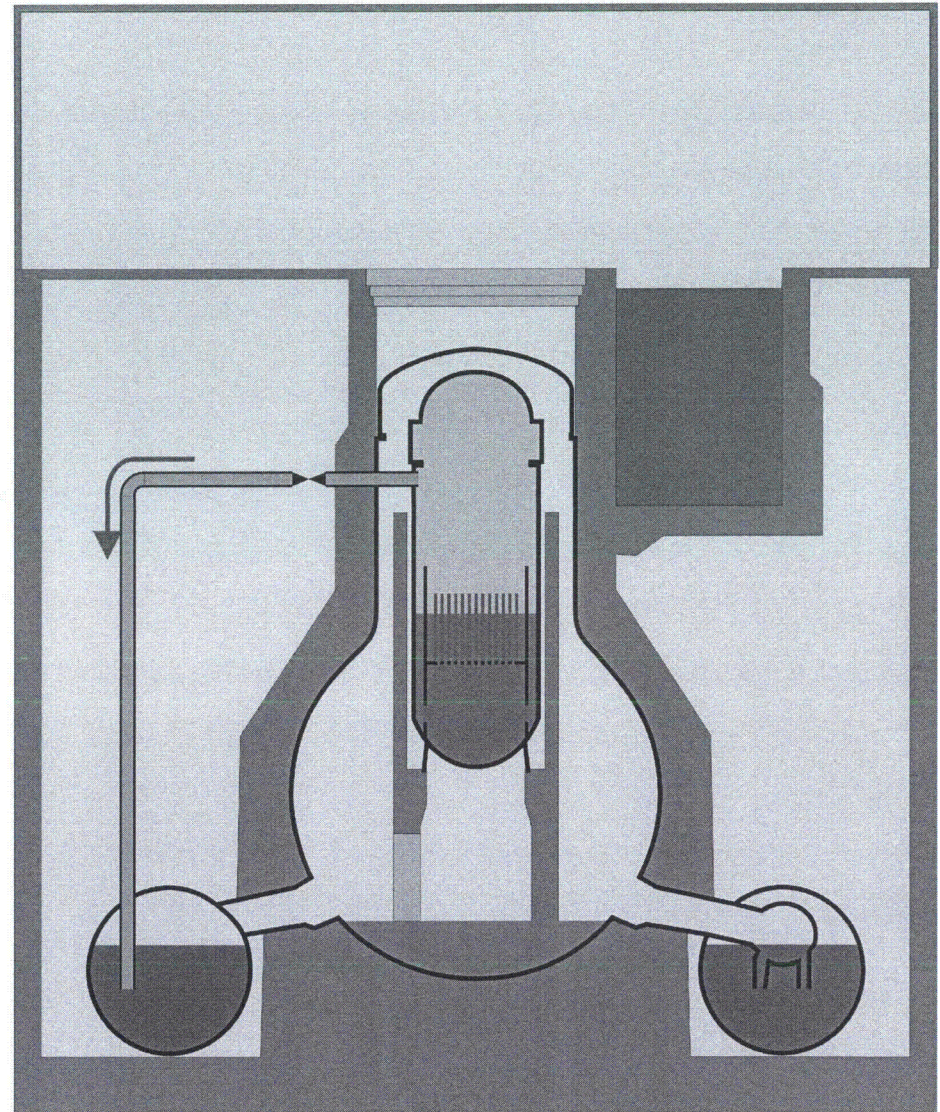




# The Fukushima Daiichi Incident

## 2. Accident progression

- ▶ Reactor Isolation pump stops
  - ◆ 11.3. 16:36 in Unit 1  
(Batteries empty)
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- ▶ Decay Heat produces still steam in Reactor pressure Vessel
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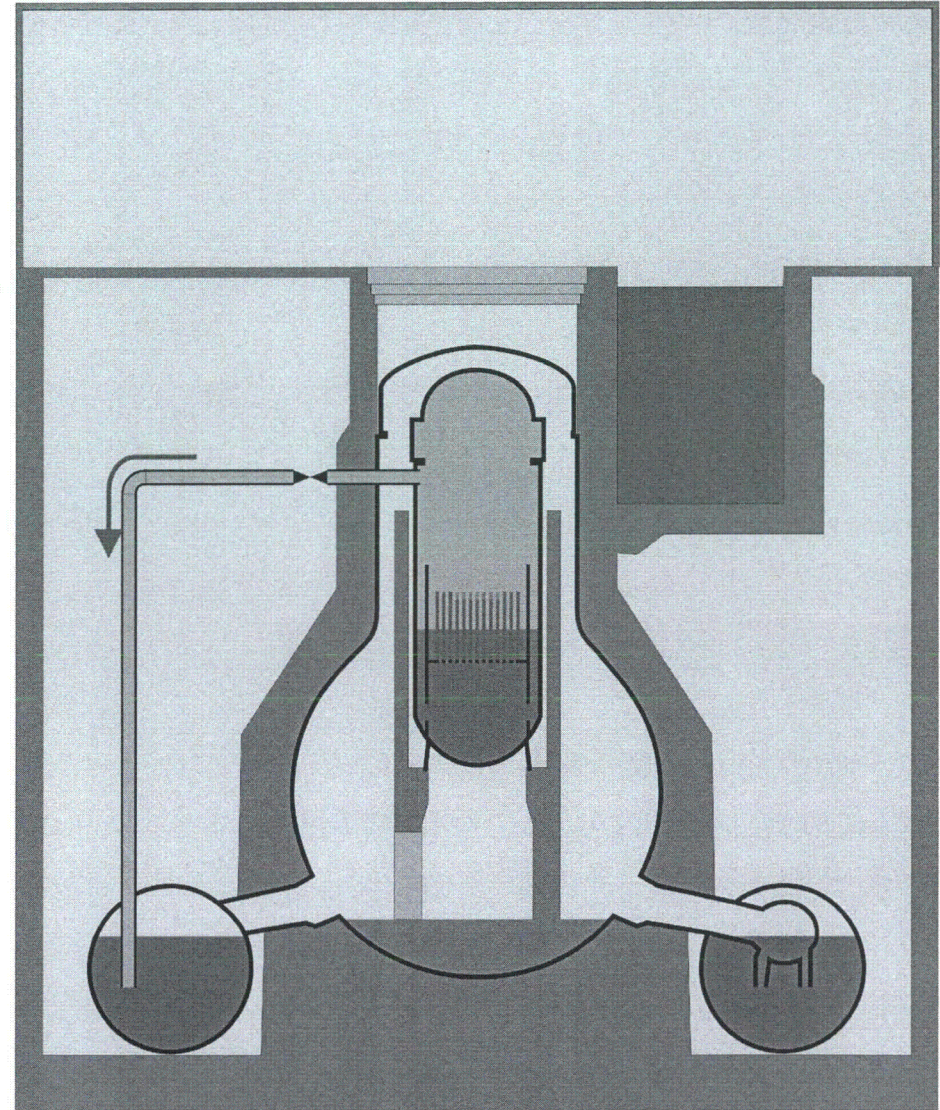




# The Fukushima Daiichi Incident

## 2. Accident progression

- ▶ Measured, and here referenced Liquid level is the collapsed level. The actual liquid level lies higher due to the steam bubbles in the liquid
- ▶ ~50% of the core exposed
  - ◆ Cladding temperatures rise, but still no significant core damage
- ▶ ~2/3 of the core exposed
  - ◆ Cladding temperature exceeds  $\sim 900^{\circ}\text{C}$
  - ◆ Ballooning / Breaking of the cladding
  - ◆ Release of fission products from the fuel rod gaps

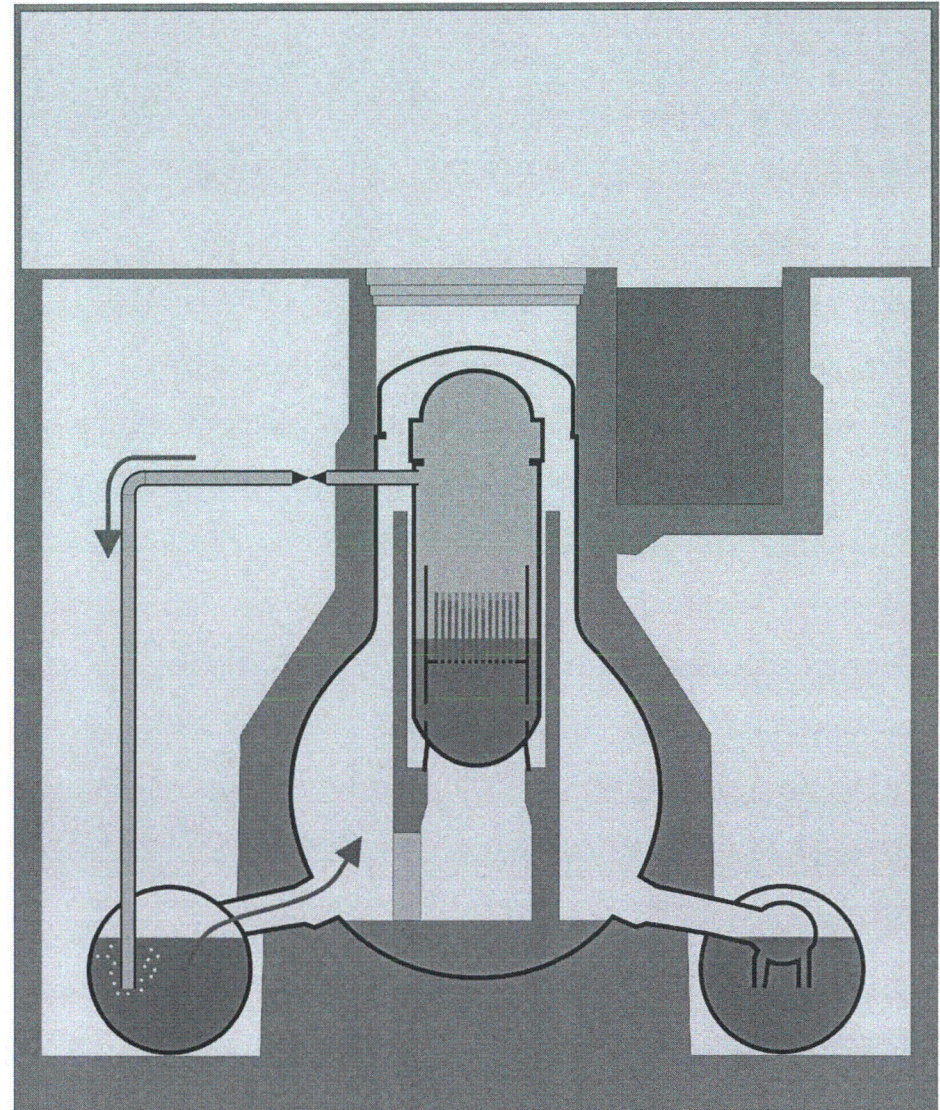




# The Fukushima Daiichi Incident

## 2. Accident progression

- ▶ ~3/4 of the core exposed
  - ◆ Cladding exceeds ~1200°C
  - ◆ Zirconium in the cladding starts to burn under Steam atmosphere
  - ◆  $\text{Zr} + 2\text{H}_2\text{O} \rightarrow \text{ZrO}_2 + 2\text{H}_2$
  - ◆ Exothermal reaction further heats the core
  - ◆ Generation of hydrogen
    - Unit 1: 300-600kg
    - Unit 2/3: 300-1000kg
  - ◆ Hydrogen gets pushed via the wet-well, the wet-well vacuum breakers into the dry-well

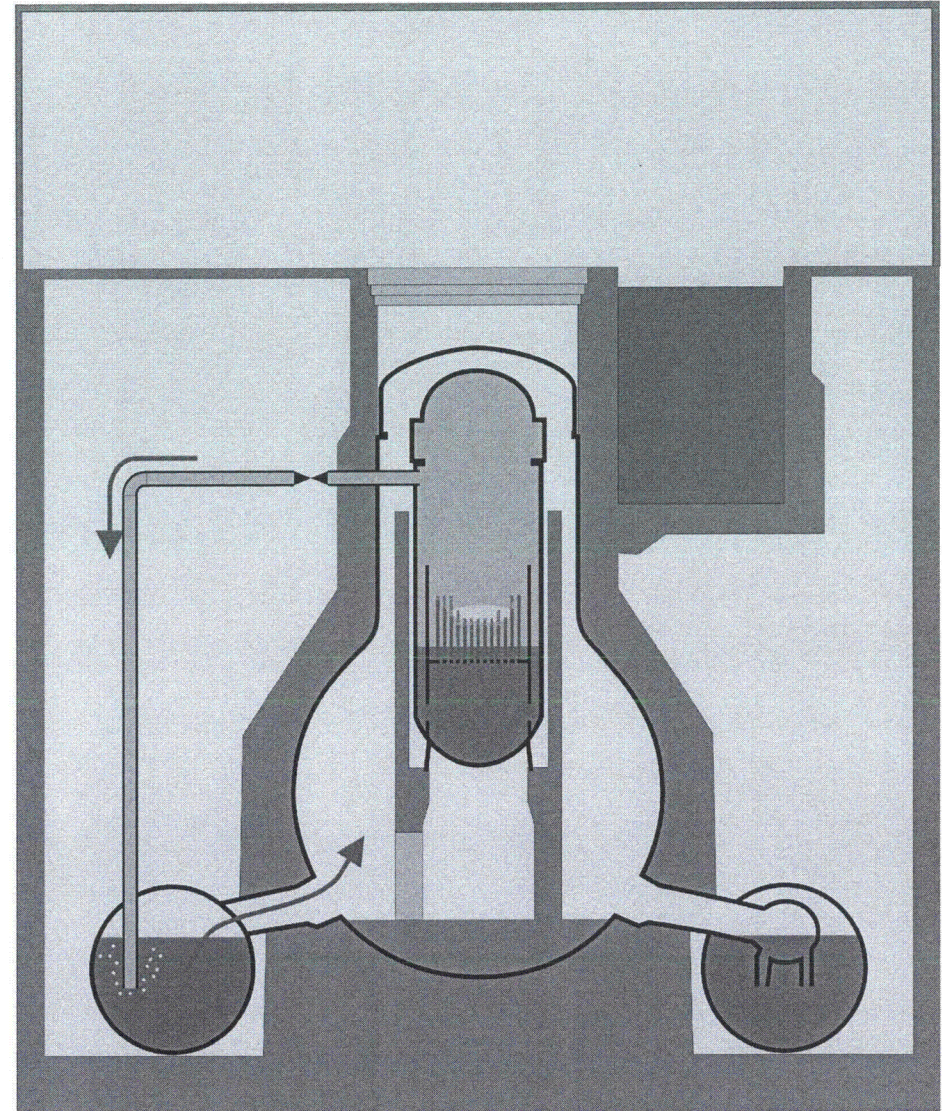




# The Fukushima Daiichi Incident

## 2. Accident progression

- ▶ at ~1800°C [Unit 1,2,3]
  - ◆ Melting of the Cladding
  - ◆ Melting of the steel structures
- ▶ at ~2500°C [Block 1,2]
  - ◆ Breaking of the fuel rods
  - ◆ debris bed inside the core
- ▶ at ~2700°C [Block 1]
  - ◆ Melting of Uranium-Zirconium eutectics
- ▶ Restoration of the water supply stops accident in all 3 Units
  - ◆ Unit 1: 12.3. 20:20 (27h w.o. water)
  - ◆ Unit 2: 14.3. 20:33 (7h w.o. water)
  - ◆ Unit 3: 13.3. 9:38 (7h w.o. water)

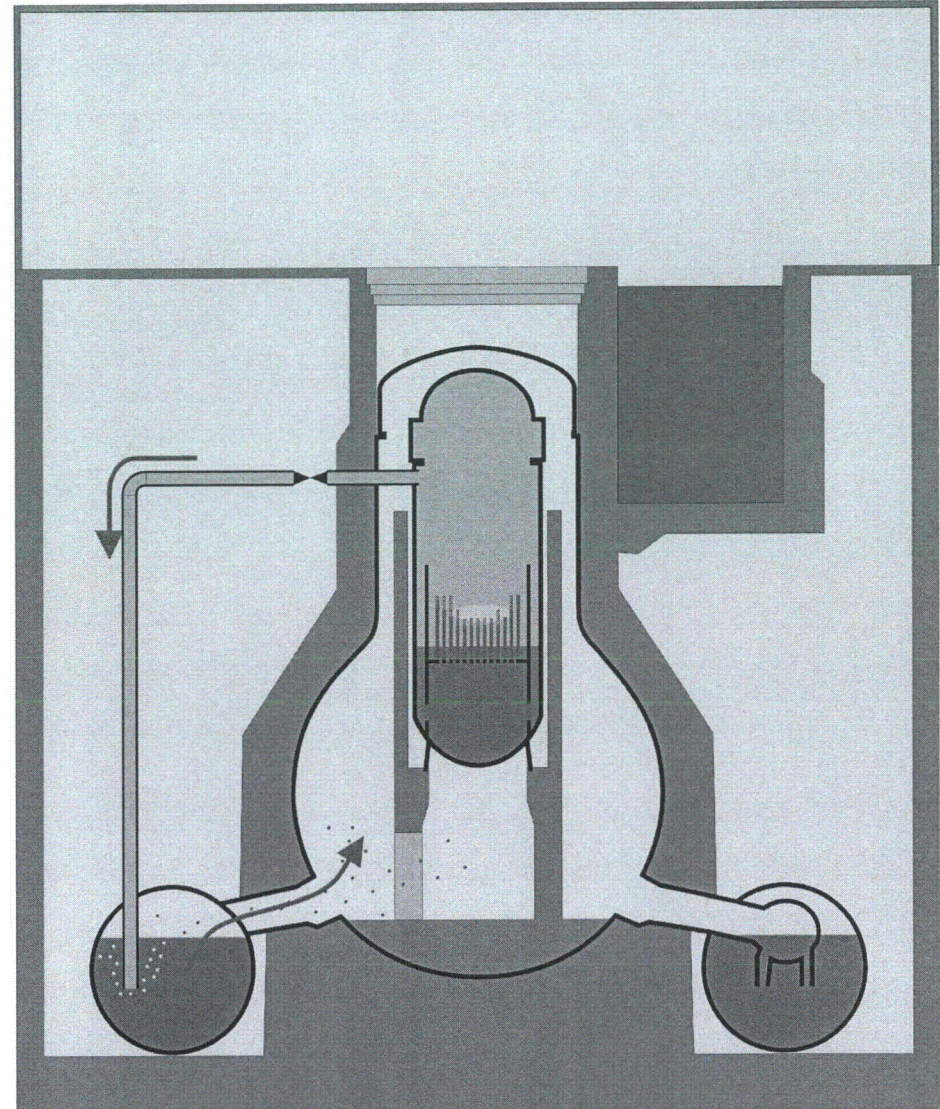




# The Fukushima Daiichi Incident

## 2. Accident progression

- ▶ Release of fission products during melt down
  - ◆ Xenon, Cesium, Iodine,...
  - ◆ Uranium/Plutonium remain in core
  - ◆ Fission products condensate to airborne Aerosols
- ▶ Discharge through valves into water of the condensation chamber
  - ◆ Pool scrubbing binds a fraction of Aerosols in the water
- ▶ Xenon and remaining aerosols enter the Dry-Well
  - ◆ Deposition of aerosols on surfaces further decontaminates air

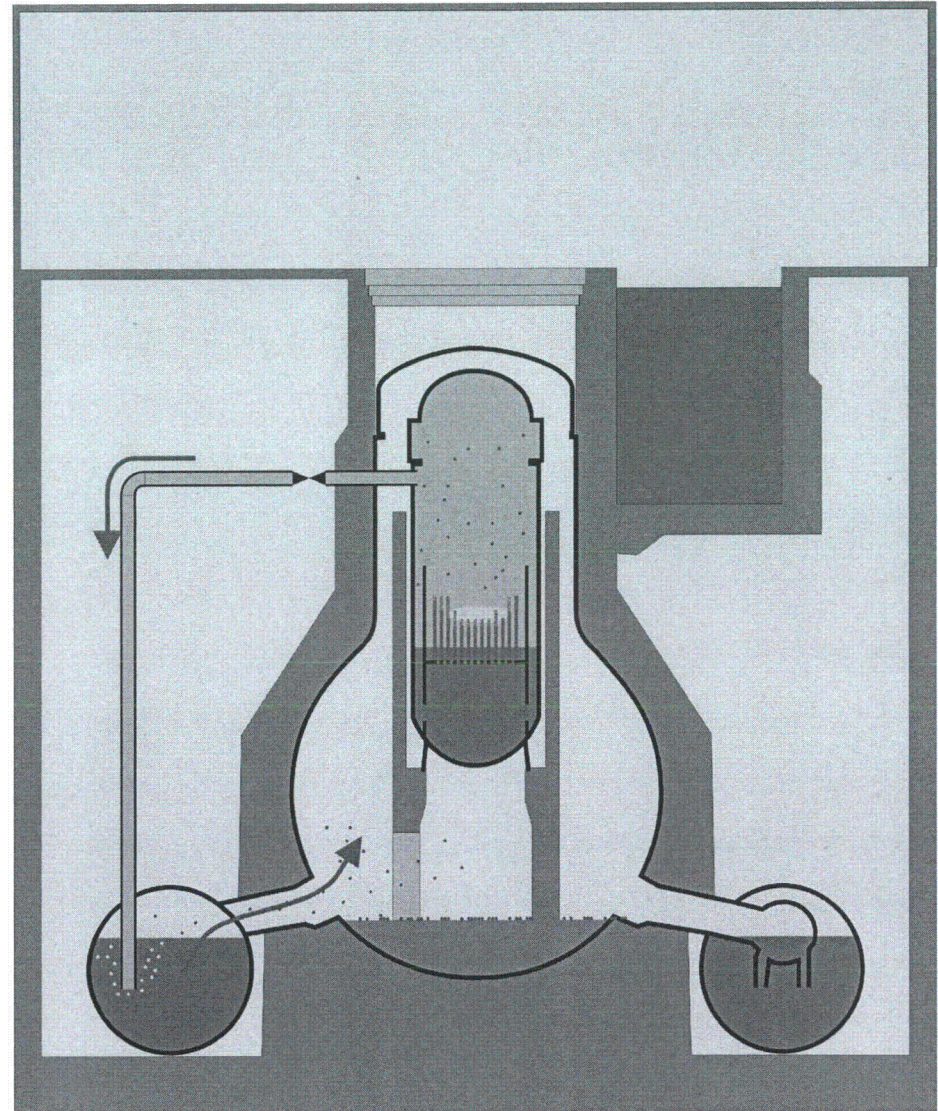




# The Fukushima Daiichi Incident

## 2. Accident progression

- ▶ Containment
  - ◆ Last barrier between Fission Products and Environment
  - ◆ Wall thickness ~3cm
  - ◆ Design Pressure 4-5bar
- ▶ Actual pressure up to 8 bars
  - ◆ Normal inert gas filling (Nitrogen)
  - ◆ Hydrogen from core oxidation
  - ◆ Boiling condensation chamber (like a pressure cooker)
- ▶ Depressurization of the containment
  - ◆ Unit 1: 12.3. 4:00
  - ◆ Unit 2: 13.3 00:00
  - ◆ Unit 3: 13.3. 8.41

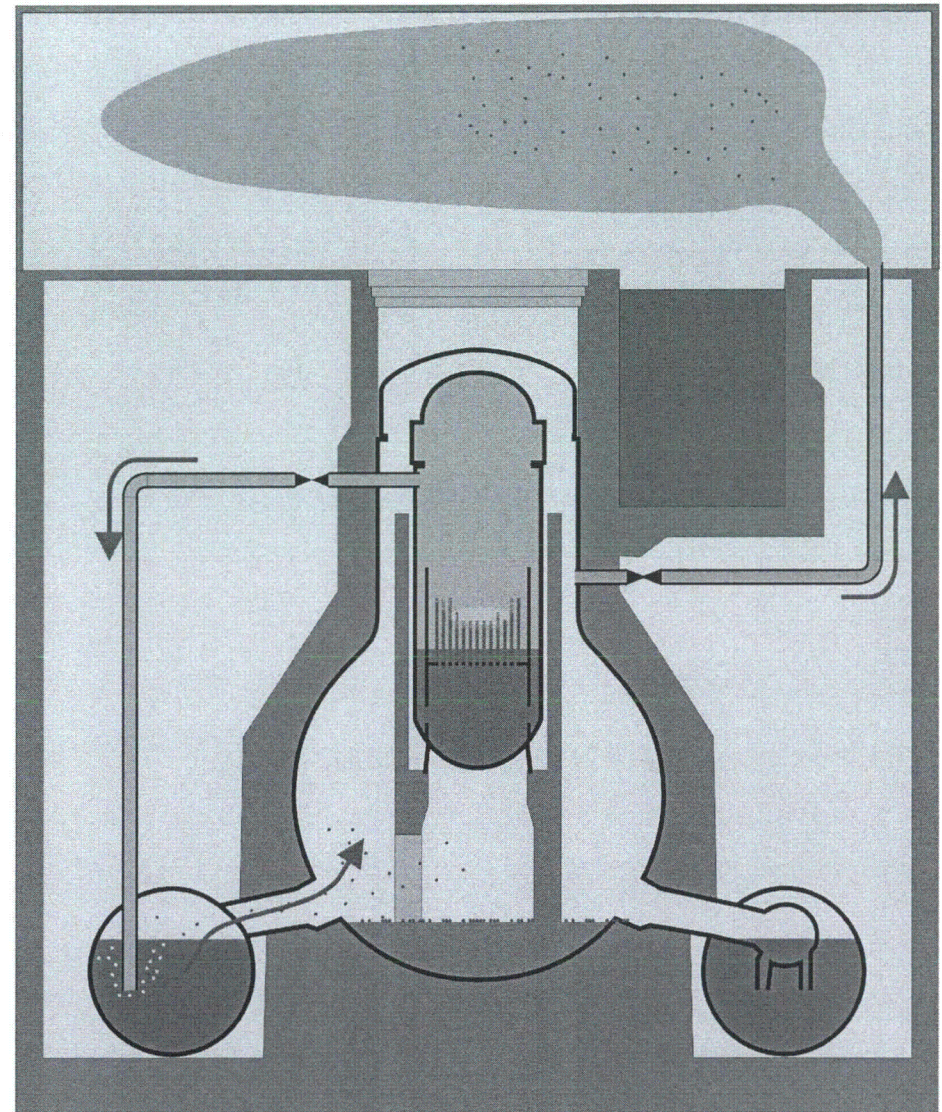




# The Fukushima Daiichi Incident

## 2. Accident progression

- ▶ Positive and negative Aspects of depressurizing the containment
  - ◆ Removes Energy from the Reactor building (only way left)
  - ◆ Reducing the pressure to ~4 bar
  - ◆ Release of small amounts of Aerosols (Iodine, Cesium ~0.1%)
  - ◆ Release of all noble gases
  - ◆ Release of Hydrogen
- ▶ Gas is released into the reactor service floor
  - ◆ Hydrogen is flammable



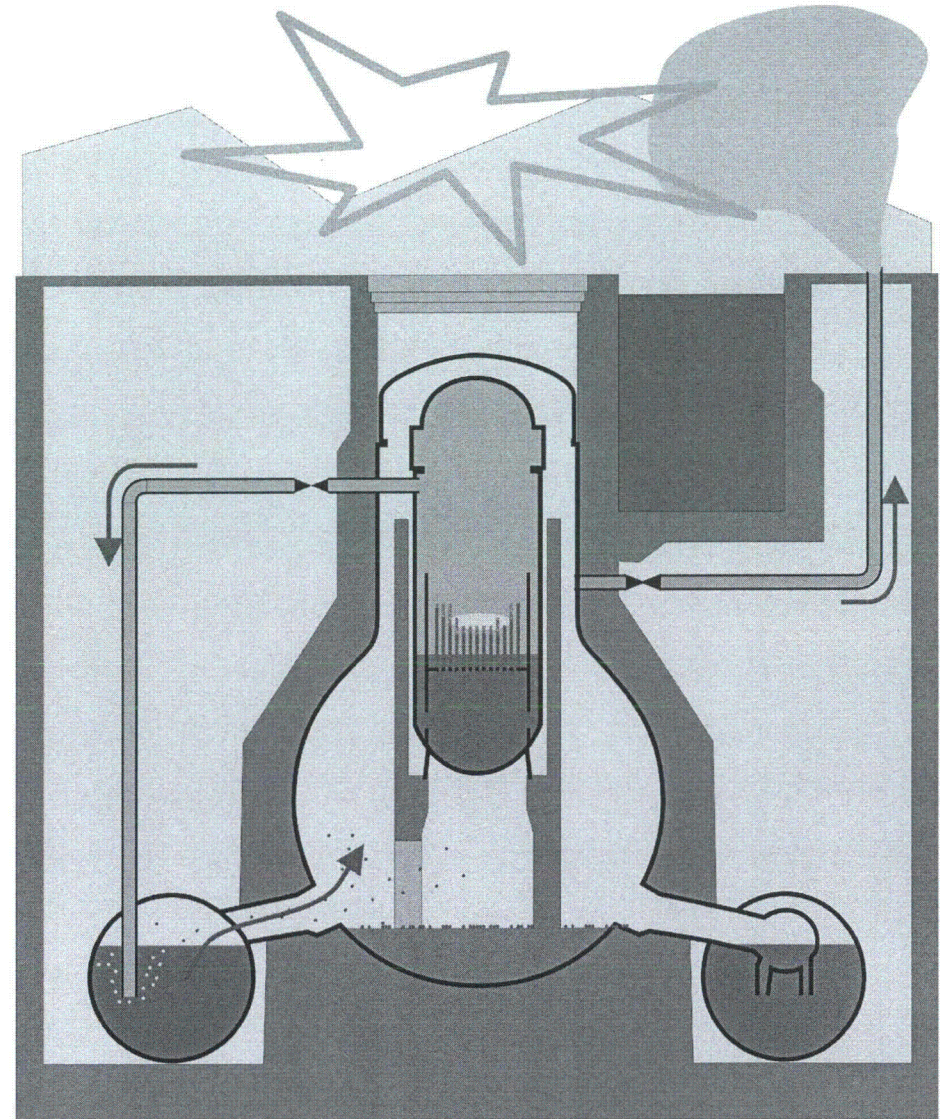
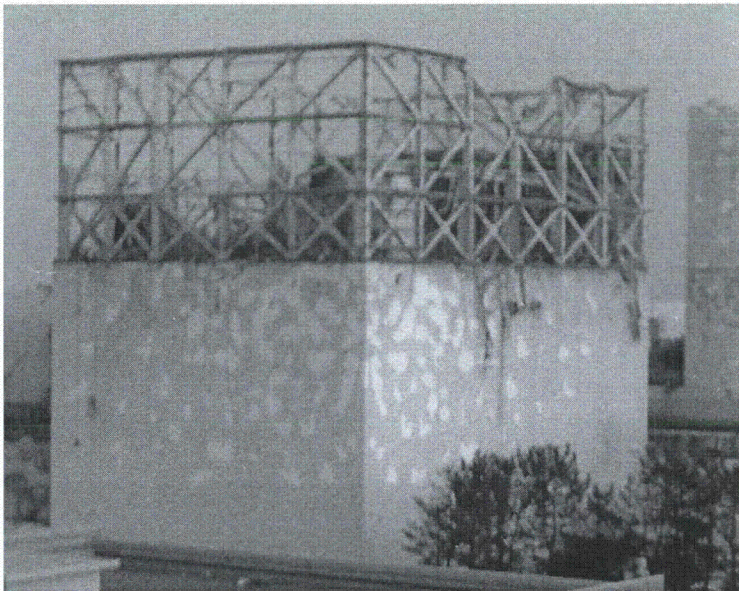


# The Fukushima Daiichi Incident

## 2. Accident progression

### ► Unit 1 und 3

- ◆ Hydrogen burn inside the reactor service floor
- ◆ Destruction of the steel-frame roof
- ◆ Reinforced concrete reactor building seems undamaged
- ◆ Spectacular but minor safety relevant





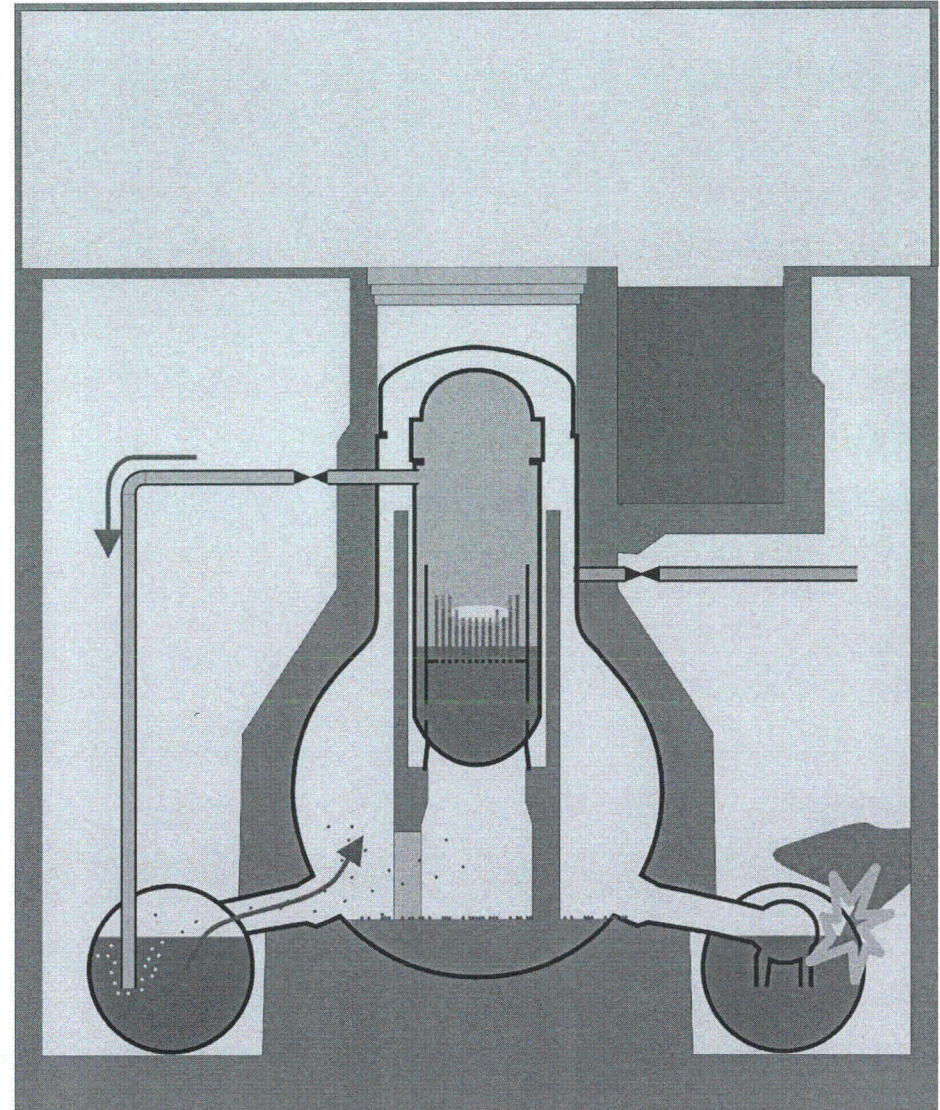
# The Fukushima Daiichi Incident

## 2. Accident progression

### ► Unit 2

- ◆ Hydrogen burn inside the reactor building
- ◆ Probably damage to the condensation chamber (highly contaminated water)
- ◆ Uncontrolled release of gas from the containment
- ◆ **Release of fission products**
- ◆ Temporal evacuation of the plant
- ◆ High local dose rates on the plant site due to wreckage hinder further recovery work

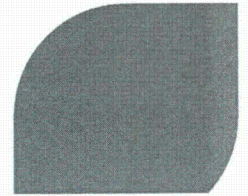
- ### ► No clear information's why Unit 2 behaved differently



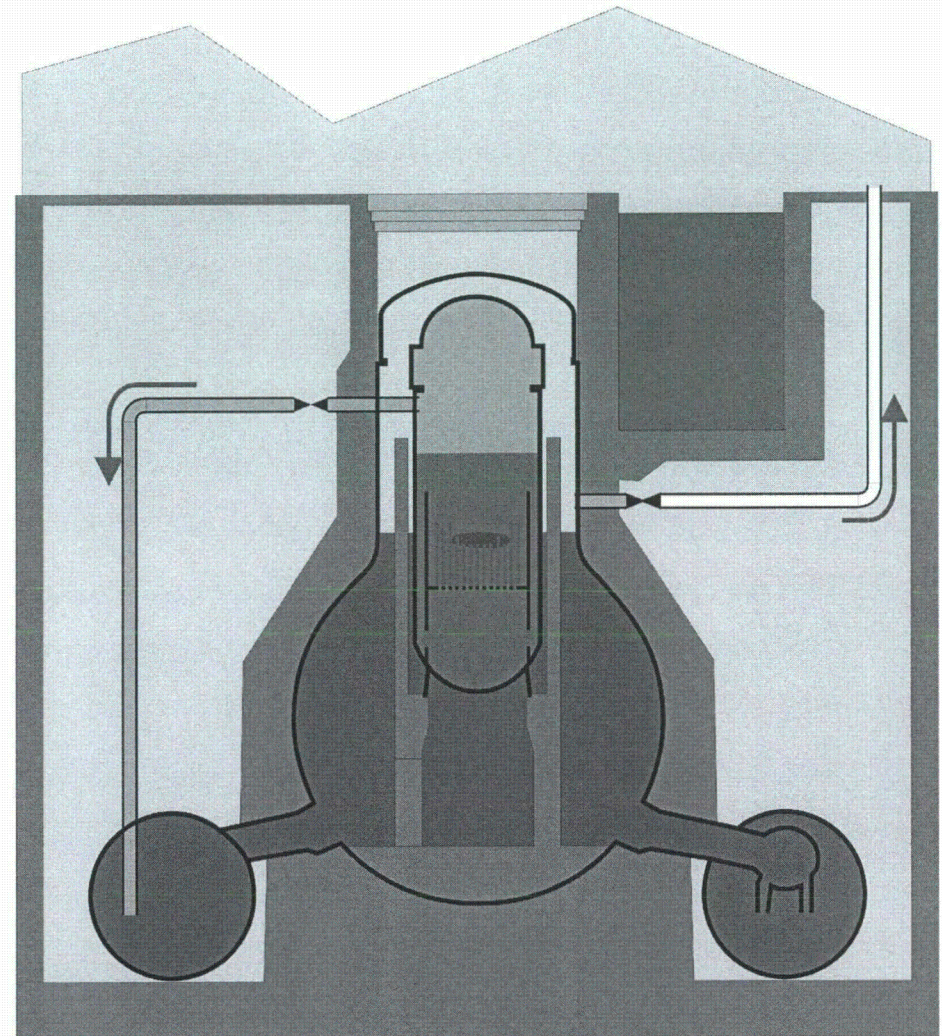


# The Fukushima Daiichi Incident

## 2. Accident progression

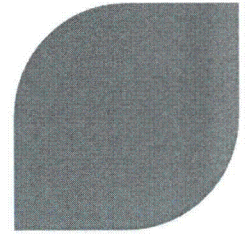


- ▶ Current status of the Reactors
  - ◆ Core Damage in Unit 1,2, 3
  - ◆ Building damage due to various burns Unit 1-4
  - ◆ Reactor pressure vessels flooded in all Units with mobile pumps
  - ◆ At least containment in Unit 1 flooded
- ▶ Further cooling of the Reactors by releasing steam to the atmosphere
- ▶ Only small further releases of fission products can be expected



# The Fukushima Daiichi Incident

## 3. Radiological releases



### ► Directly on the plant site

#### ◆ Before Explosion in Unit Block 2

- Below 2mSv / h
- Mainly due to released radioactive noble gases
- Measuring posts on west side. Maybe too small values measured due to wind

#### ◆ After Explosion in Unit 2 (Damage of the Containment)

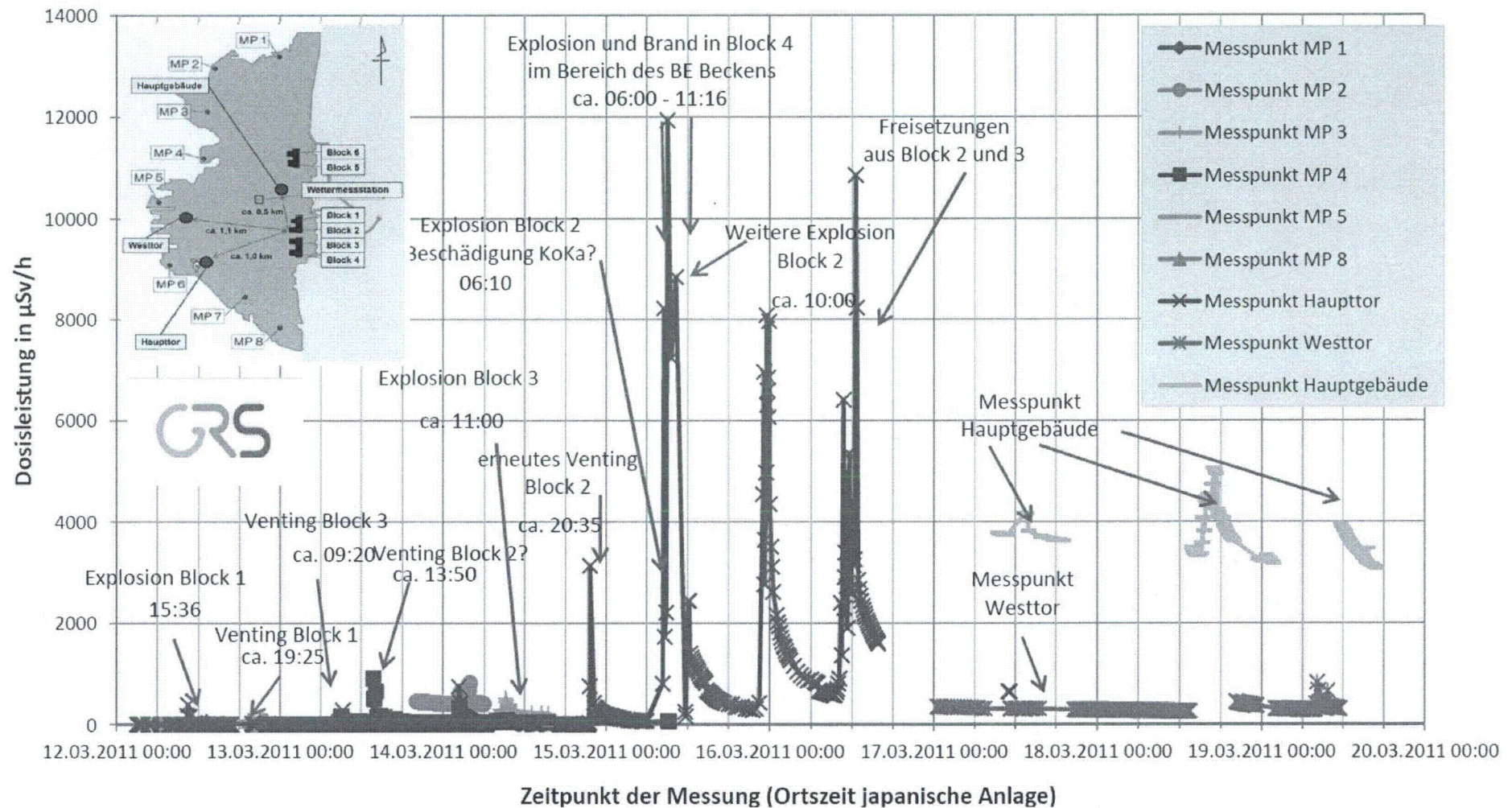
- Temporal peak values 12mSv / h
- (Origin not entirely clear)
- Local peak values on site up to 400mSv /h (wreckage / fragments?)
- Currently stable dose on site at 5mSv /h
- Inside the buildings a lot more

#### ◆ Limiting time of exposure of the workers necessary



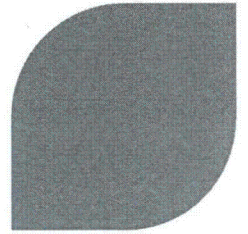
# The Fukushima Daiichi Incident

## 3. Radiological releases



# The Fukushima Daiichi Incident

## 3. Radiological releases

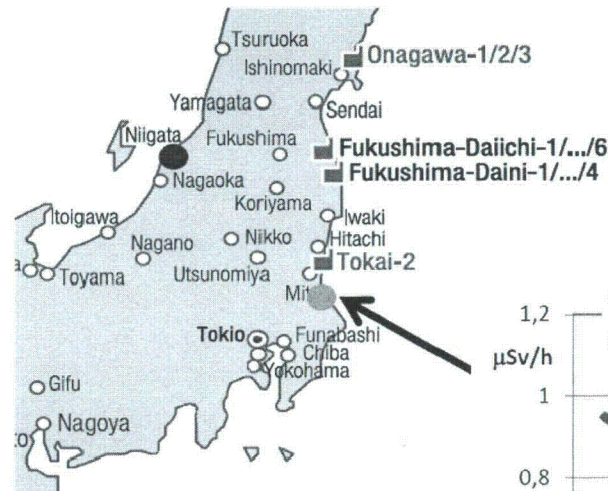
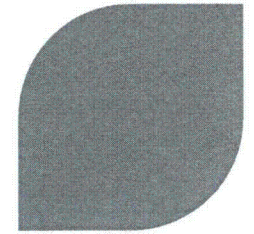


- ▶ Outside the Plant site
  - ◆ As reactor building mostly intact  
=> reduced release of Aerosols (not Chernobyl-like)
  - ◆ Fission product release in steam  
=> fast Aerosol grows, large fraction falls down in the proximity of the plant
  - ◆ Main contribution to the radioactive dose outside plant are the radioactive noble gases
  - ◆ Carried / distributed by the wind, decreasing dose with time
  - ◆ No „Fall-out“ of the noble gases, so no local high contamination of soil
  
- ▶ ~20km around the plant
  - ◆ Evacuations were adequate
  - ◆ Measured dose up to 0.3mSv/h for short times
  - ◆ Maybe destruction of crops / dairy products this year
  - ◆ Probably no permanent evacuation of land necessary

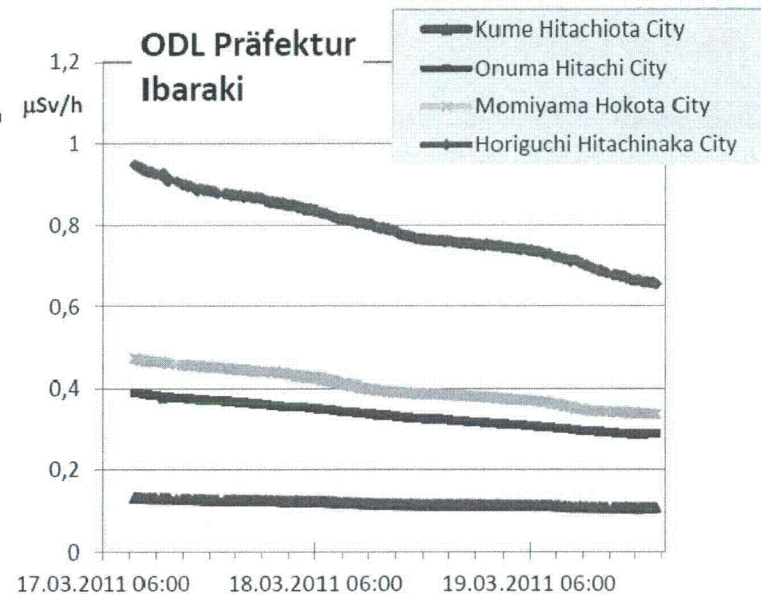


# The Fukushima Daiichi Incident

## 3. Radiological releases



GRS.de



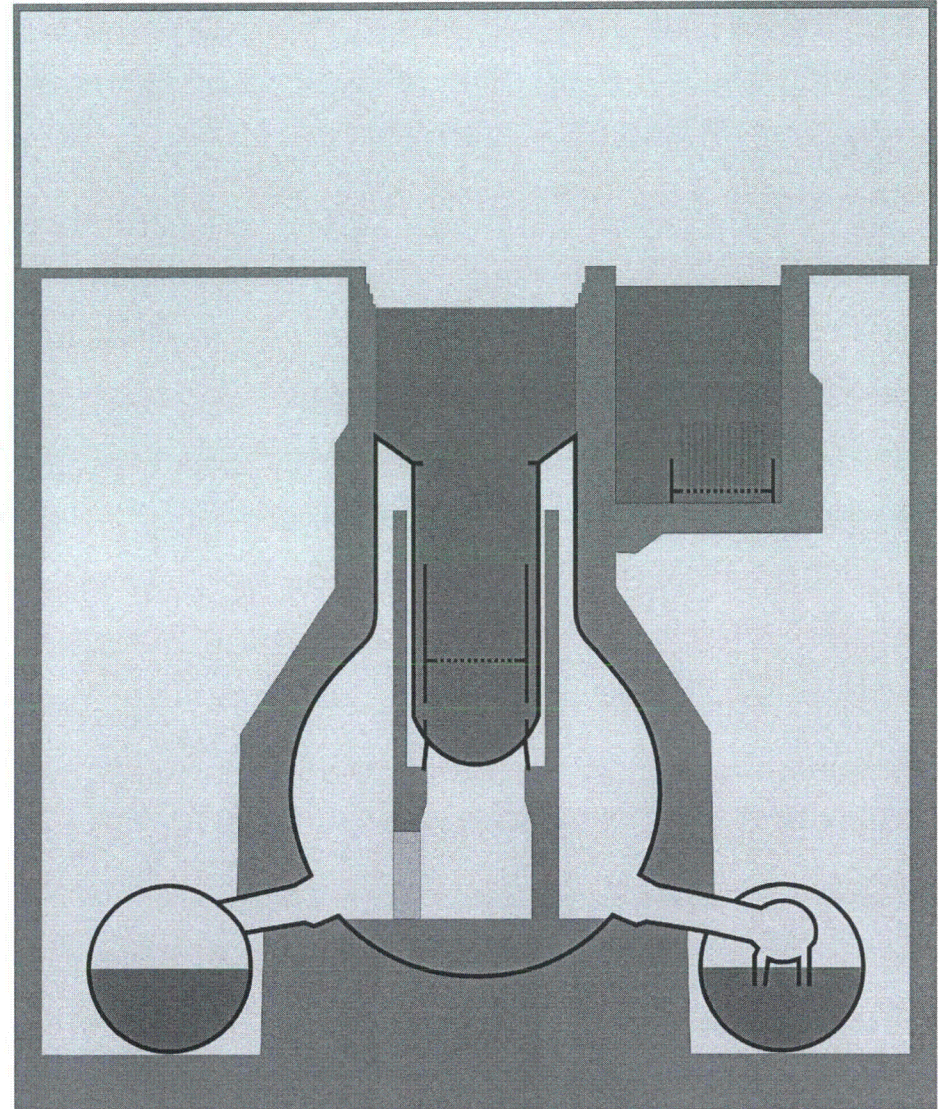
- ▶ ~50km around the plant
  - ◆ Control of Crop / Dairy products
  - ◆ Usage of Iodine pills  
(Caution, pills can interfere with heart medicine)



# The Fukushima Daiichi Incident

## 4. Spend fuel pools

- ▶ Spend fuel stored in Pool on Reactor service floor
  - ◆ Due to maintenance in Unit 4 entire core stored in Fuel pool
  - ◆ Dry-out of the pools
    - Unit 4: in 10 days
    - Unit 1-3,5,6 in few weeks
  - ◆ **Leakage of the pools due to Earthquake?**
- ▶ Consequences
  - ◆ Core melt „on fresh air “
  - ◆ Nearly no retention of fission products
  - ◆ Large release

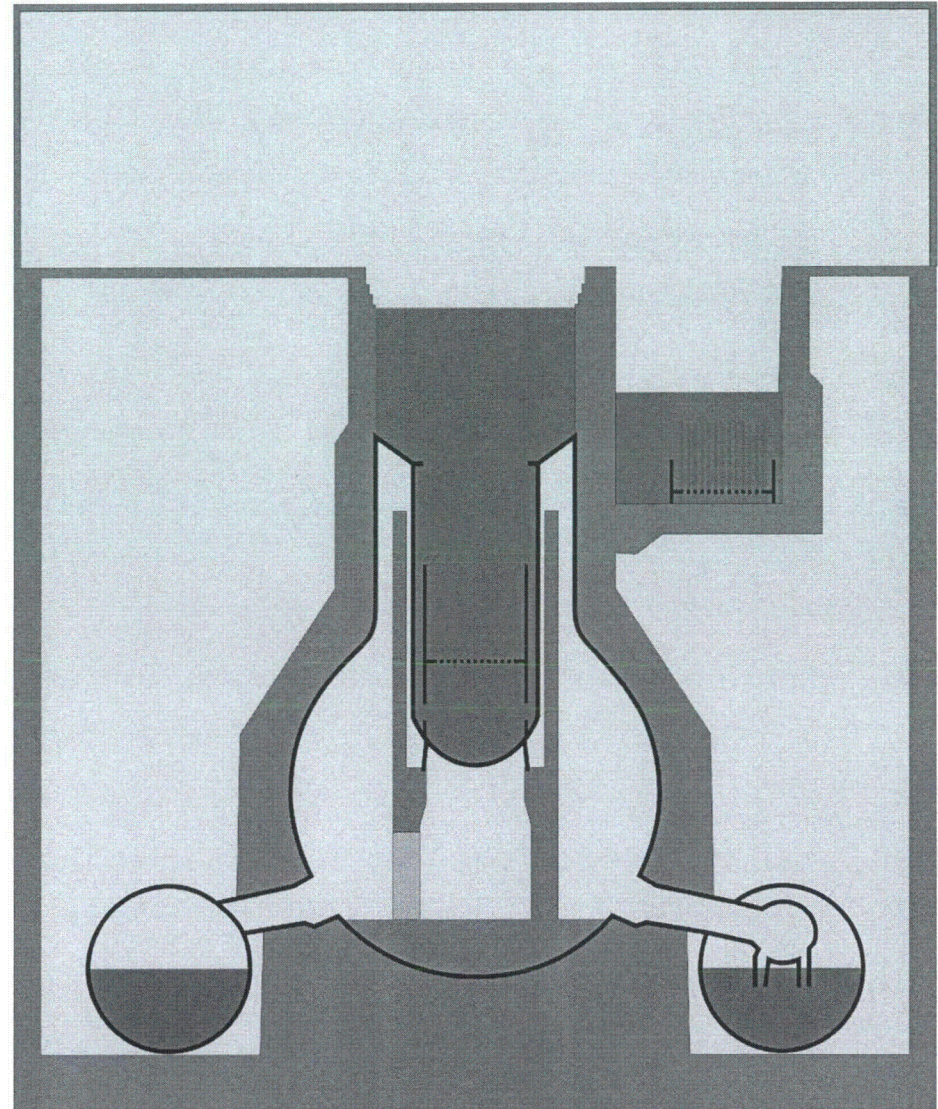




# The Fukushima Daiichi Incident

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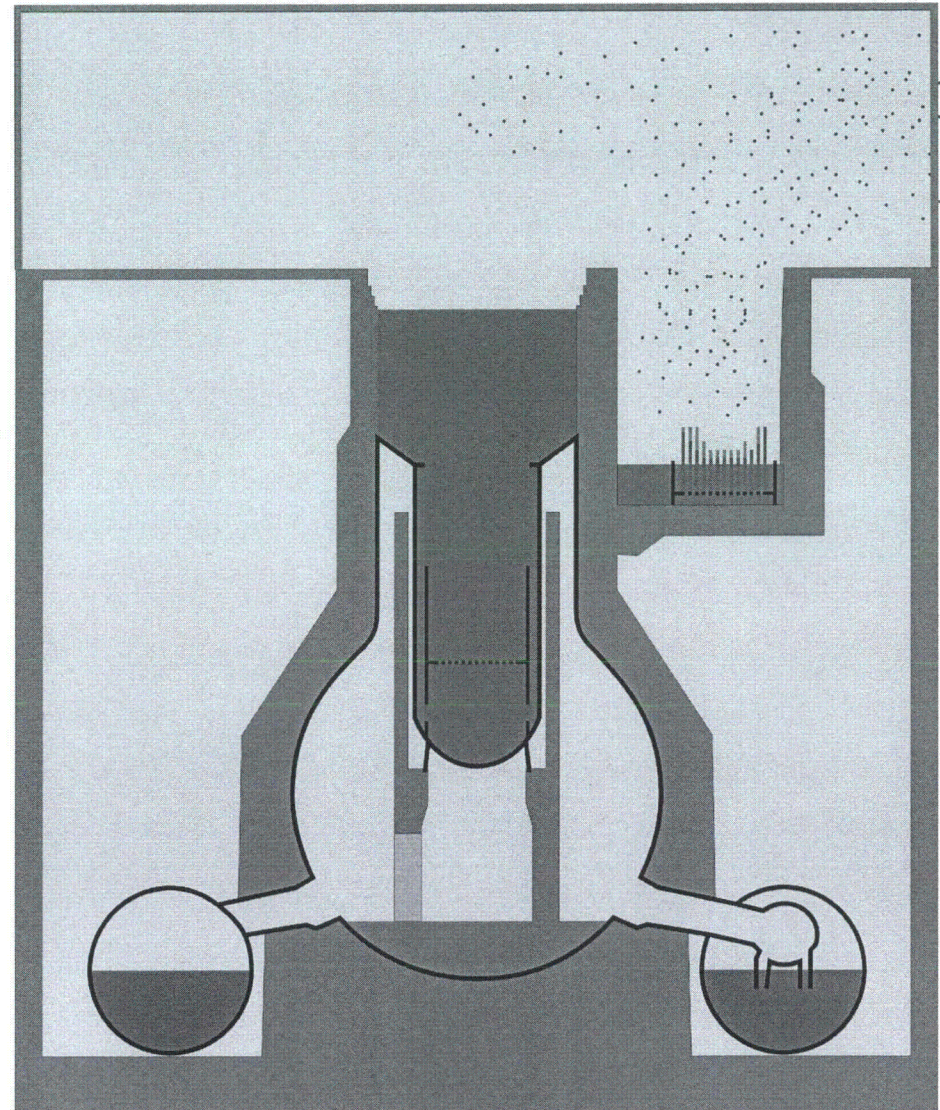




# The Fukushima Daiichi Incident

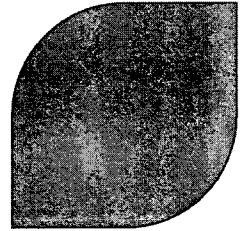
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- ▶ Consequences
  - ◆ Core melt „on fresh air “
  - ◆ Nearly no retention of fission products
  - ◆ Large release
- ▶ **It is currently unclear if release from fuel pool already happened**



# The Fukushima Daiichi Incident

## 5. Sources of Information



### ► Good sources of Information

#### ◆ Gesellschaft für Reaktorsicherheit [GRS.de]

- Up to date
- Radiological measurements published
- German translation of japanese/englisch web pages

#### ◆ Japan Atomic Industrial Forum [jaif.or.jp/english/]

- Current Status of the plants
- Measurement values of the reactors (pressure liquid level)

#### ◆ Tokyo Electric Power Company [Tepco.co.jp]

- Status of the recovery work
- Casualties

### ► May too few information are released by TEPCO, the operator of the plant



**Merzke, Daniel**

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**From:** Merzke, Daniel  
**Sent:** Friday, April 15, 2011 9:02 AM  
**To:** Dudek, Michael  
**Subject:** Status of Papers

Michael, Marty asked me to check on the status of three "papers." One was the Global Assessment slides, which I saw a draft of and are being reviewed, so I know about that. Where are we with the composite paper (re-entry criteria), and he said there is a paper for the Global Assessment? Do you happen to know where that is? Thanks in advance.

Dan

**Wittick, Brian**

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**From:** Wittick, Brian  
**Sent:** Friday, April 15, 2011 8:38 PM  
**To:** 'STEVENS Thomas (AREVA)'  
**Subject:** RE: Activity list

Thanks Tom

---

**From:** STEVENS Thomas (AREVA) [<mailto:Thomas.Stevens@areva.com>]  
**Sent:** Friday, April 15, 2011 8:30 PM  
**To:** Wittick, Brian  
**Subject:** RE: Activity list

Brian

Sorry we have not corralled this info yet—just sent another reminder, so hopefully I will at least get a status later today.

Tom

---

**From:** Wittick, Brian [<mailto:Brian.Wittick@nrc.gov>]  
**Sent:** Friday, April 15, 2011 7:29 PM  
**To:** STEVENS Thomas (RS/NB)  
**Subject:** Activity list

Hi Tom,

Hope all is well with your activities. I wanted to check in with you on the status of validating the list I generated. Any insights you can provide are most appreciated.

Kind regards,  
Brian

Y/395



**Wittick, Brian**

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**From:** Wittick, Brian  
**Sent:** Friday, April 15, 2011 10:48 PM  
**To:** Call, Michel  
**Subject:** RE: Proposal from R. Tanaka of US military

Thanks Mike

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**From:** Call, Michel  
**Sent:** Friday, April 15, 2011 9:11 PM  
**To:** Wittick, Brian  
**Cc:** Gepford, Heather; Huffert, Anthony  
**Subject:** Proposal from R. Tanaka of US military

Brian,

Mr. Reid Tanaka talked with me after the 04/15/11 11am meeting with NISA and TEPCO and offered that the military has about 600 small Pb blankets at Atsugi. Mr. Tanaka offered them for use at Fukushima Daiichi if TEPCO/NISA would like to have them. I am passing this on to you to go through the proper channels for such offers.

Thanks.  
Mike

621 5 7  
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0  
**Kock, Andrea**

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**From:** Franovich, Mike  
**Sent:** Sunday, April 17, 2011 2:47 AM  
**To:** Ostendorff, William  
**Cc:** Nieh, Ho; Kock, Andrea; Zorn, Jason  
**Subject:** FW: Final Slides - NRC INTERIM COMPREHENSIVE ASSESSMENT OF FUKUSHIMA EVENT  
**Attachments:** JapenGlobalAssessmentFinalApril15.pptx

The latest set of slides for Sec Clinton, et al. There appears to be one minor change from the previous set of slides in that the core damage estimates being used appear to be the TEPCO provided estimated of 70, 30, 25 percent for units 1, 2, 3 respectively. Hopefully the IAEA package is also used to supplement as it provides more comprehensive information than these slides convey.

---

**From:** Casto, Chuck  
**Sent:** Saturday, April 16, 2011 10:57 PM  
**To:** ET07 Hoc; HOO Hoc  
**Cc:** Moore, Scott; Zimmerman, Roy; Virgilio, Martin; Reynolds, Steven  
**Subject:** Final slides for the ET - please pass along

Attached are the final slides I sent to the Ambassador's secretary. They will have them for the on-site briefing package. If SoS wants a few minutes we will give quick verbal. Otherwise Ast. Sec. Donohue (DOE) is traveling with her and will have these details. We've briefed him and his staff previously so he is up to speed. It is expected that she will at least say something to the NRC folks.....The ambassador recommended to her that she discuss the NRC.

Thanks  
chuck



**Kock, Andrea**

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**From:** Franovich, Mike  
**Sent:** Sunday, April 17, 2011 1:17 AM  
**To:** Ostendorff, William  
**Cc:** Nieh, Ho; Kock, Andrea; Zorn, Jason  
**Subject:** IAEA distributed document 4-17-11  
**Attachments:** Summary\_of\_reactor\_unit\_status\_at\_17-April\_0000UTC.pdf

Attached is the latest IAEA report which is quite comprehensive. Some items to note from the report:

- ☐ Work on the backup system to provide alternate cooling water to the RPVs is ongoing.
- ☐ On 13 April, NISA requested TEPCO to conduct an assessment and report on the current status of earthquake-proof safety of the Fukushima Daiichi reactor buildings and to identify what countermeasures might be needed.
- ☐ As a countermeasure against a possible future tsunami, the electrical distribution boards for the pumps injecting water to the reactor pressure vessels of Units 1, 2 and 3 were transferred to higher ground on April 15<sup>th</sup>.
- ☐ The removal of rubble (amount equivalent to a container) using remote-control heavy machineries was carried out on April 15<sup>th</sup>.
- ☐ Some relocations of residents beyond 20 km due to assessment of long-term exposure. This is being reported as "evacuations" in the IAEA report and in the media when they are really relocations based on PARs and local dose assessment.
- ☐ Japanese testing and approach to limit radioactive material into the ocean. Three sand bags containing Zeolite material have been deployed in front of the inlet screens (seawater intake). The Zeolite material is designed to capture specific radioactive elements. It is intended to sample and analyze the Zeolite material periodically to determine the effectiveness of this procedure. (BTW, according to NHK news, Zeolite is supposedly effective at absorbing Cesium 134/137).
- ☐ On April 16<sup>th</sup>, restrictions were lifted on the distribution of raw milk produced in 24 areas in Fukushima prefecture.

As an aside, the Russians lifted restrictions on their residents travel to Tokyo.  
Russians have been monitoring dose rates and say the dose rates in Tokyo are lower than in Moscow.



**Kock, Andrea**

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**From:** Franovich, Mike  
**Sent:** Monday, April 18, 2011 8:51 AM  
**To:** Ostendorff, William  
**Cc:** Nieh, Ho; Kock, Andrea; Zorn, Jason  
**Subject:** Japan One Pager 0700 EDT 4-18-11  
**Attachments:** Japan One Pager 0700 EDT 4-18-11.pdf

Note DOE personnel (at the Embassy) are departing Japan this week.

Y/299

**Kock, Andrea**

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**From:** Franovich, Mike  
**Sent:** Monday, April 18, 2011 9:20 AM  
**To:** Ostendorff, William  
**Cc:** Nieh, Ho; Kock, Andrea; Zorn, Jason  
**Subject:** DAILY DOE SITREP 18 APR 0600  
**Attachments:** SITREP\_APR18 0600 FINAL.docx; Japan\_Earthquake\_Response\_04182011\_0600.pdf

Slide 14 has a side by side comparison of GOJ/USG dose assumptions and projected impacts. USG slightly more conservative but in sync with GOJ results.

Y/400



**Kock, Andrea**

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**From:** Franovich, Mike  
**Sent:** Tuesday, April 19, 2011 11:50 AM  
**To:** Ostendorff, William  
**Cc:** Nieh, Ho; Kock, Andrea; Zorn, Jason  
**Subject:** UPADTE- TA briefing 4-19-11 on Fukushima-Daiichi Event  
**Attachments:** Summary\_of\_reactor\_unit\_status\_at\_19-April\_0100UTC.PDF;  
Japan\_Earthquake\_Response\_04192011\_0600.pdf; SITREP\_APR19 0600.docx; NRC Daily Assessment of Daiichi - 4-19-11.pdf

Zimmerman led the call

- ☐ No change in units of SFPs status.
- ☐ Robotic surveillances ongoing in Reactor Buildings (Unit 1 and 3). Dose rates very high with mention of up to 57 R/hr (I believe the highest readings were 57 mSv/hr or 5.7 R/hr according to various reports). Robotic surveillance takes video, O<sub>2</sub> sampling (for worker habitability), rad levels, temperatures, etc....
- ☐ TEPCO still evaluating possible entombment of lower basement of Unit 2 reactor building to seal leaks.
- ☐ Regarding cleanup of water in turbine buildings, it will take Tepco 26 days to pump water to the common rad waste facility building. Tepco believes leakage in one turbine building may come from another unit. Still investigating.
- ☐ Unit 1 and 2 primary containments drywells are flooded by way of leakage from RPV or recirc pump seals. Believed to be flooded up to lower RPV head and close to core level. Some indirect indications are being used to estimate flood level. Belief is Unit 1 will achieve similar water level by April 27 and that are several feet of water in the lower drywell.
- ☐ Purging of Unit 2 viewed as not needed at this time because of lack of containment integrity (self venting possibly). Unit 3 can't nitrogen purge primary containment because areas in the reactor building are inaccessible (rad levels and debris).
- ☐ The issue of reimbursement for NRC activities is still an issue and the Japanese are invoking the IAEA charter as a basis for no reimbursement.
- ☐ Grab and go reentry criteria in evacuation zone was discussed and NRC will continue to work with other agencies. These criteria are for US citizens. I asked about the Japanese if they have criteria established. ET will check. I noted reports of Japanese citizens performing unauthorized reentry. I commented that

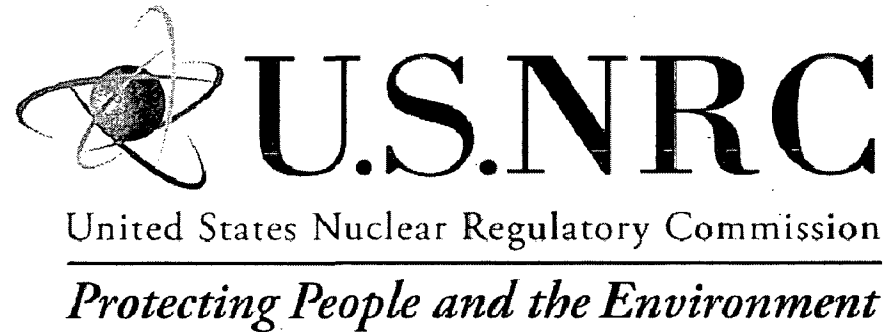
Y/401

timeliness of establishing criteria may be an issue if people are reentering irrespective of government advice. Roy indicated the ET is receiving similar feedback from other Federal partners.

- ☐ Requested a copy of the NRC's consolidated comments on the TEPCO Roadmap to Restoration document.
- ☐ Latest IAEA and DOE reports are attached. Also attached a new arrival called the "Daily Assessment" report that the staff generates.

*Mike Franovich  
Technical Assistant for Reactors  
Office of Commissioner Ostendorff  
301-415-1784*





Y/402

# **Presentation on Fukushima to NGA Center for Best Practices**

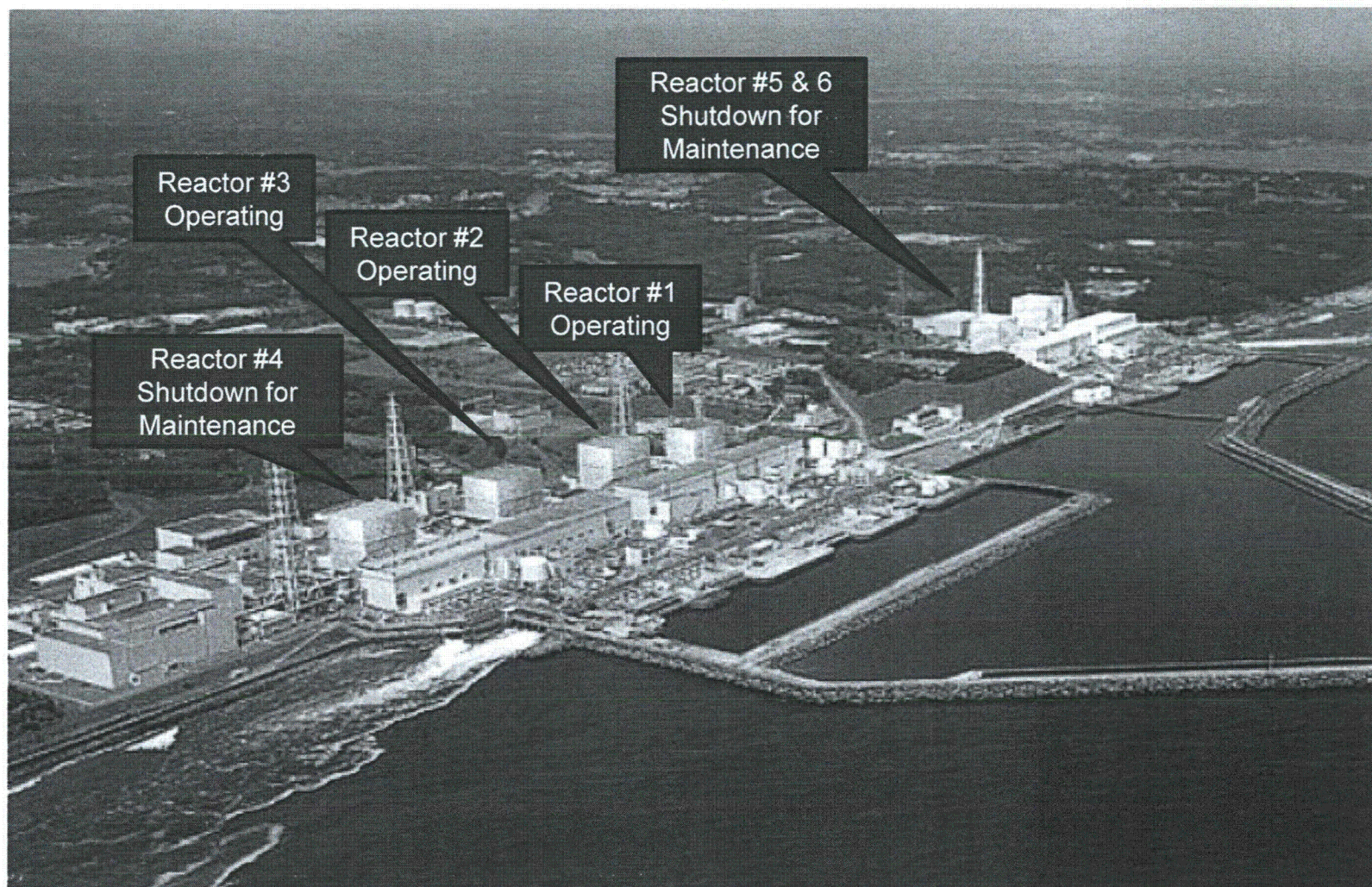
**Eric Leeds, Director  
Office of Nuclear Reactor Regulation  
(NRR)**

## **NRC Mission – What Do We Do?**

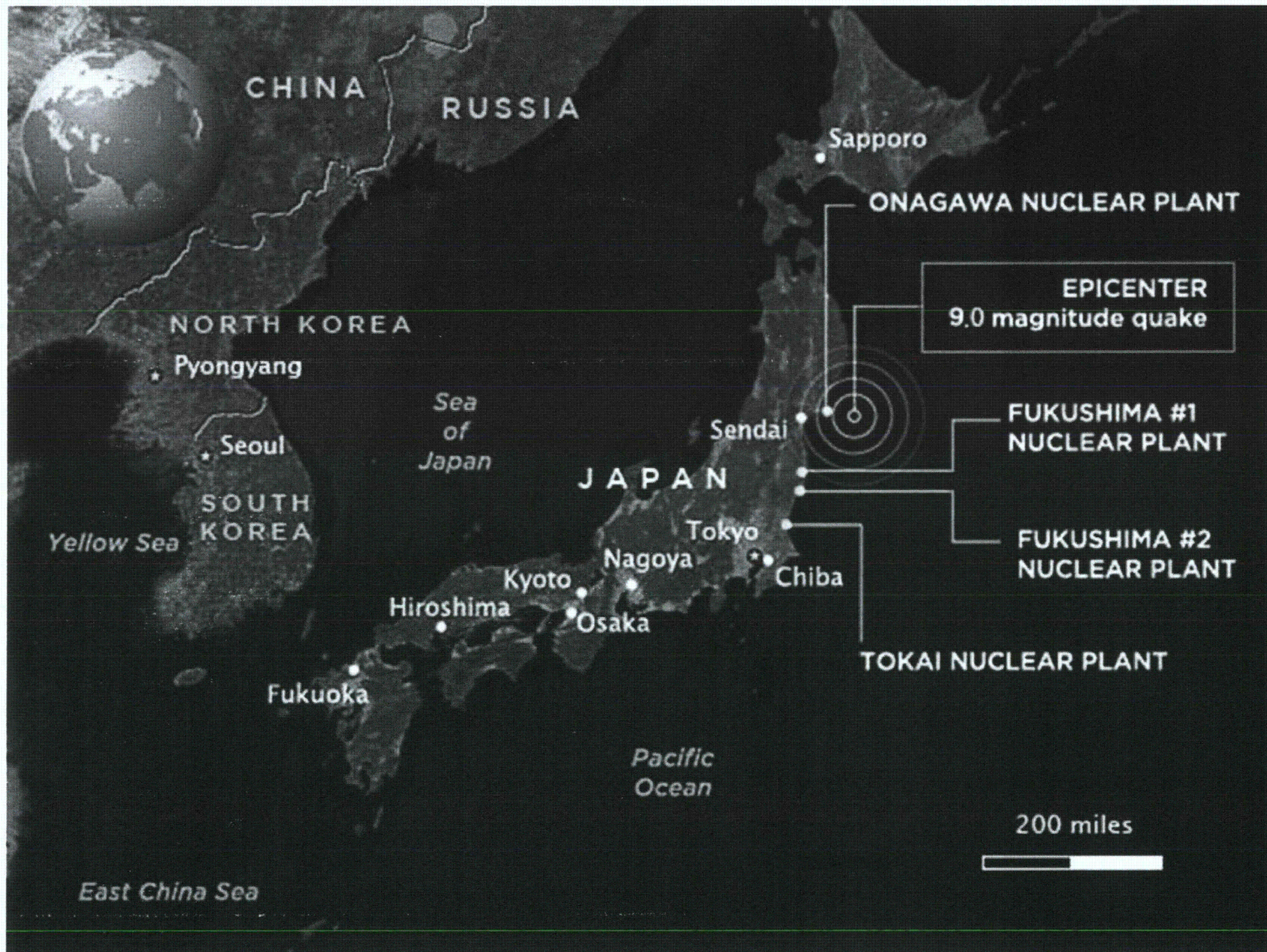
- The mission of the NRC is to license and regulate the Nation's civilian use of byproduct, source, and special nuclear materials in order to **protect public health and safety, promote the common defense and security, and protect the environment.**



## Overview of Fukushima Daiichi Nuclear Power Station









# Earthquake & tsunami sequence of events

Friday March 11<sup>th</sup> @ 2:36 pm local

- Magnitude 9.0 earthquake 231 miles northeast of Tokyo.
- Quake is fifth largest in the world (since 1900).
- Earthquake generated a 14m Tsunami

# Plant Response

## Earthquake

- Earthquake Caused Automatic Shutdown of 3 Operating Units
- Offsite Power Lost
- Initial indications were that Emergency Diesels operated

## 14m Tsunami (less than 1 hour later)

- All Emergency Back-up Power Lost
- 8-10 hours later Station Batteries Depleted

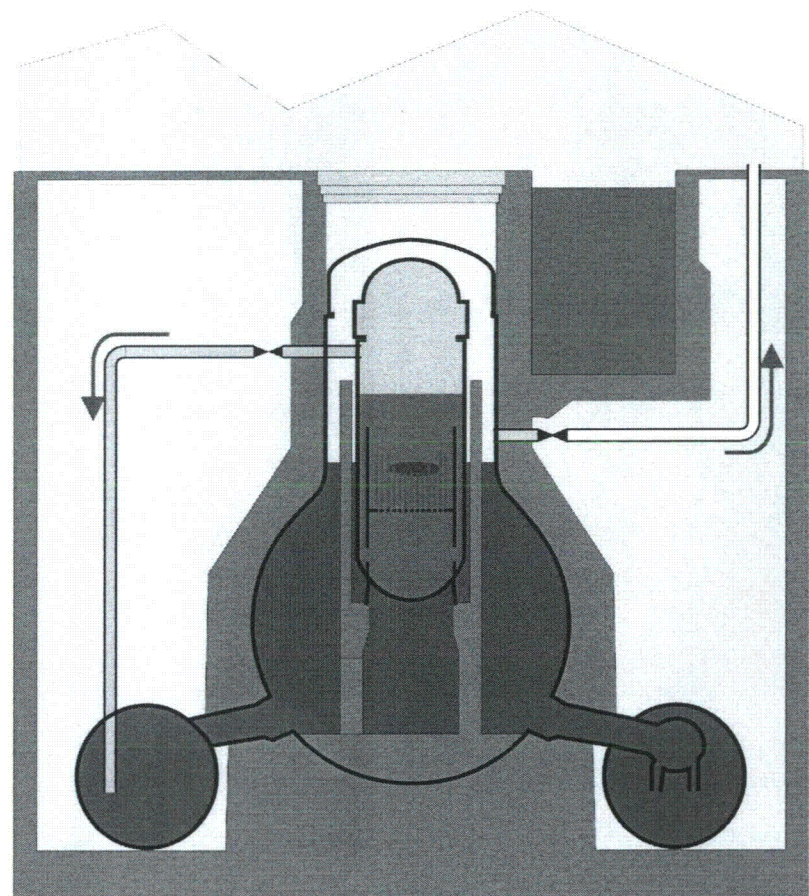


- **Current status of the Reactors**

- Core Damage in Unit 1,2, 3
- Electrical Power Restored
- Fresh Cooling Water supplied to All Units

- **Spent Fuel Pool Status**

- Suspect Fuel Damage in Pools 3 & 4
- Providing periodic make up water



## **NRC Response**

- Ops Center 24/7
- Team of experts to Tokyo
- Support to U.S. Ambassador and Japanese
- Coordinating Environmental Monitoring with DOE & EPA



## **Domestic Considerations**

- Harmful Levels of Radiation Not Expected in the U.S.
- U.S. Plants Designed for External Events
- U.S. Industry Initiated Review
- NRC has initiated additional inspections at all U.S. Plants
- NRC conducting Near-Term and Long-Term Reviews.

## **NRC Near Term Actions**

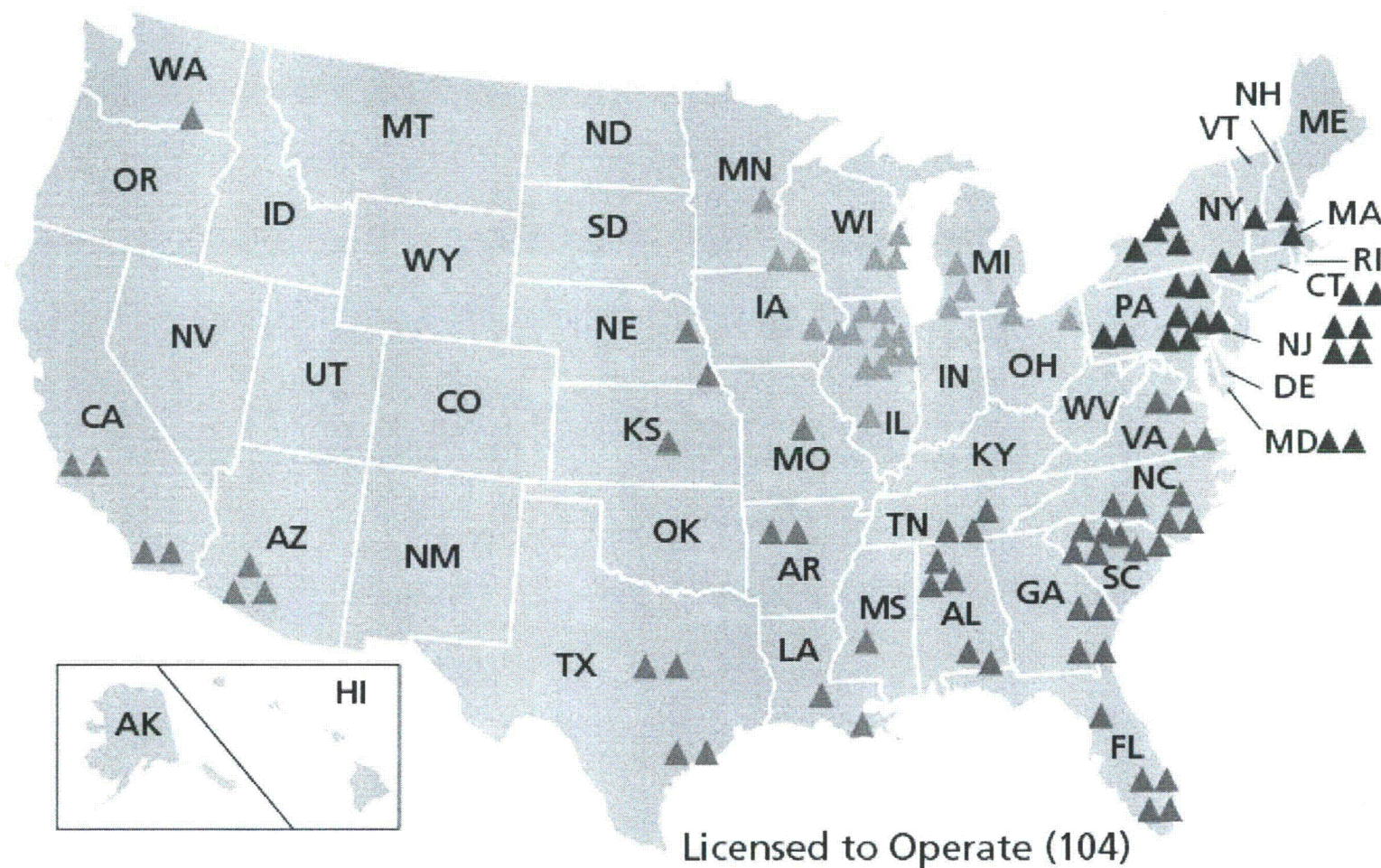
- Evaluate Fukushima Daiichi Events
- Domestic Operating Reactors and Spent Fuel Pools
  - External Events
  - Station Blackout
  - Severe Accident Mitigation
  - Emergency Preparedness
  - Combustible Gas Control
- Near Term Review due in 90 days (mid June)



## **NRC Longer Term Actions**

- Based on Near Term Review and Additional Insights from Fukushima Event
- Identify Potential Technical and Policy Issues
  - Research Activities
  - Generic Issues
  - Reactor Oversight Process
  - Regulatory Framework
  - Interagency Emergency Preparedness

# Operating Commercial Power Reactors







# Questions?

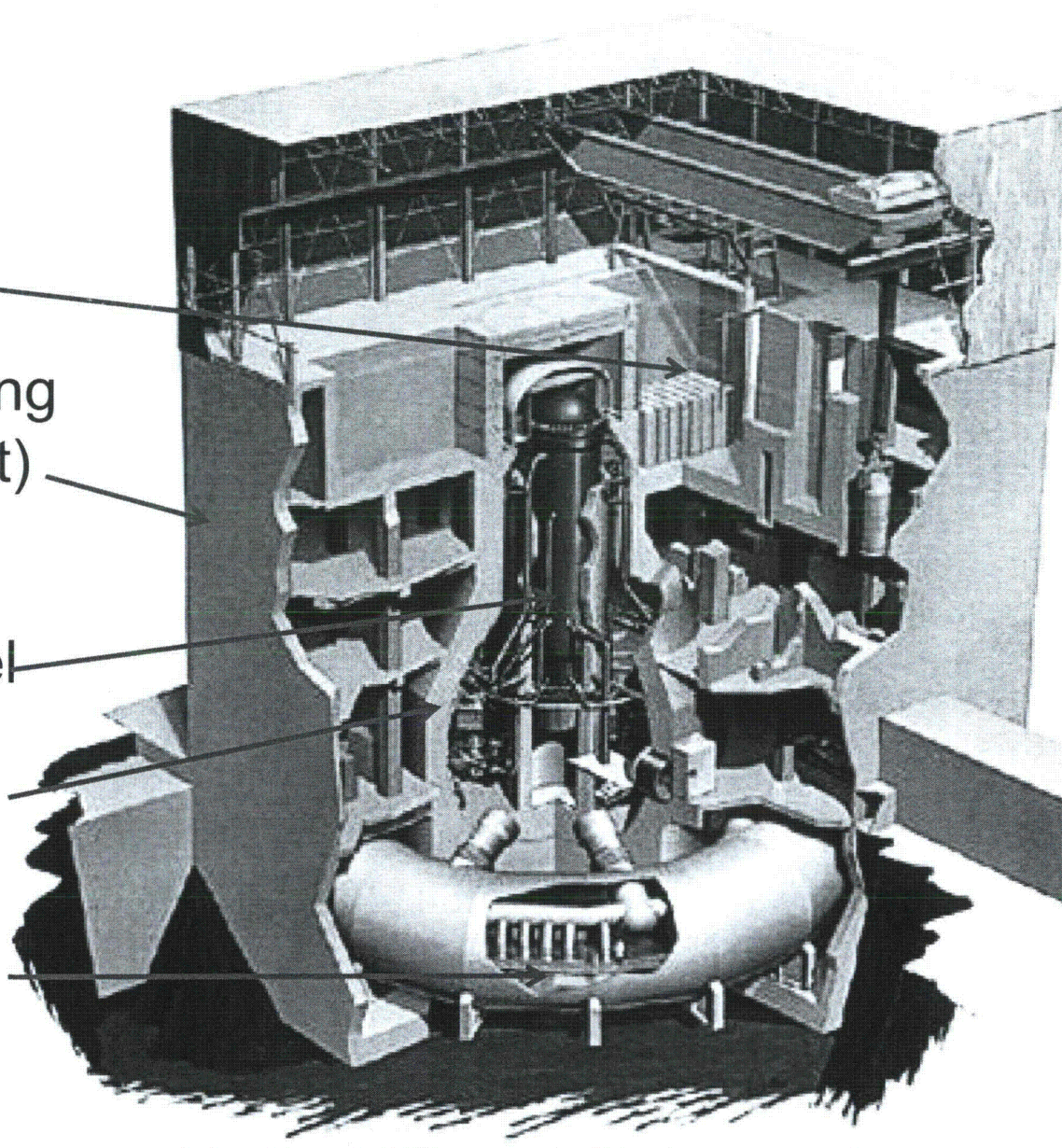
# PARS

- NRC Regulations have 2 Emergency Planning Zones (EPZs) 10/50 miles
- EPZs are not limits, but frameworks that allow for expansion as needed
- 50 miles in Japan due to extraordinary situation
  - 4 units severely challenged
  - Unclear information as to state of reactors, mitigative strategies, radiological releases
  - Decision to evacuate conservative, better to err on conservative
- Precautionary evacuation occurred days before fuel melt.



## BWR Mark I

- ▶ Spent Fuel Pool
- ▶ Concrete Reactor Building (secondary Containment)
- ▶ Reactor Pressure Vessel
- ▶ Containment (Drywell)
- ▶ Containment (Wet Well)





► Reactor Service Floor  
(Steel Construction)

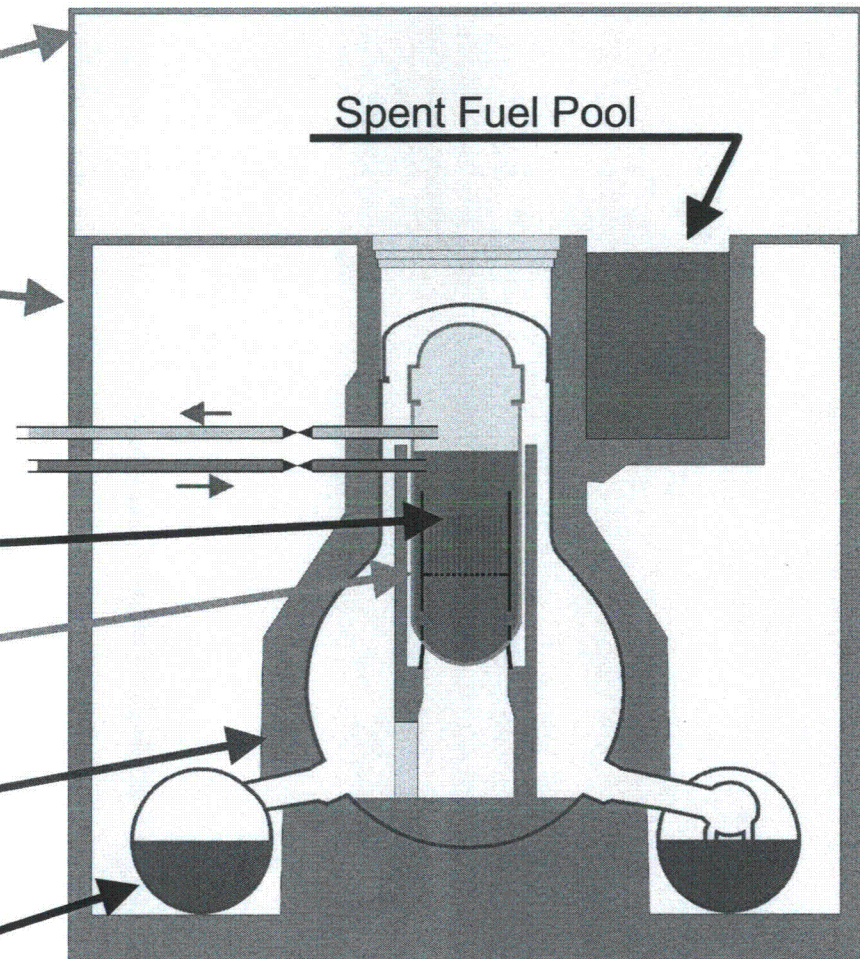
► Concrete Reactor Building  
(secondary Containment)

► Reactor Core

► Reactor Pressure Vessel

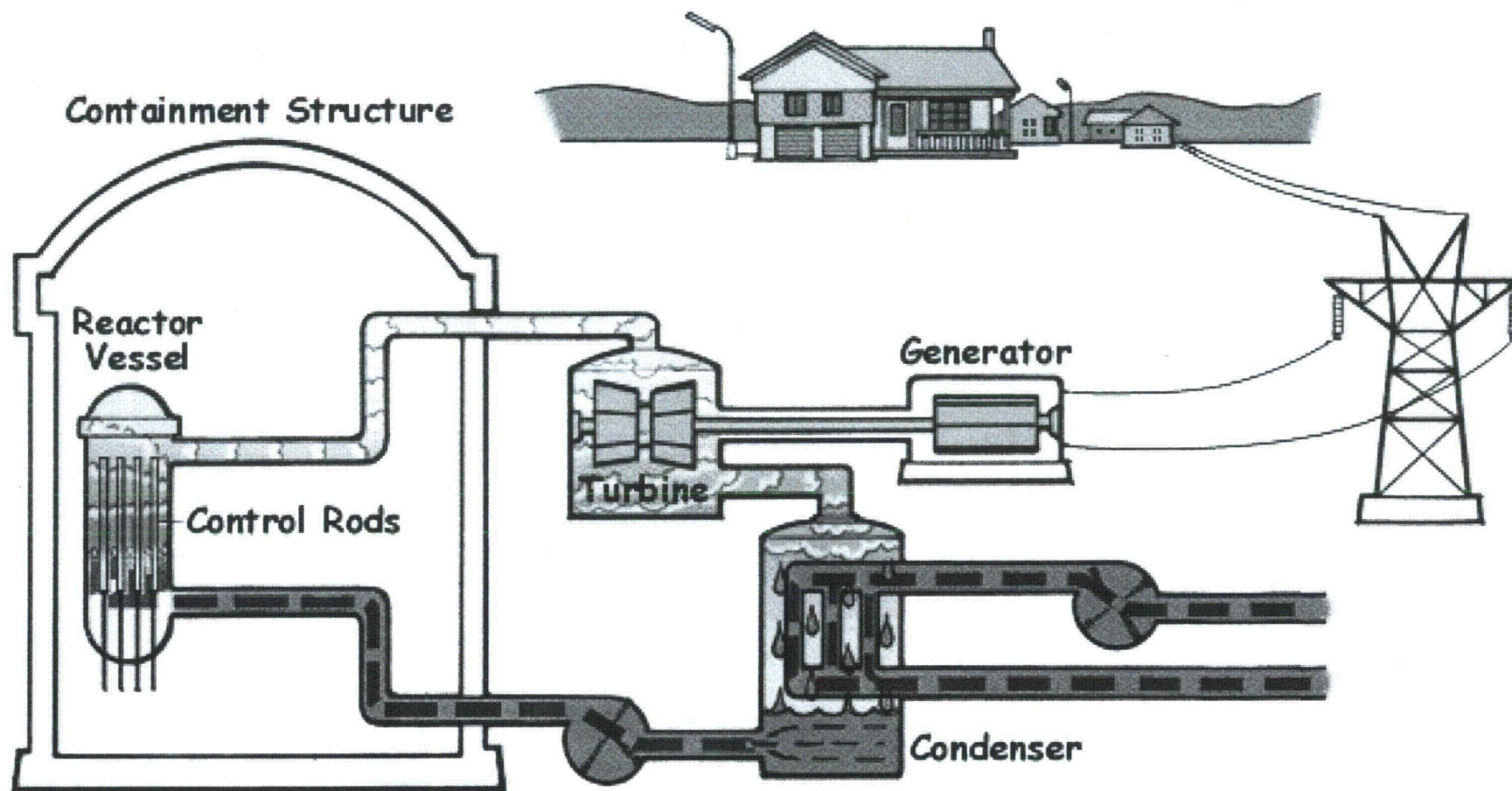
► Containment (Dry well)

► Containment (Wet Well)

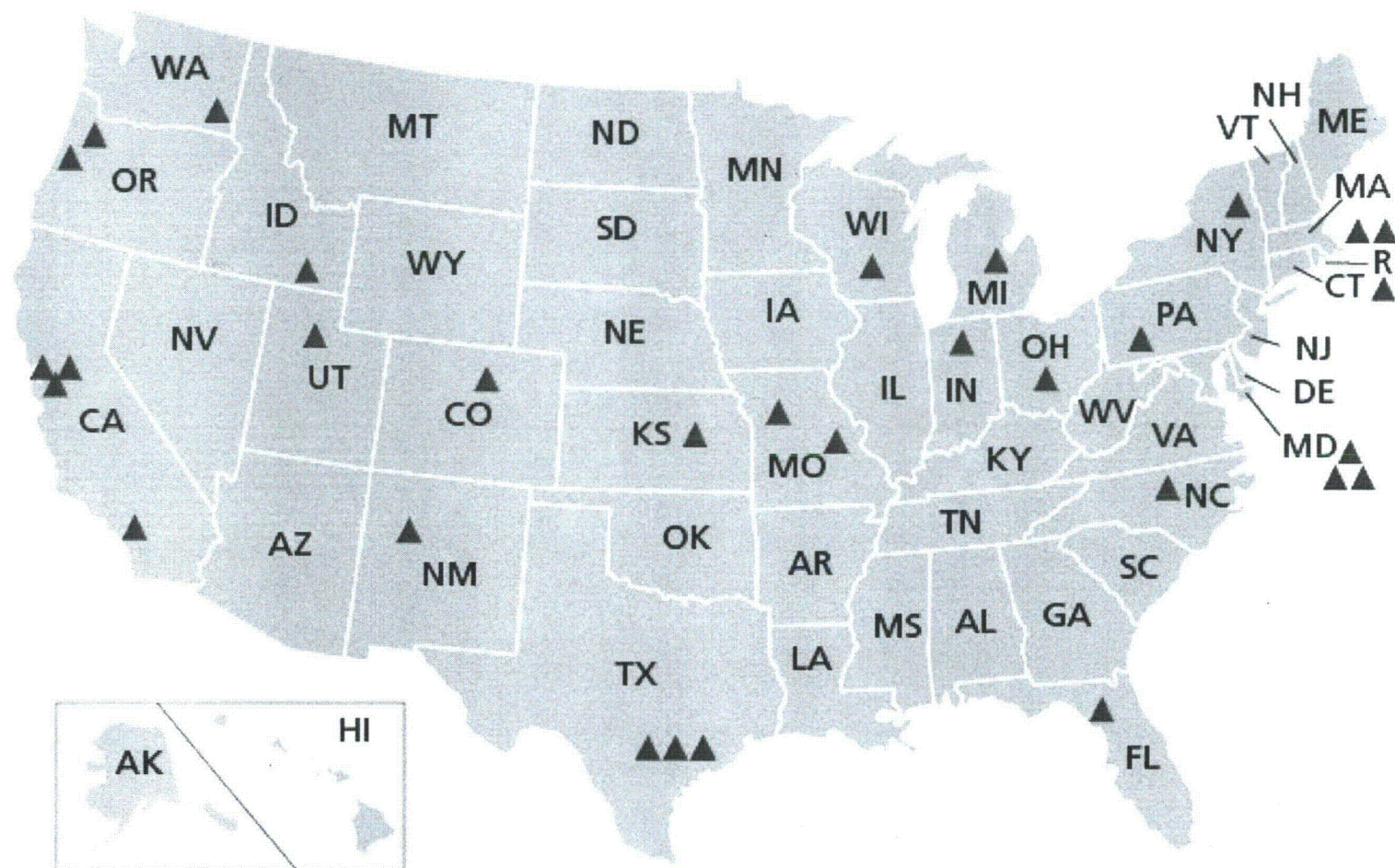




# Generic BWR



## Research and Test Reactors



▲ Licensed/Currently Operating (31)



# Radionuclides Rule: A Quick Reference Guide

## Overview of the Rule

Title*	Radionuclides Rule 66 FR 76708 December 7, 2000 Vol. 65, No. 236
Purpose	Reducing the exposure to radionuclides in drinking water will reduce the risk of cancer. This rule will also improve public health protection by reducing exposure to all radionuclides.
General Description	The rule retains the existing MCLs for combined radium-226 and radium-228, gross alpha particle radioactivity, and beta particle and photon activity. The rule regulates uranium for the first time.
Utilities Covered	Community water systems, all size categories.
*This document provides a summary of federal drinking water requirements; to ensure full compliance, please consult the federal regulations at 40 CFR 141 and any approved state requirements.	

## Public Health Benefits

Implementation of the Radionuclides Rule will result in . . .	Reduced uranium exposure for 620,000 persons, protection from toxic kidney effects of uranium, and a reduced risk of cancer.
Estimated impacts of the Radionuclides Rule include . . .	Annual compliance costs of \$81 million.  Only 795 systems will have to install treatment.

## Regulated Contaminants

Regulated Radionuclide	MCL	MCLG
Beta/photon emitters**	4mrem/yr	0
Gross alpha particle	15 pCi/L	0
Combined radium-226/228	5 pCi/L	0
Uranium	30µg/L	0
**A total of 168 individual beta particle and photon emitters may be used to calculate compliance with the MCL.		

## Critical Deadlines & Requirements

For Drinking Water Systems	
June 2000 - December 8, 2003	When allowed by the State, data collected between these dates may be eligible for use as grandfathered data (excluding beta particle and photon emitters).
December 8, 2003	Systems begin initial monitoring under State-specified monitoring plan unless the State permits use of grandfathered data.
December 31, 2007	All systems must complete initial monitoring.
For States	
December 2000 - December 2003	States work with systems to establish monitoring schedules.
December 8, 2000	States should begin to update vulnerability assessments for beta photon and particle emitters and notify systems of monitoring requirements.
Spring 2001	EPA meets and works with States to explain new rules and requirements and to initiate adoption and implementation activities.
December 8, 2002	State submits primacy revision application to EPA. (EPA approves within 90 days.)

Y/403



## Monitoring Requirements

**Gross Alpha, Combined Radium-226/228, and Uranium (1)**

**Beta Particle and Photon Radioactivity (1)**

### Initial Monitoring

Four consecutive quarters of monitoring.

No monitoring required for most CWSs. Vulnerable CWSs (2) must sample for:

- Gross beta: quarterly samples.
- Tritium and Strontium-90: annual samples.

### Reduced Monitoring

If the average of the initial monitoring results for each contaminant is below the detection limit: One sample every 9 years.

If the average of the initial monitoring results for each contaminant is greater than or equal to the detection limit, but less than or equal to one-half the MCL: One sample every 6 years.

If the average of the initial monitoring results for each contaminant is greater than one-half the MCL, but less than or equal to the MCL: One sample every 3 years.

If the running annual average of the gross beta particle activity minus the naturally occurring potassium-40 activity is less than or equal to 50 pCi/L: One sample every 3 years.

### Increased Monitoring

A system with an entry point result above the MCL must return to quarterly sampling until 4 consecutive quarterly samples are below the MCL.

If gross beta particle activity minus the naturally occurring potassium-40 activity exceeds 50 pCi/L, the system must:

- Speciate as required by the State.
- Sample at the initial monitoring frequency.

(1) All samples must be collected at each entry point to the distribution system.

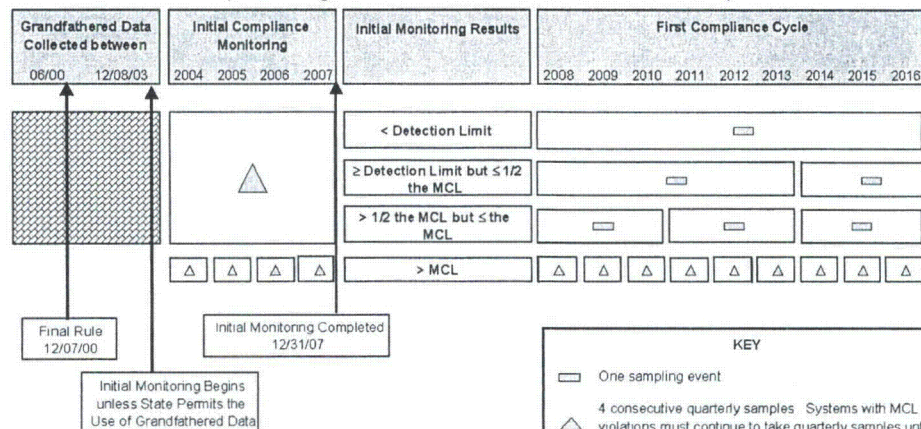
(2) The rule also contains requirements for CWSs using waters contaminated by effluents from nuclear facilities.

## Grandfathering of Data

When allowed by the State, data collected between June, 2000 and December 8, 2003 may be used to satisfy the initial monitoring requirements if samples have been collected from:

- Each entry point to the distribution system (EPTDS).
- The distribution system, provided the system has a single EPTDS.
- The distribution system, provided the State makes a written justification explaining why the sample is representative of all EPTDS.

## Applicability of the Standardized Monitoring Framework to Radionuclides (Excluding the Beta Particle and Photon Emitters)



For additional information on the Radionuclides Rule

Call the Safe Drinking Water Hotline at 1-800-426-4791; visit the EPA Web site at <http://water.epa.gov/drink>.



EPA

# Derived Concentrations (pCi/l) of Beta and Photon Emitters in Drinking Water

Yielding a Dose of 4 mrem/yr to the Total Body or to any Critical Organ as defined in NBS  
Handbook 69

Nuclide	pCi/l	Nuclide	pCi/l	Nuclide	pCi/l	Nuclide	pCi/l	Nuclide	pCi/l	Nuclide	pCi/l
H-3	20,000	Ni-65	300	Nb-95	300	Sb-124	60	Nd-147	200	Os-191	600
Be-7	6,000	Cu-64	900	Nb-97	3,000	Sb-125	300	Nd-149	900	Os-191m	9,000
C-14	2,000	Zn-65	300	Mo-99	600	Te-125m	600	Pm-147	600	Os-193	200
F-18	2,000	Zn-69	6,000	Tc-96	300	Te-127	900	Pm-149	100	Ir-190	600
Na-22	400	Zn-69m	200	Tc-96m	30,000	Te-127m	200	Sm-151	1,000	Ir-192	100
Na-24	600	Ga-72	100	Tc-97	6,000	Te-129	2,000	Sm-153	200	Ir-194	90
Si-31	3,000	Ge-71	6,000	Tc-97m	1,000	Te-129m	90	Eu-152	200	Pt-191	300
P-32	30	As-73	1,000	Tc-99	900	Te-131m	200	Eu-154	60	Pt-193	3,000
S-35 inorg	500	As-74	100	Tc-99m	20,000	Te-132	90	Eu-155	600	Pt-193m	3,000
Cl-36	700	As-76	60	Ru-97	1,000	I-126	3	Gd-153	600	Pt-197	300
Cl-38	1,000	As-77	200	Ru-103	200	I-129	1	Gd-159	200	Pt-197m	3,000
K-42	900	Se-75	900	Ru-105	200	I-131	3	Tb-160	100	Au-196	600
Ca-45	10	Br-82	100	Ru-106	30	I-132	90	Dy-165	1,000	Au-198	100
Ca-47	80	Rb-86	600	Rh-103m	30,000	I-133	10	Dy-166	100	Au-199	600
Sc-46	100	Rb-87	300	Rh-105	300	I-134	100	Ho-166	90	Hg-197	900
Sc-47	300	Sr-85m	20,000	Pd-103	900	I-135	30	Er-169	300	Hg-197m	600
Sc-48	80	Sr-85	900	Pd-109	300	Cs-131	20,000	Er-171	300	Hg-203	60
V-48	90	Sr-89	20	Ag-105	300	Cs-134	80	Tm-170	100	Tl-200	1,000
Cr-51	6,000	Sr-90	8	Ag-110m	90	Cs-134m	20,000	Tm-171	1,000	Tl-201	900
Mn-52	90	Sr-91	200	Ag-111	100	Cs-135	900	Yb-175	300	Tl-202	300
Mn-54	300	Sr-92	200	Cd-109	600	Cs-136	800	Lu-177	300	Tl-204	300
Mn-56	300	Y-90	60	Cd-115	90	Cs-137	200	Hf-181	200	Pb-203	1,000
Fe-55	2,000	Y-91	90	Cd-115m	90	Ba-131	600	Ta-182	100	Bi-206	100
Fe-59	200	Y-91m	9,000	In-113m	3,000	Ba-140	90	W-181	1,000	Bi-207	200
Co-57	1,000	Y-92	200	In-114m	60	La-140	60	W-185	300	Pa-230	600
Co-58	300	Y-93	90	In-115	300	Ce-141	300	W-187	200	Pa-233	300
Co-58m	9000	Zr-93	2,000	In-115m	1,000	Ce-143	100	Re-186	300	Np-239	300
Co-60	100	Zr-95	200	Sn-113	300	Ce-144	30	Re-187	9,000	Pu-241	300
Ni-59	300	Zr-97	60	Sn-125	60	Pr-142	90	Re-188	200	Bk-249	2,000
Ni-63	50	Nb-93m	1,000	Sb-122	90	Pr-143	100	Os-185	200		

no MCLs specifically for I-131 or Cs-137

do have gross alpha, beta, gamma

Sam Anderson