

34
Doerflein, Lawrence

From: Doerflein, Lawrence
Sent: Thursday, March 24, 2011 1:19 PM
To: Williams, Christopher
Subject: RE: Areva's Presentation on the Fukuchima Event

thanks

From: Williams, Christopher
Sent: Thursday, March 24, 2011 12:37 PM
To: Doerflein, Lawrence
Subject: FW: Areva's Presentation on the Fukuchima Event

This looks like Areva's thoughts with some German thrown in.

From: McHugh, James
Sent: Thursday, March 24, 2011 9:41 AM
To: Ayala, Juan; Ehrhardt, Frank; Cronk, Kevin; Myers, Valerie; Williams, Christopher; Jennerich, Matthew
Subject: FW: Areva's Presentation on the Fukuchima Event

From: Bussey, Scott
Sent: Thursday, March 24, 2011 6:52 AM
To: TTC RTTB; TTC STTB
Subject: Areva's Presentation on the Fukuchima Event

Hey everyone, here is Areva's presentation on the Fukuchima Event.

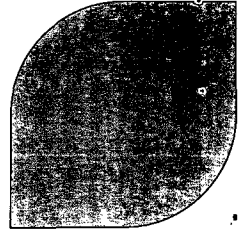


Scott F. Bussey

Reactor Technology Instructor (PWR)
USNRC Technical Training Center
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The Fukushima Daiichi Incident

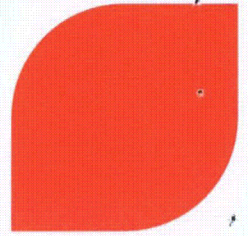


1. Plant Design
2. Accident Progression
3. Radiological releases
4. Spent fuel pools
5. Sources of Information

Matthias Braun
PEPA4-G, AREVA–NP GmbH
Matthias.Braun@AREVA.com

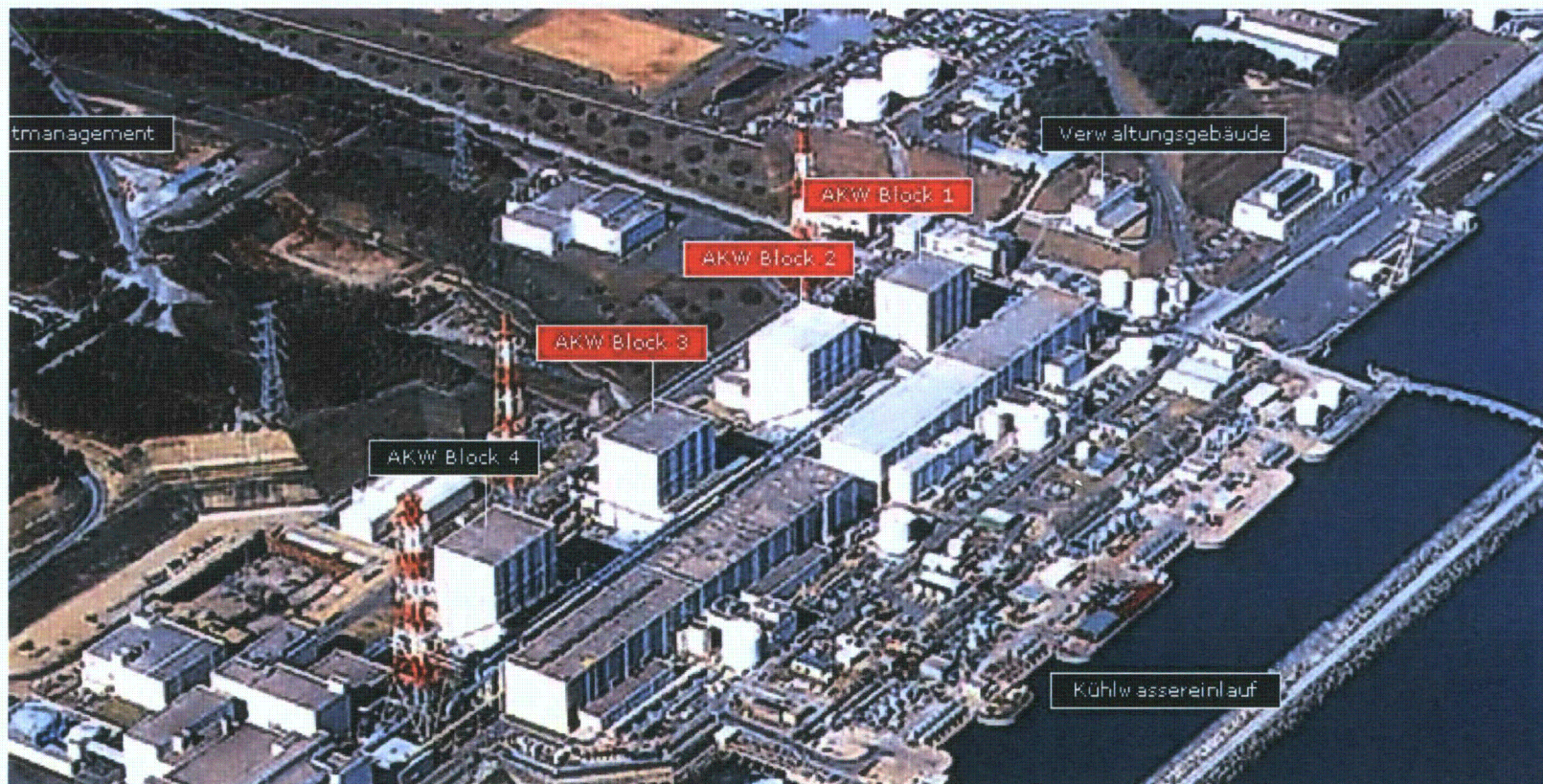
The Fukushima Daiichi Incident

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

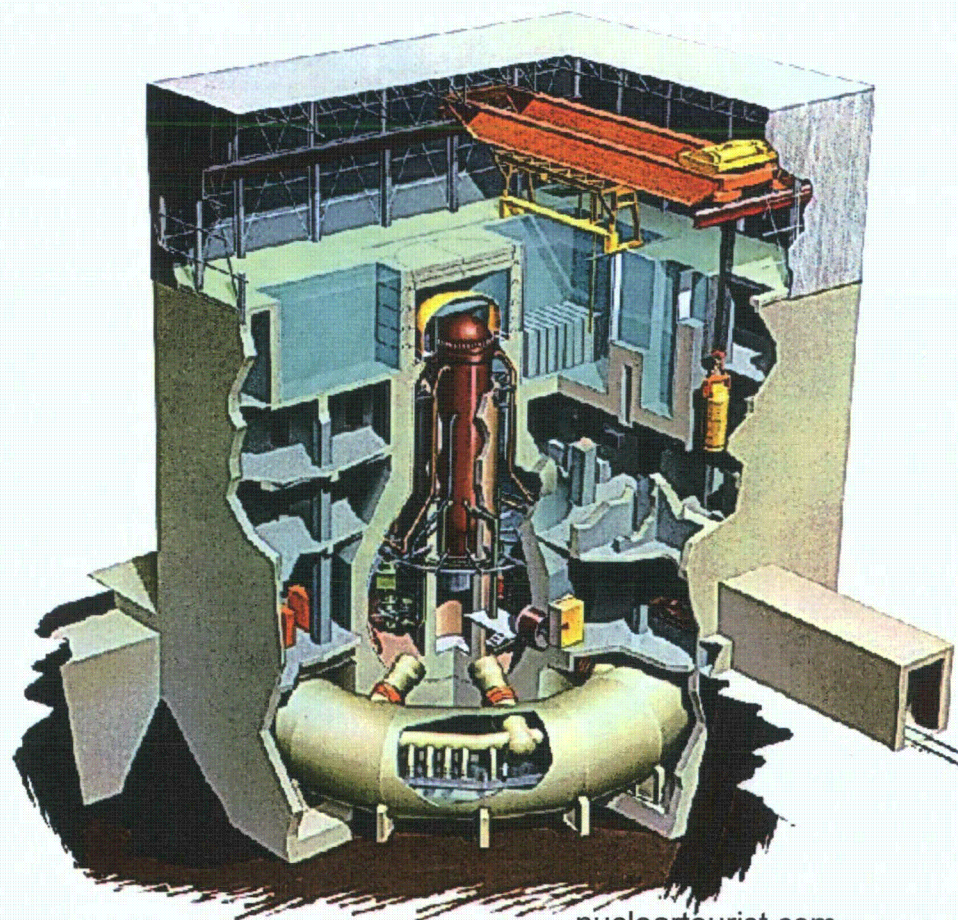


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1. Plant Design

► Building structure

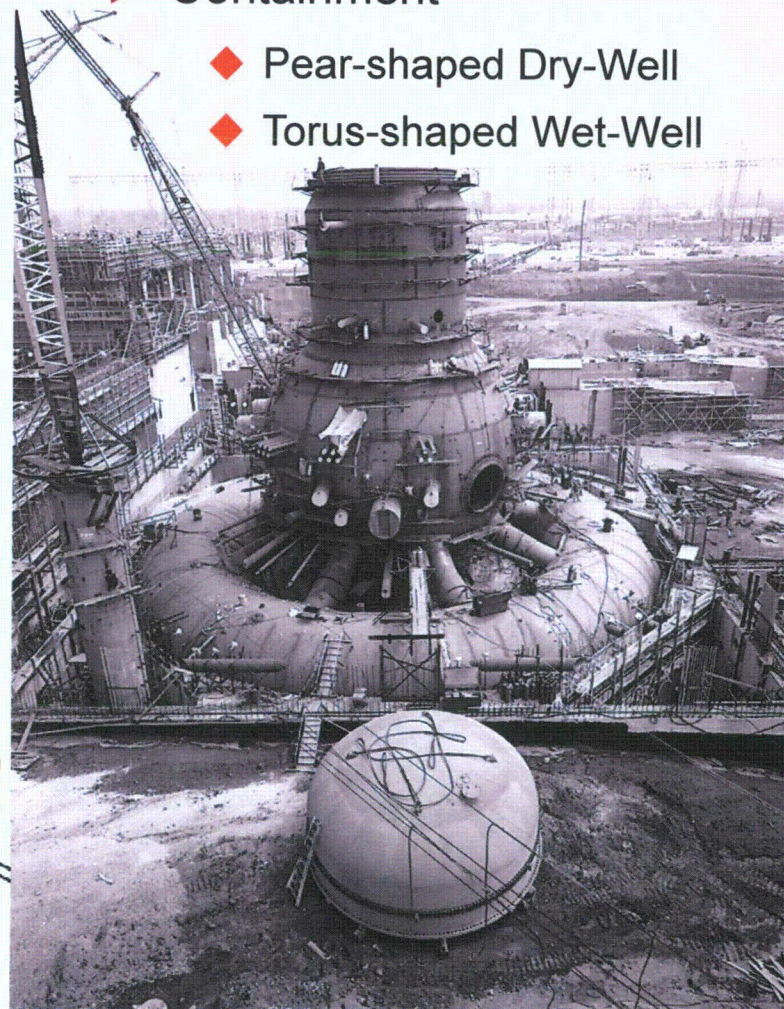
- ◆ Concrete Building
- ◆ Steel-framed Service Floor



nucleartourist.com

► Containment

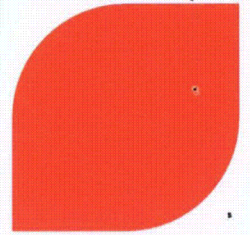
- ◆ Pear-shaped Dry-Well
- ◆ Torus-shaped Wet-Well



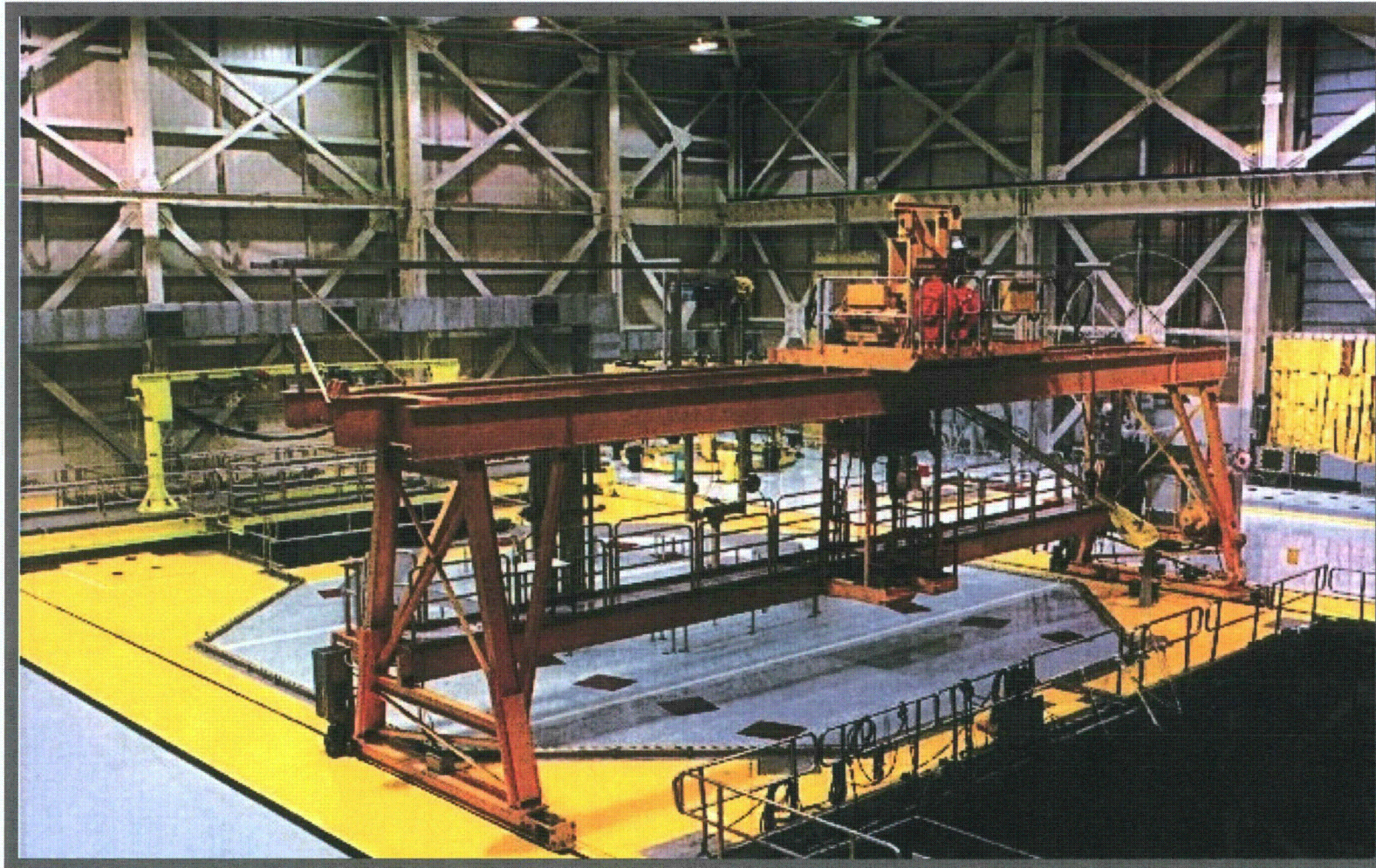
en.wikipedia.org/wiki/Browns_Ferry_Nuclear_Power_Plant

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1. Plant Design

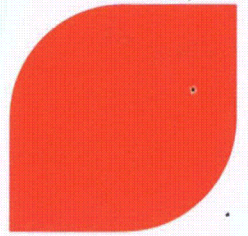


► Service Floor

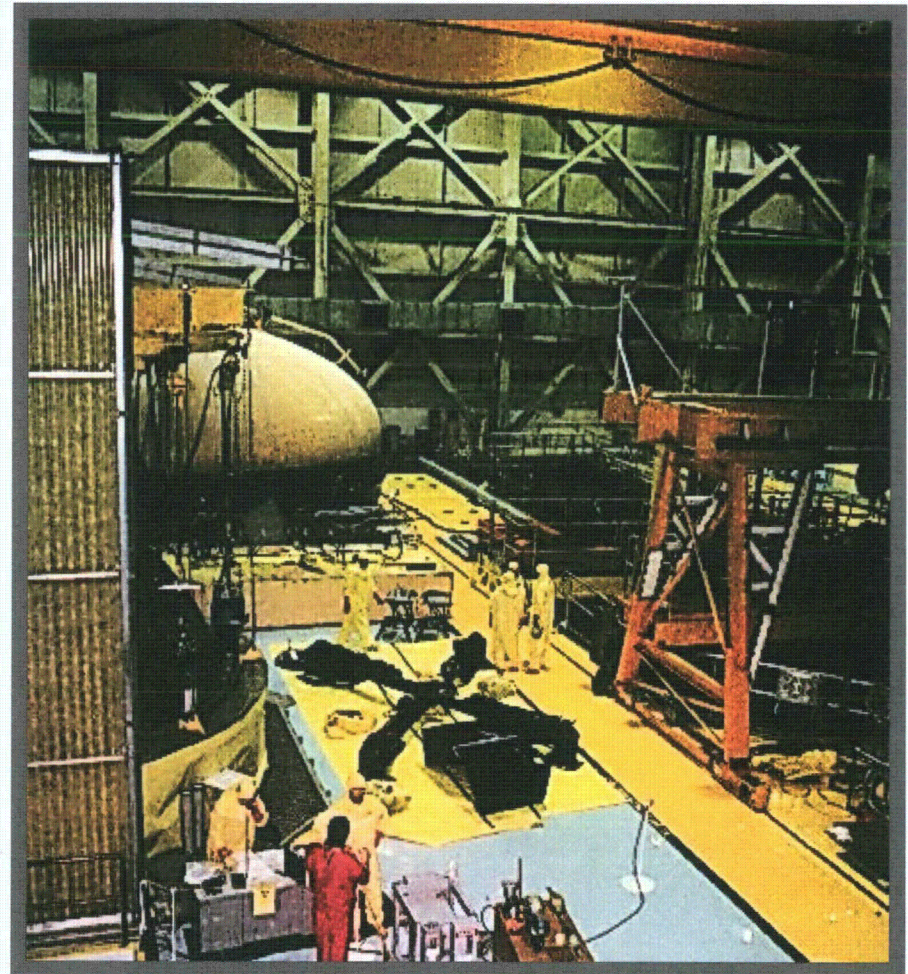
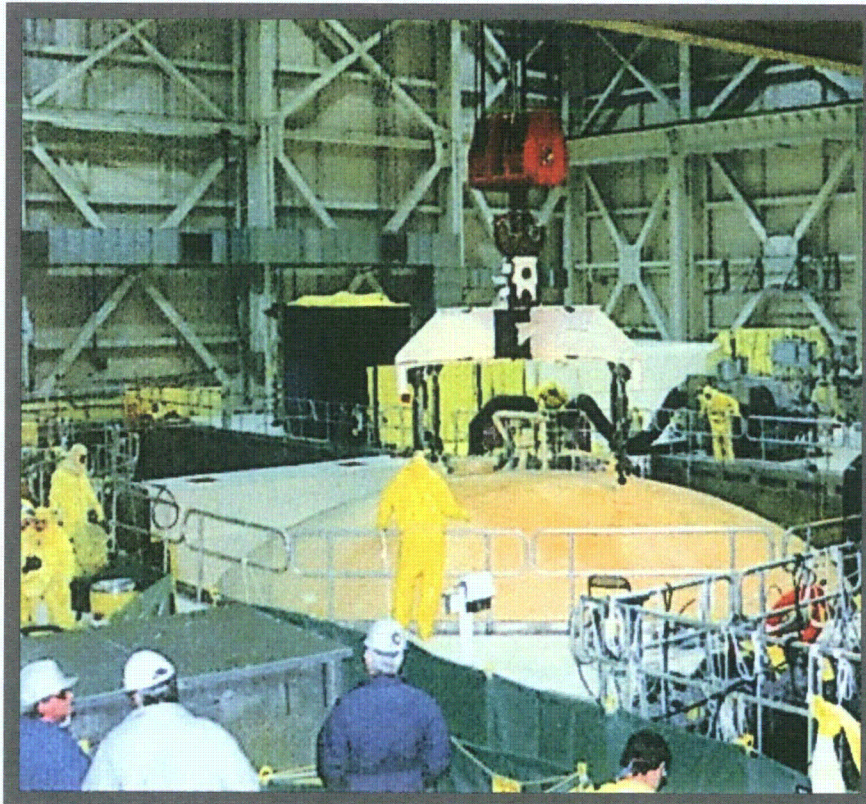


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1. Plant Design

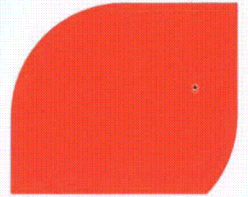


- Lifting the Containment closure head



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1. Plant Design



▶ Reactor Service Floor
(Steel Construction)

▶ Concrete Reactor Building
(secondary Containment)

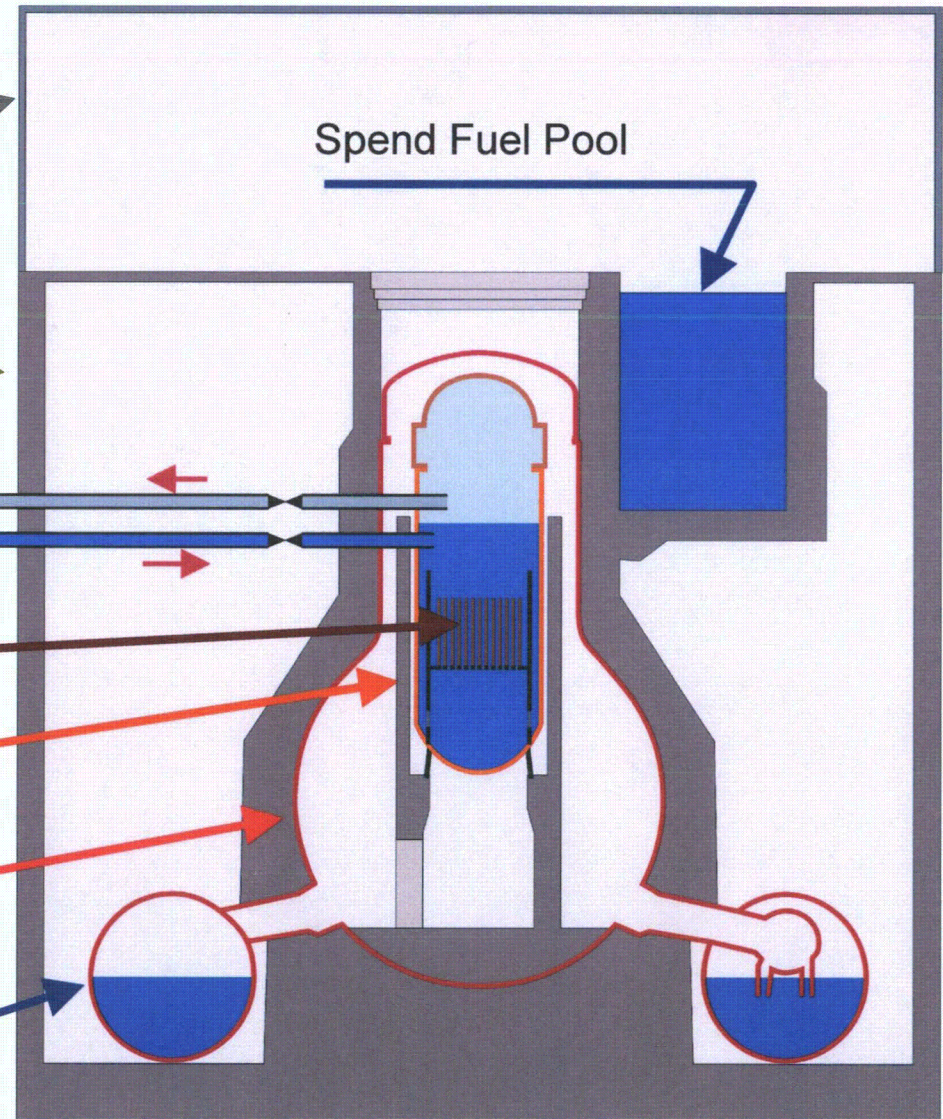
Fresh Steam line
Main Feedwater

▶ Reactor Core

▶ Reactor Pressure Vessel

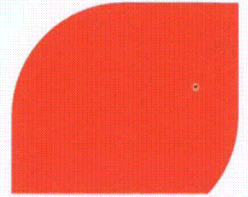
▶ Containment (Dry well)

▶ Containment (Wet Well) /
Condensation Chamber



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2. Accident progression

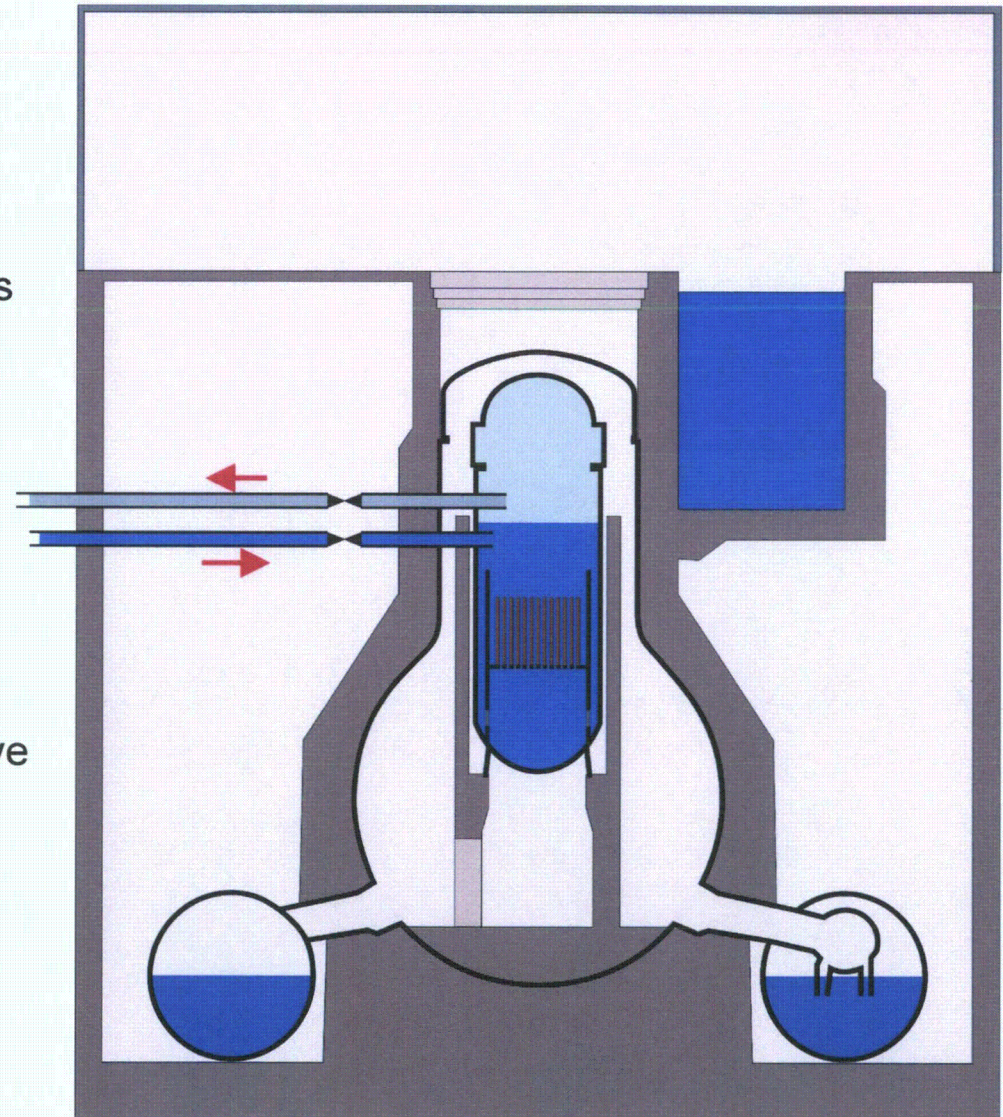


► 11.3.2011 14:46 - Earthquake

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

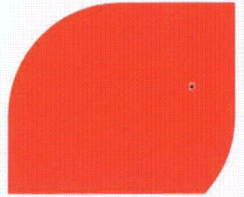
► SCRAM

- ◆ 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%

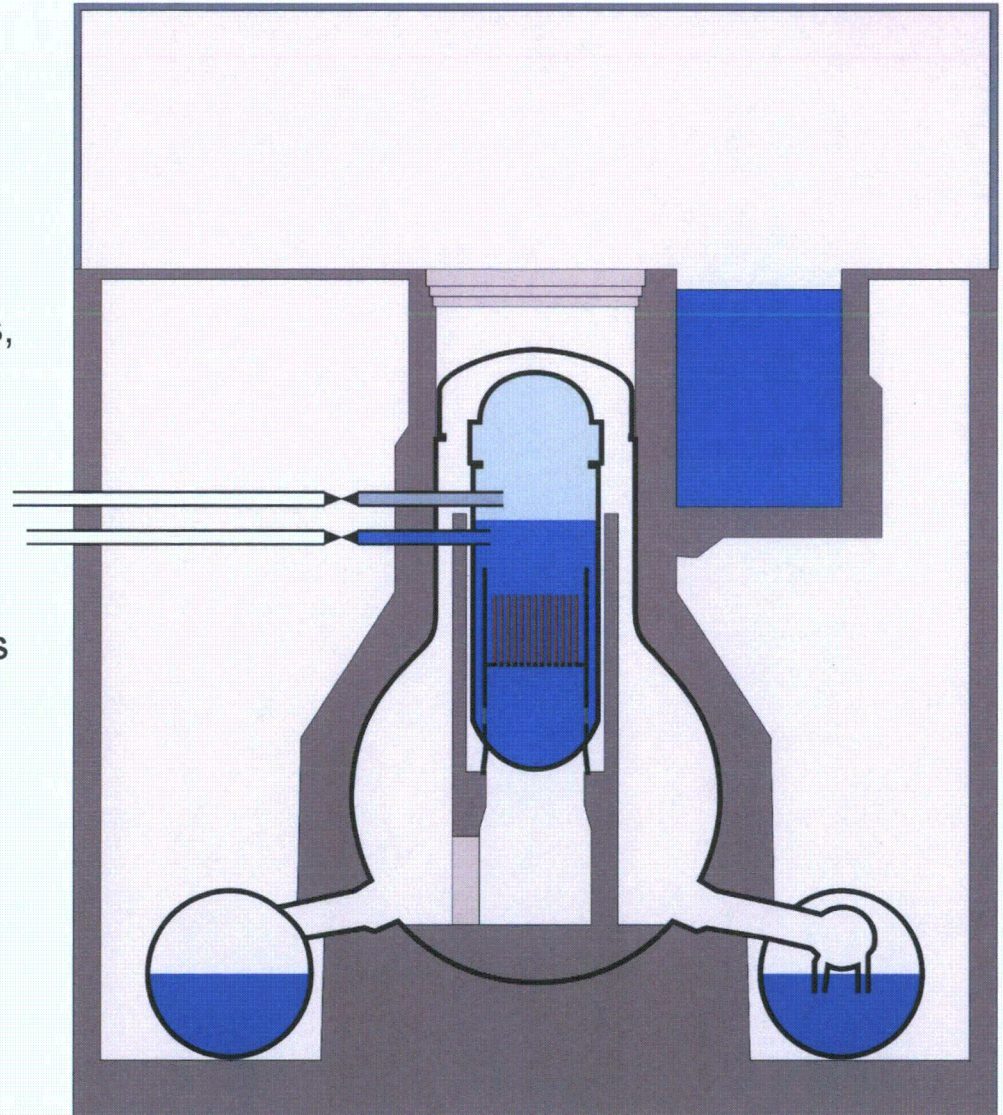


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2. Accident progression

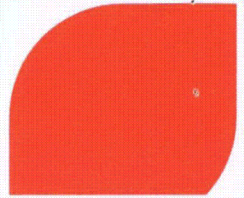


- ▶ Containment Isolation
 - ◆ Closing of all non-safety related Penetrations of the containment
 - ◆ Cuts off Machine hall
 - ◆ If containment isolation succeeds, a large early release of fission products is highly unlikely
- ▶ Diesel generators start
 - ◆ Emergency Core cooling systems are supplied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

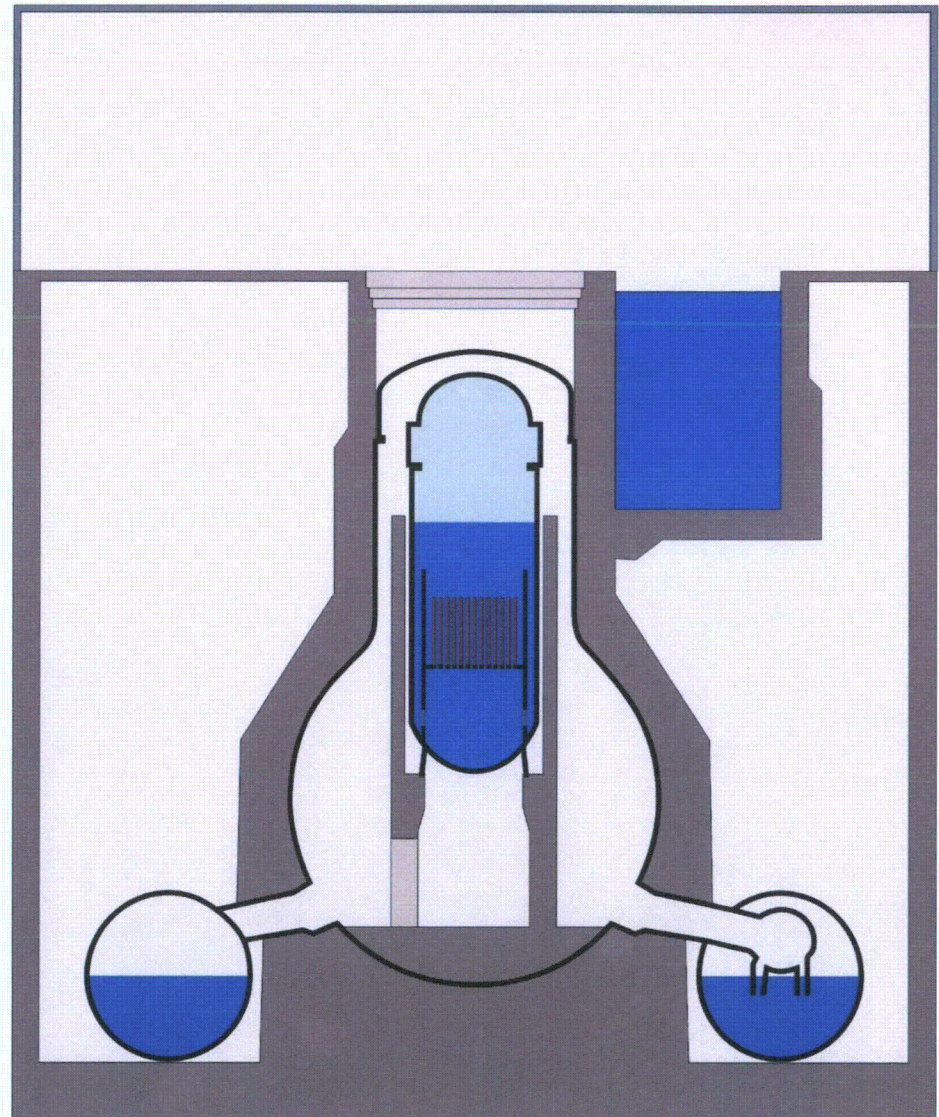


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2. Accident progression

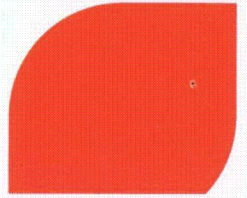


- ▶ 11.3. 15:41 Tsunami hits the plant
 - ◆ Plant Design for Tsunami height of up to 6.5m
 - ◆ Actual Tsunami height >7m
 - ◆ Flooding of
 - Diesel Generators and/or
 - Essential service water building cooling the generators
- ▶ Station Blackout
 - ◆ Common cause failure of the power supply
 - ◆ Only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

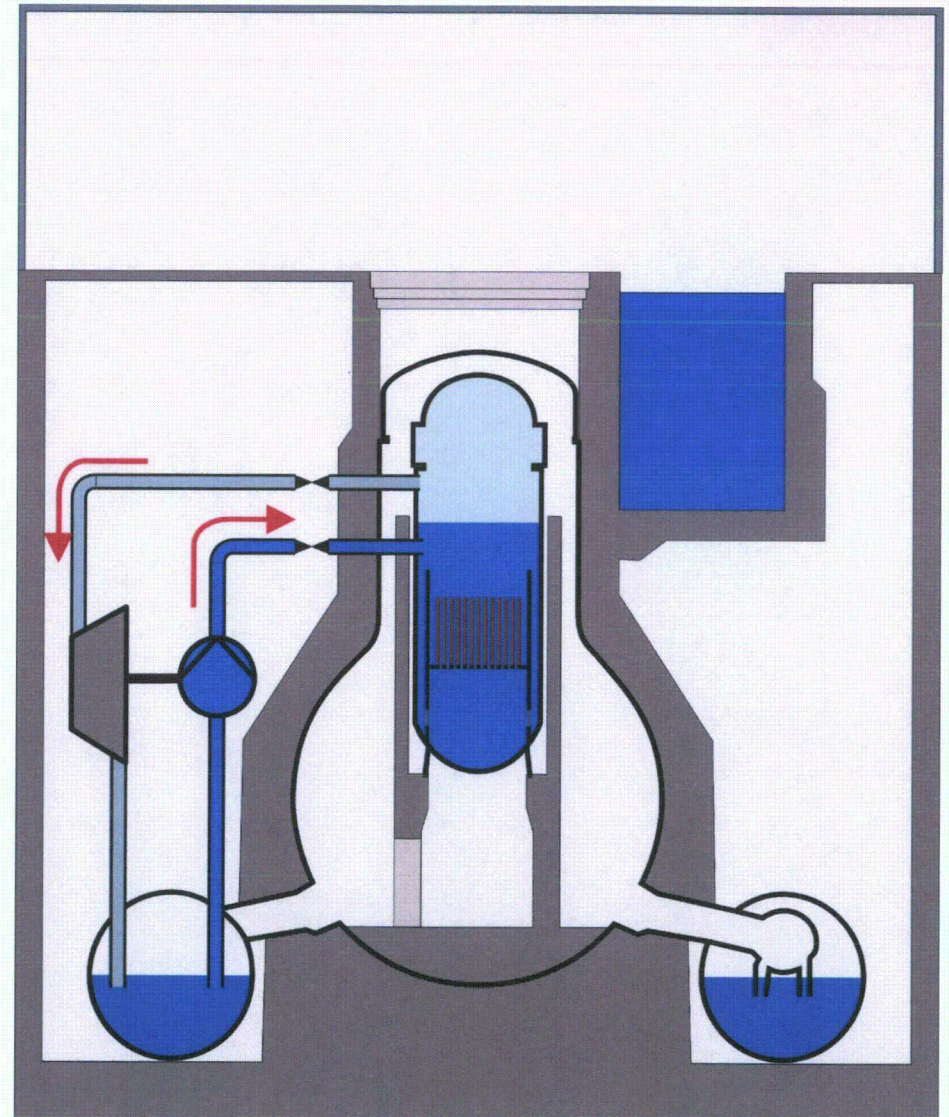


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2. Accident progression

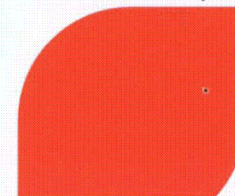


- ▶ Reactor Core Isolation Pump still available
 - ◆ Steam from the Reactor drives a Turbine
 - ◆ Steam gets condensed in the Wet-Well
 - ◆ Turbine drives a Pump
 - ◆ Water from the Wet-Well gets pumped in Reactor
 - ◆ Necessary:
 - Battery power
 - Temperature in the wet-well must be below 100°C
- ▶ As there is no heat removal from the building, the Core isolation pump can't work infinitely

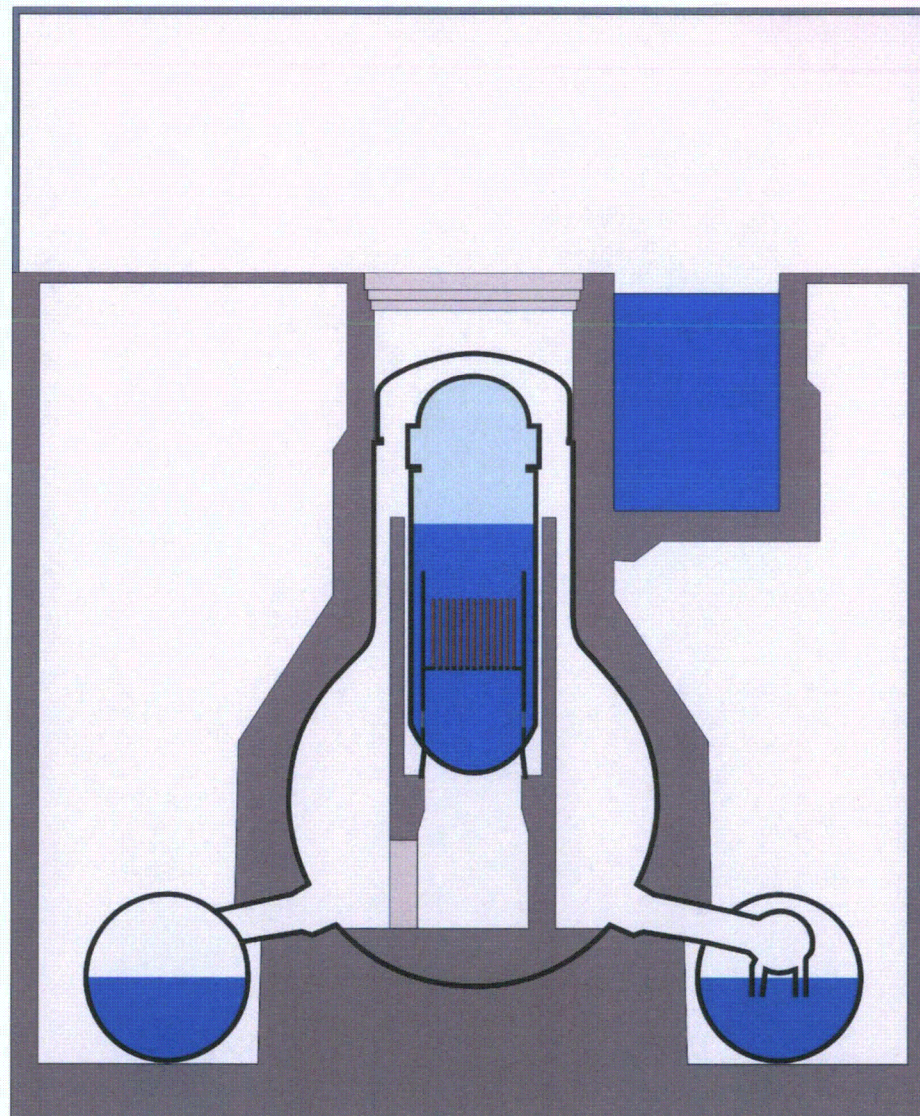


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2. Accident progression

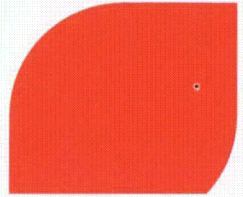


- ▶ Reactor Isolation pump stops
 - ◆ 11.3. 16:36 in Unit 1 (Batteries empty)
 - ◆ 14.3. 13:25 in Unit 2 (Pump failure)
 - ◆ 13.3. 2:44 in Unit 3 (Batteries empty)
- ▶ Decay Heat produces still steam in Reactor pressure Vessel
 - ◆ Pressure rising
- ▶ Opening the steam relief valves
 - ◆ Discharge Steam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

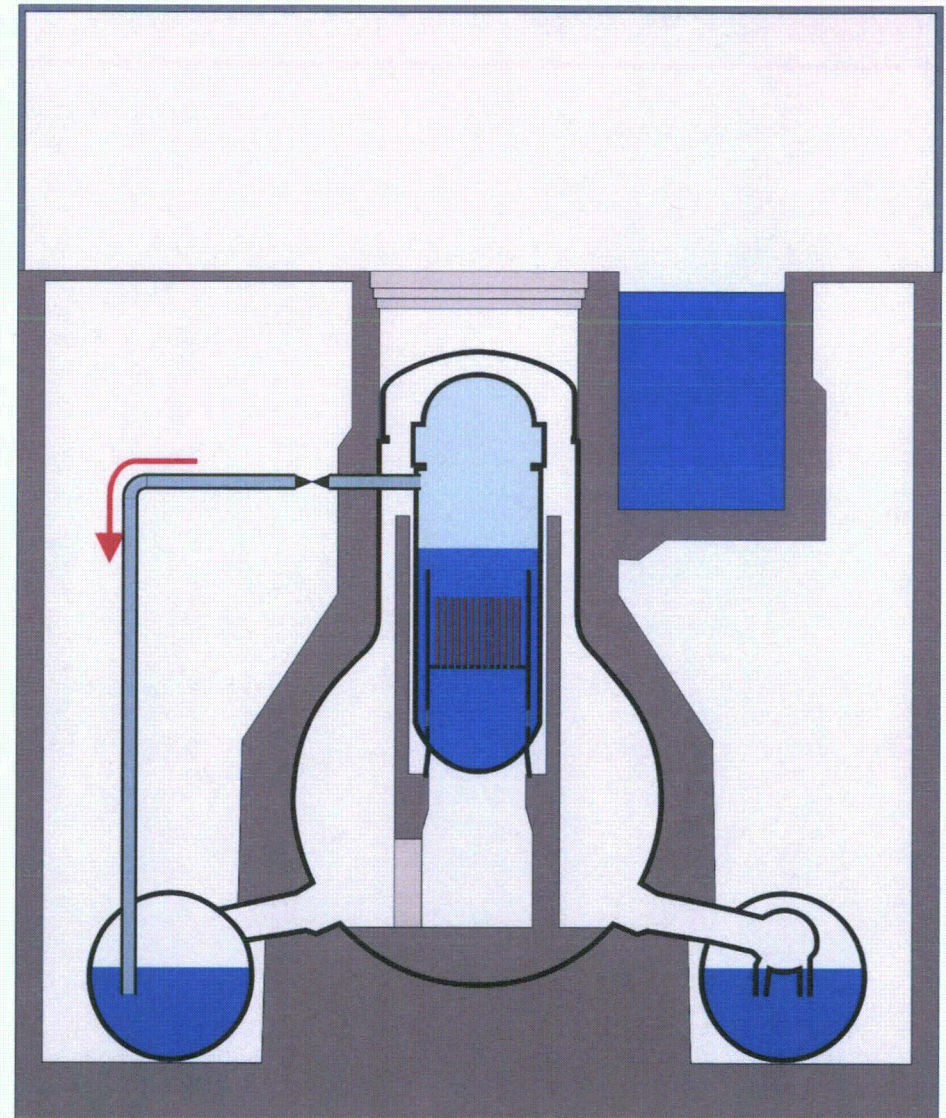


The Fukushima Daiichi Incident

2. Accident progression

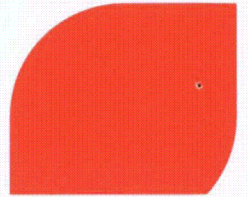


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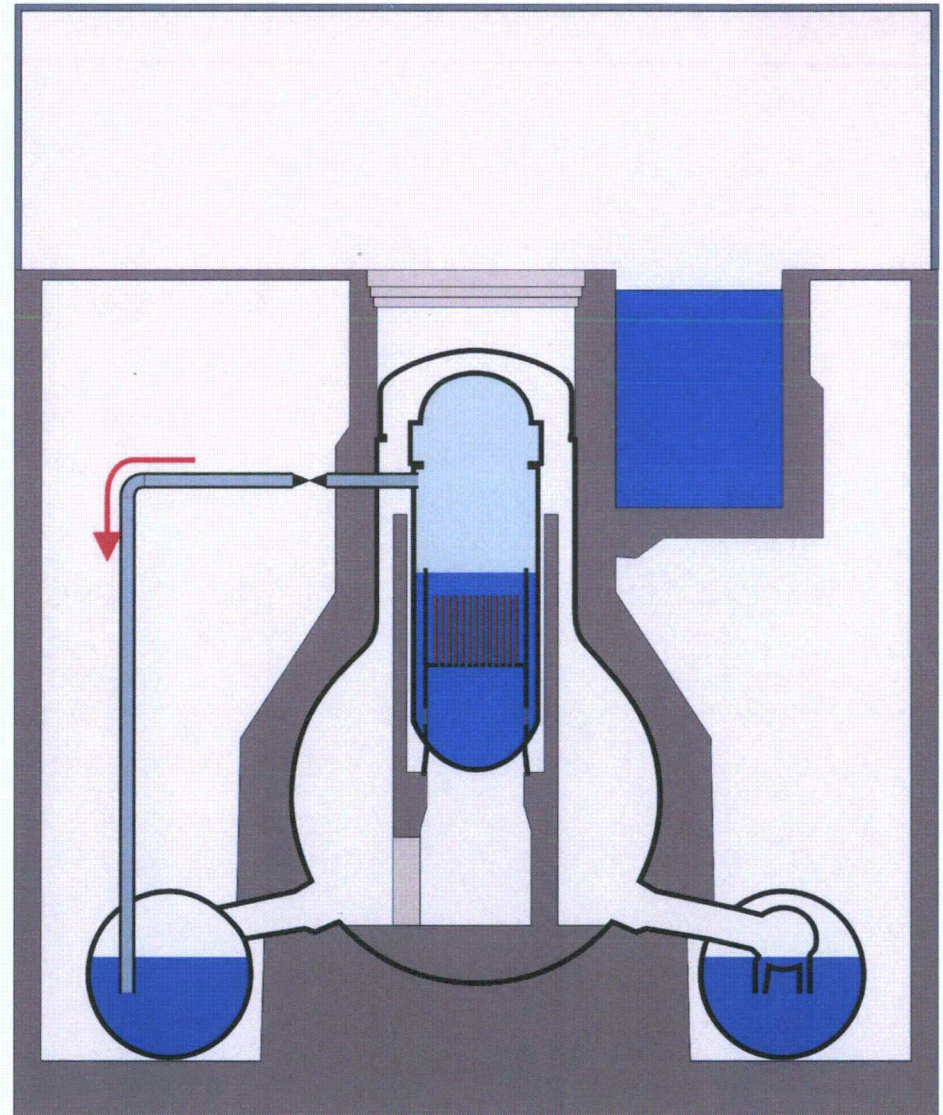


The Fukushima Daiichi Incident

2. Accident progression

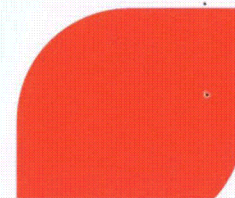


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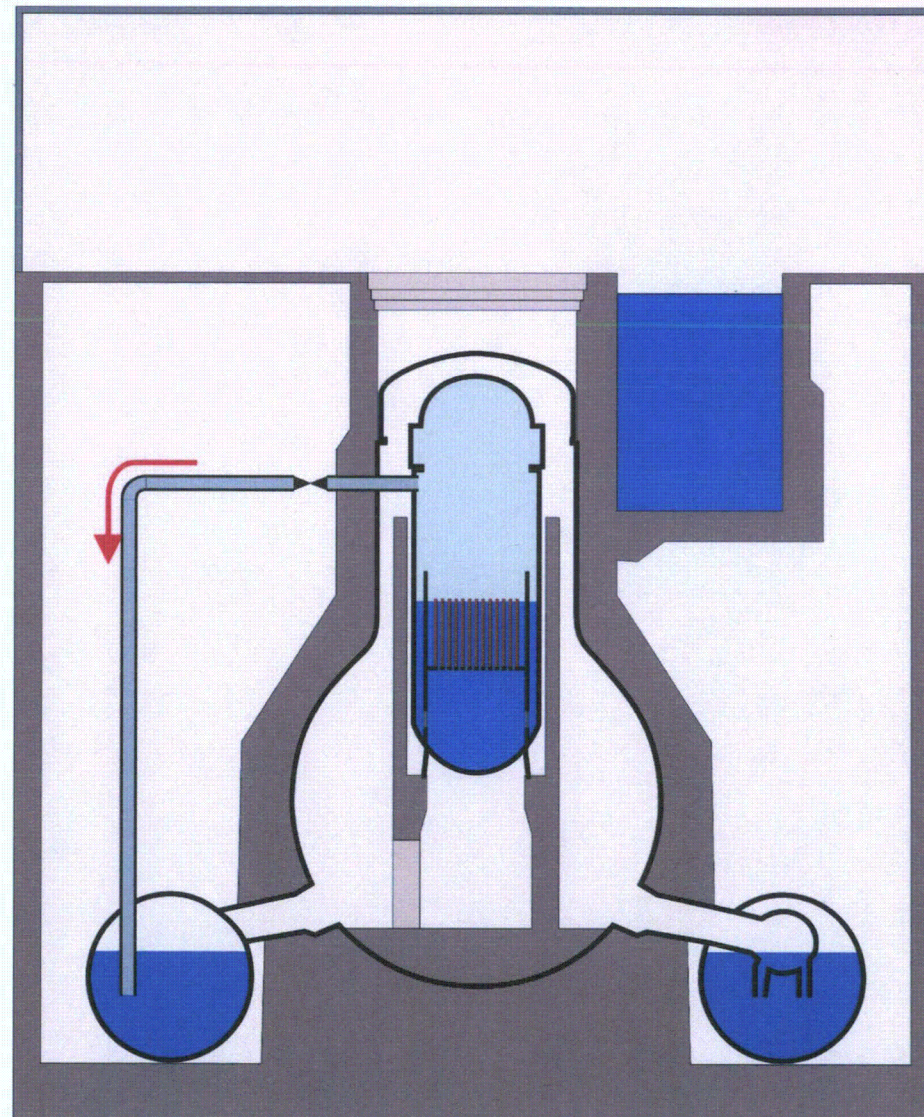


The Fukushima Daiichi Incident

2. Accident progression

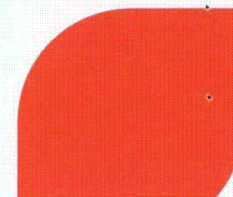


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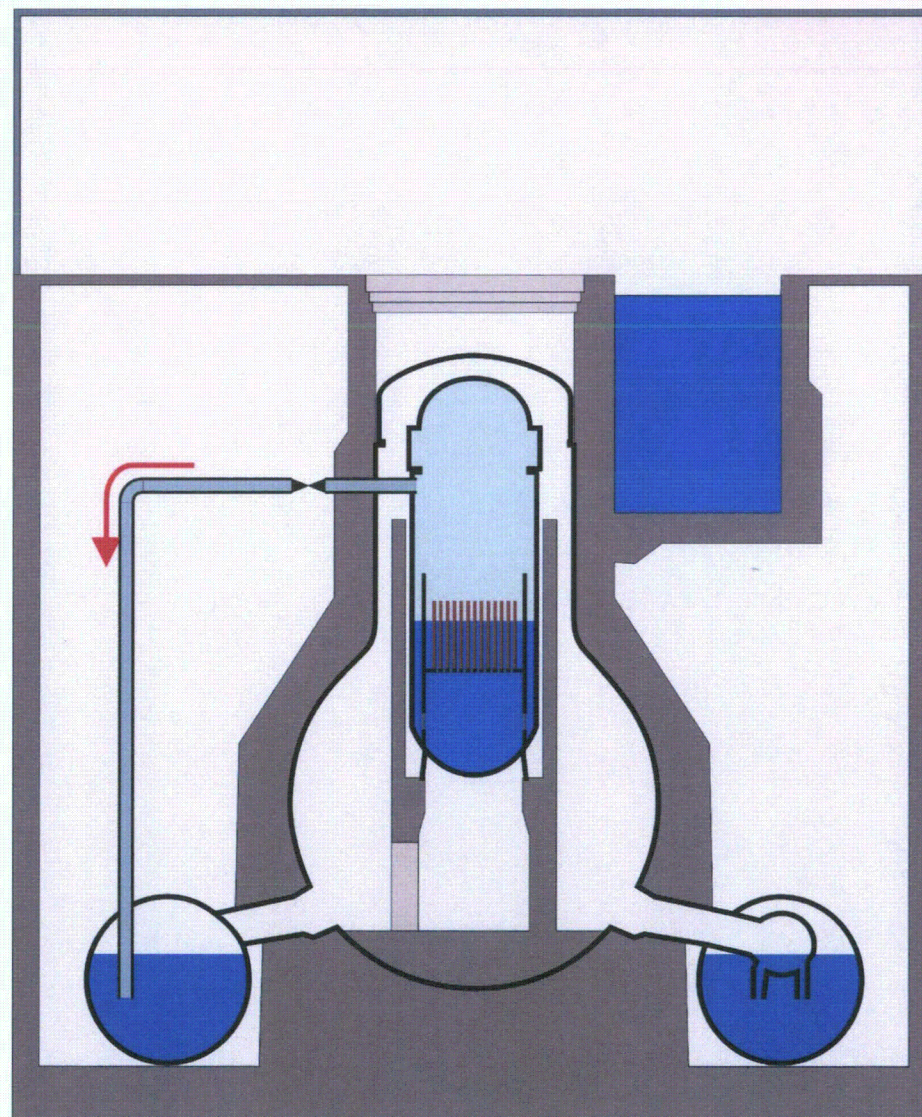


The Fukushima Daiichi Incident

2. Accident progression

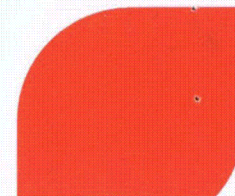


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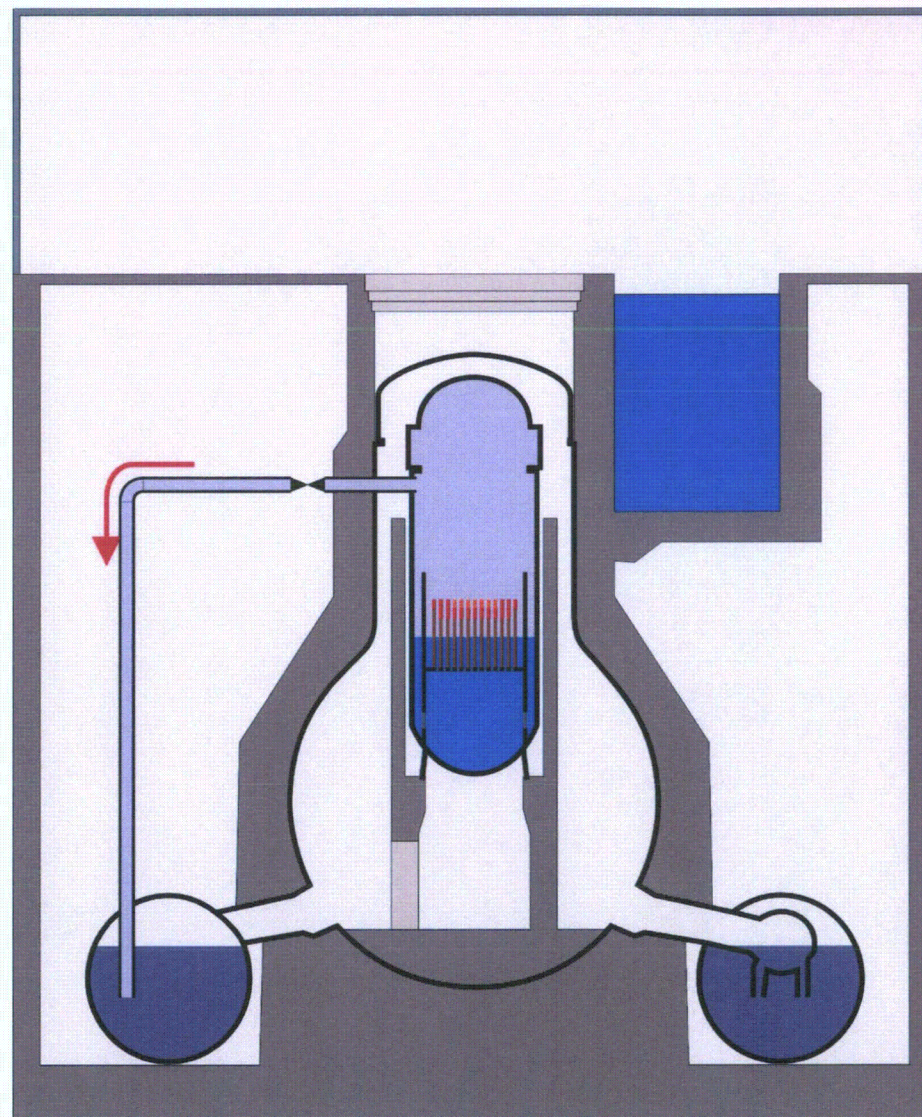


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2. Accident progression

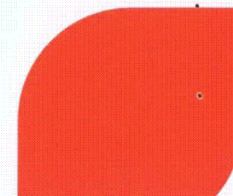


- ▶ Measured, and here referenced Liquid level is the collapsed level. The actual liquid level lies higher due to the steam bubbles in the liquid
- ▶ ~50% of the core exposed
 - ◆ Cladding temperatures rise, but still no significant core damage
- ▶ ~2/3 of the core exposed
 - ◆ Cladding temperature exceeds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

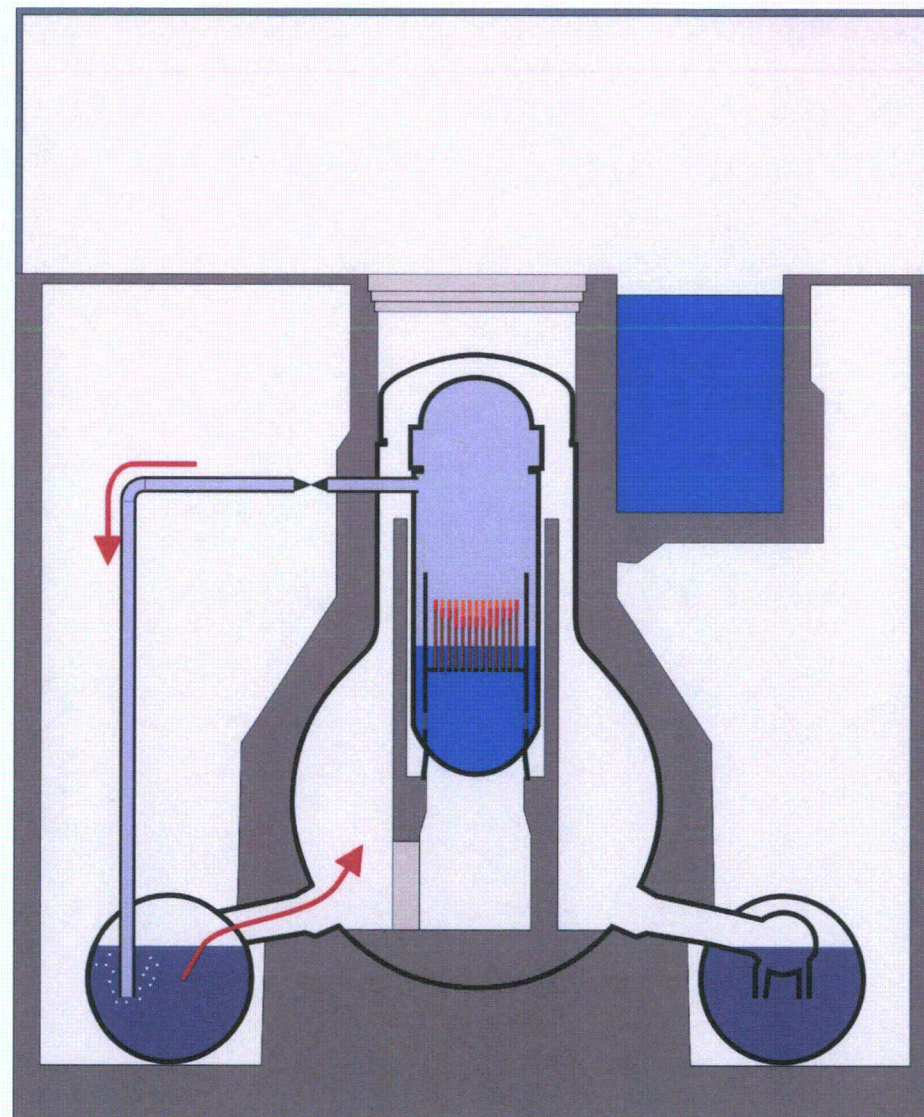


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2. Accident progression

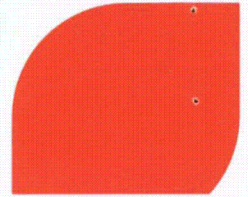


- ▶ ~3/4 of the core exposed
 - ◆ Cladding exceeds ~1200°C
 - ◆ Zirconium in the cladding starts to burn under Steam atmosphere
 - ◆ $\text{Zr} + 2\text{H}_2\text{O} \rightarrow \text{ZrO}_2 + 2\text{H}_2$
 - ◆ Exothermal reaction further heats the core
 - ◆ Generation of hydrogen
 - Unit 1: 300-600kg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

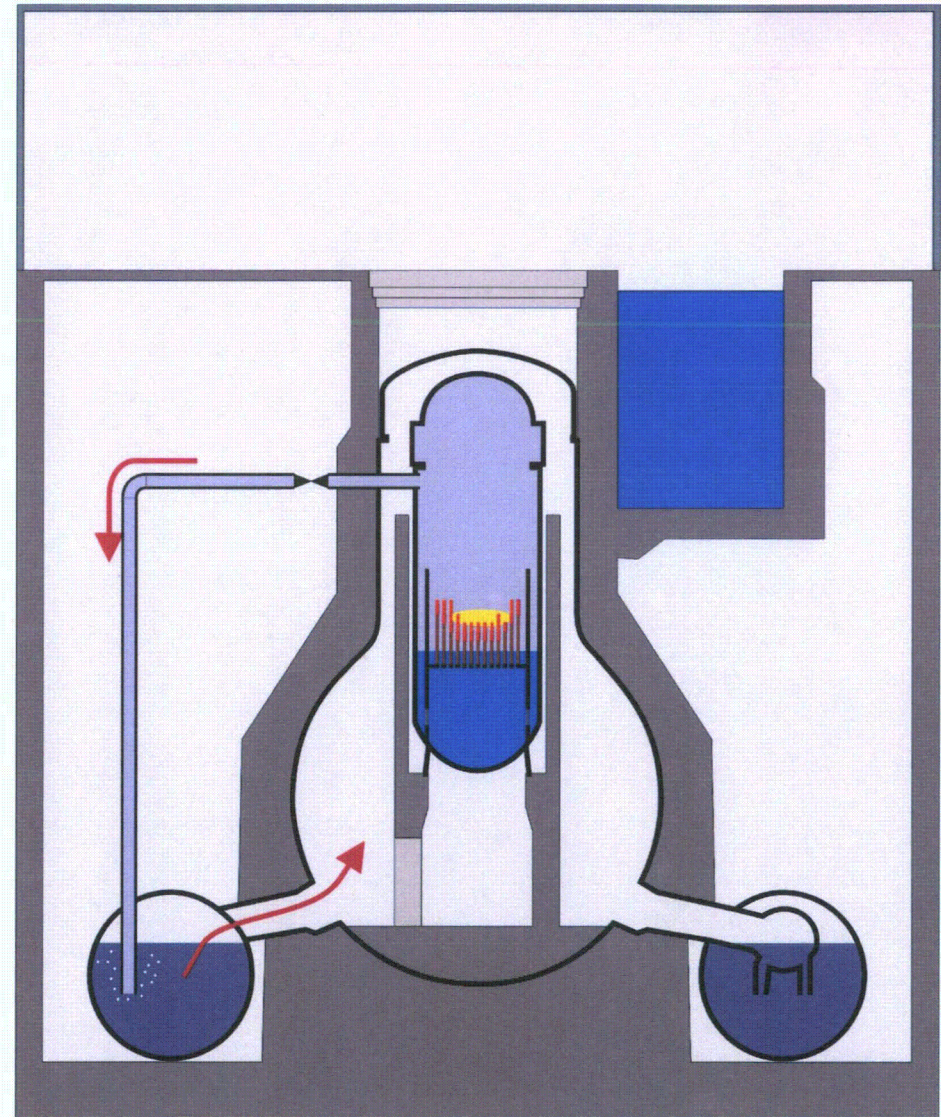


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2. Accident progression

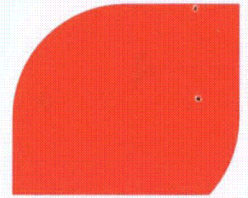


- ▶ at ~1800°C [Unit 1,2,3]
 - ◆ Melting of the Cladding
 - ◆ Melting of the steel structures
- ▶ at ~2500°C [Block 1,2]
 - ◆ Breaking of the fuel rods
 - ◆ debris bed inside the core
- ▶ at ~2700°C [Block 1]
 - ◆ Melting of Uranium-Zirconium eutectics
- ▶ Restoration of the water supply stops accident 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)

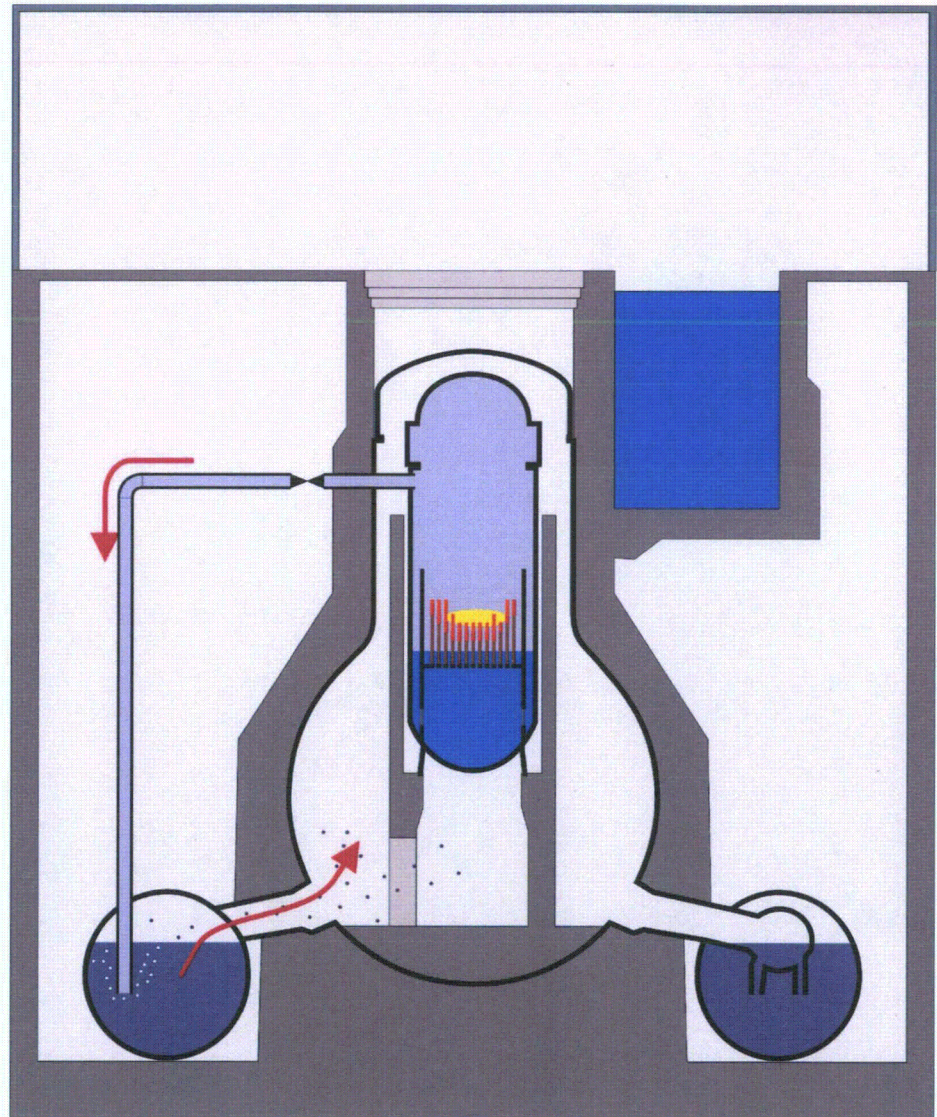


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2. Accident progression

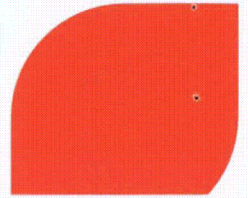


- ▶ Release of fission products during melt down
 - ◆ Xenon, Cesium, Iodine,...
 - ◆ Uranium/Plutonium remain in core
 - ◆ Fission products condensate to airborne Aerosols
- ▶ Discharge through valves into water of the condensation chamber
 - ◆ Pool scrubbing binds a fraction of Aerosols in the water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



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2. Accident progression



► Containment

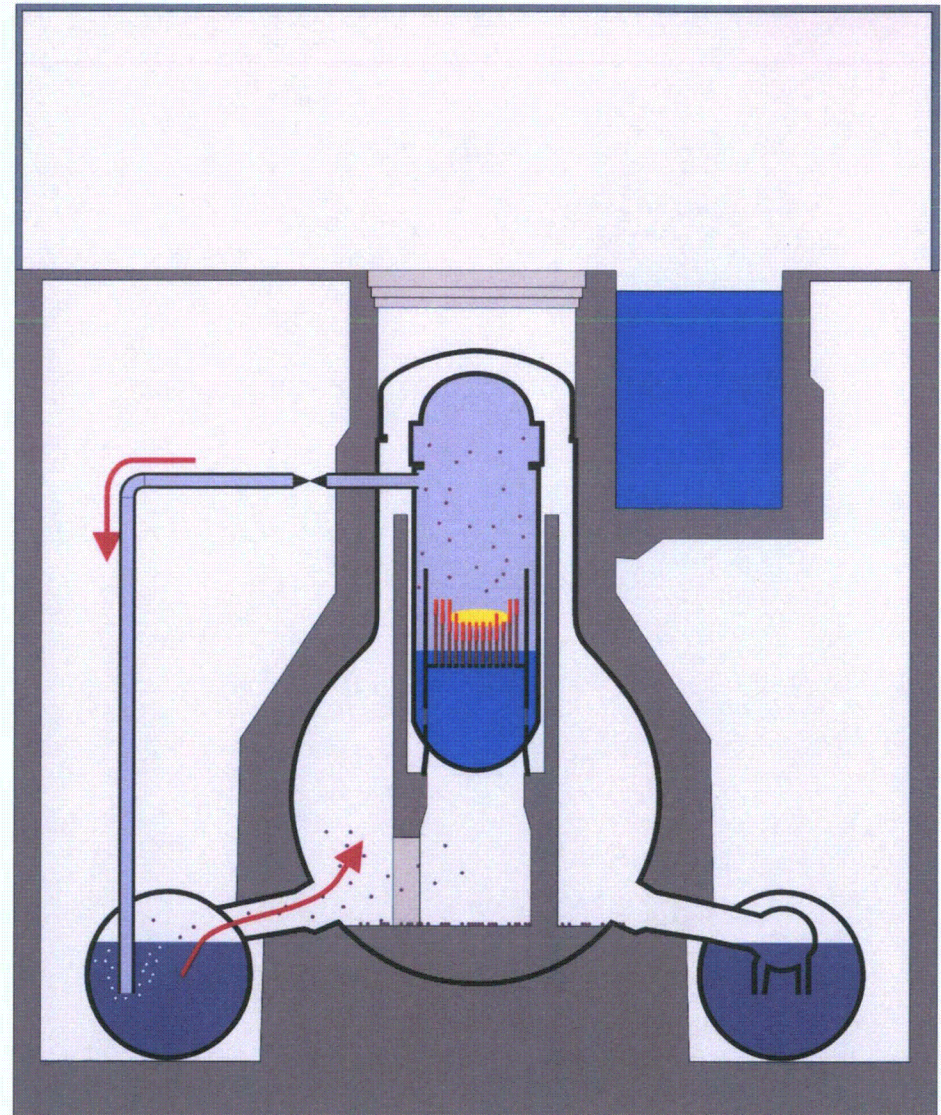
- ◆ Last barrier between Fission Products and Environment
- ◆ Wall thickness ~3cm
- ◆ Design Pressure 4-5bar

► Actual pressure up to 8 bars

- ◆ Normal inert gas filling (Nitrogen)
- ◆ Hydrogen from core oxidation
- ◆ Boiling condensation chamber (like a pressure cooker)

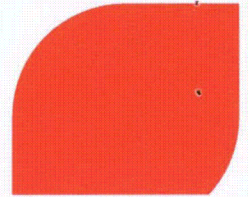
► Depressurization of the containment

- ◆ Unit 1: 12.3. 4:00
- ◆ Unit 2: 13.3 00:00
- ◆ Unit 3: 13.3. 8.41

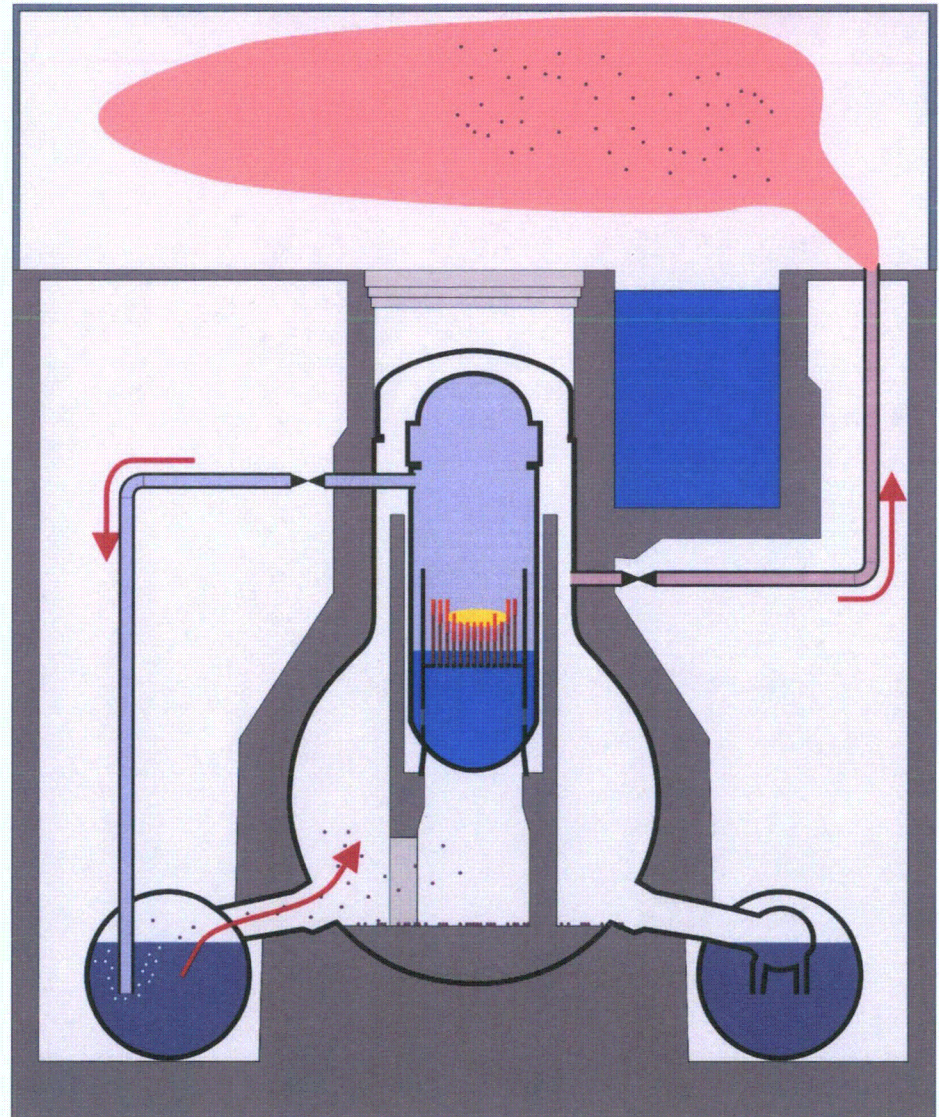


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2. Accident progression



- ▶ 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

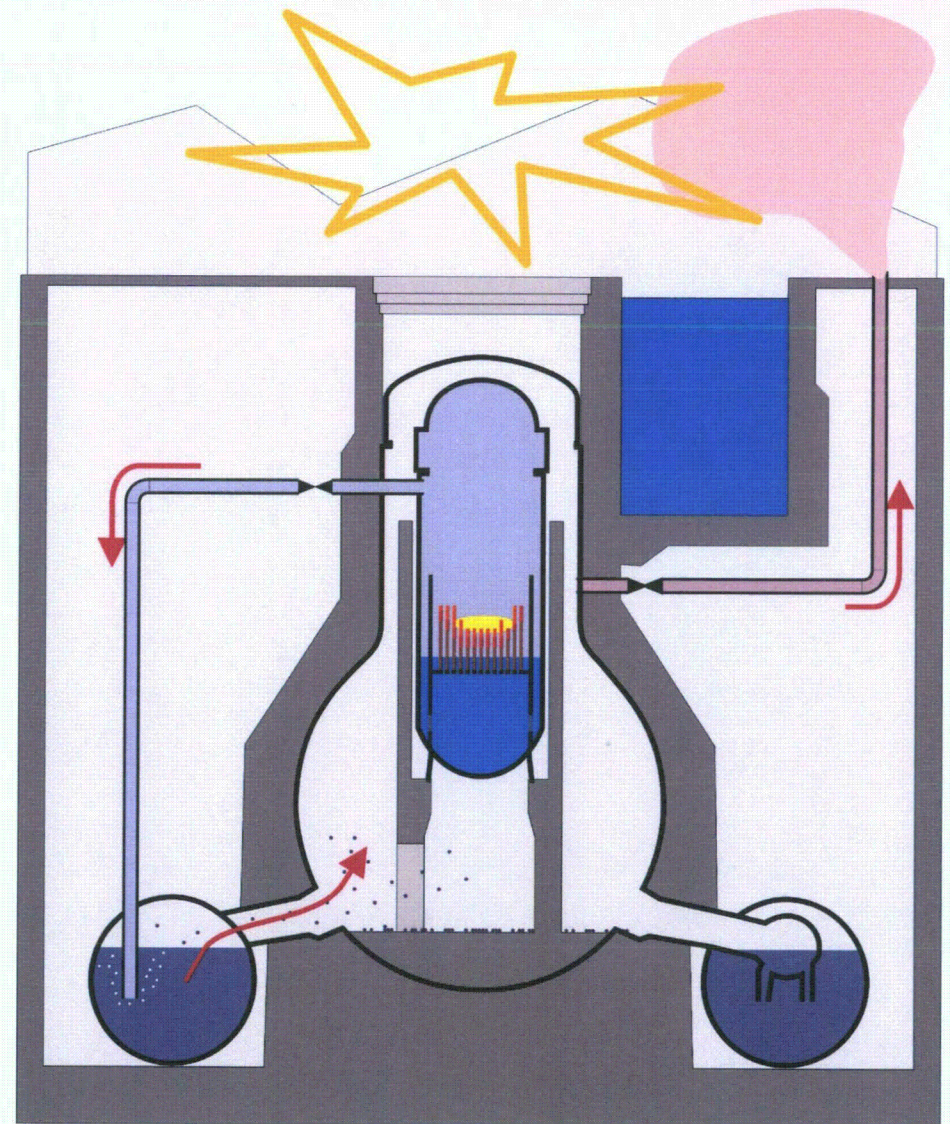
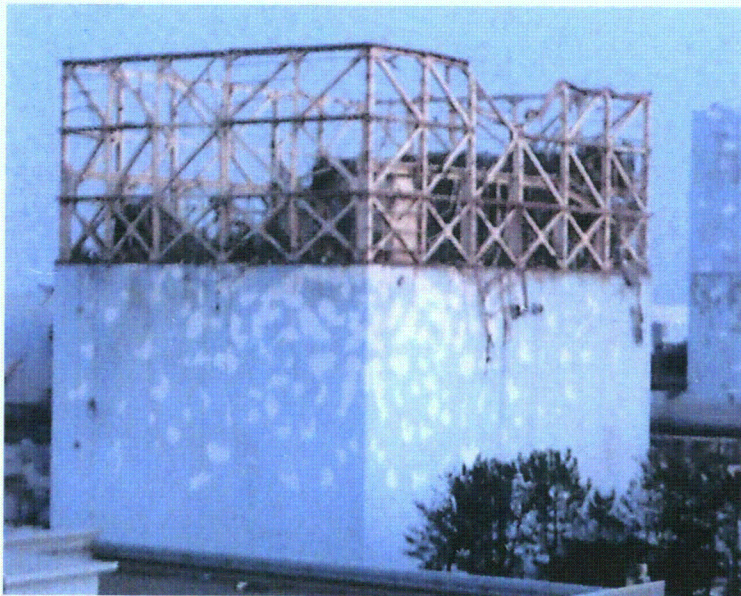


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2. Accident progression

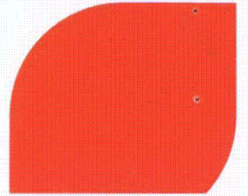
► Unit 1 und 3

- ◆ 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

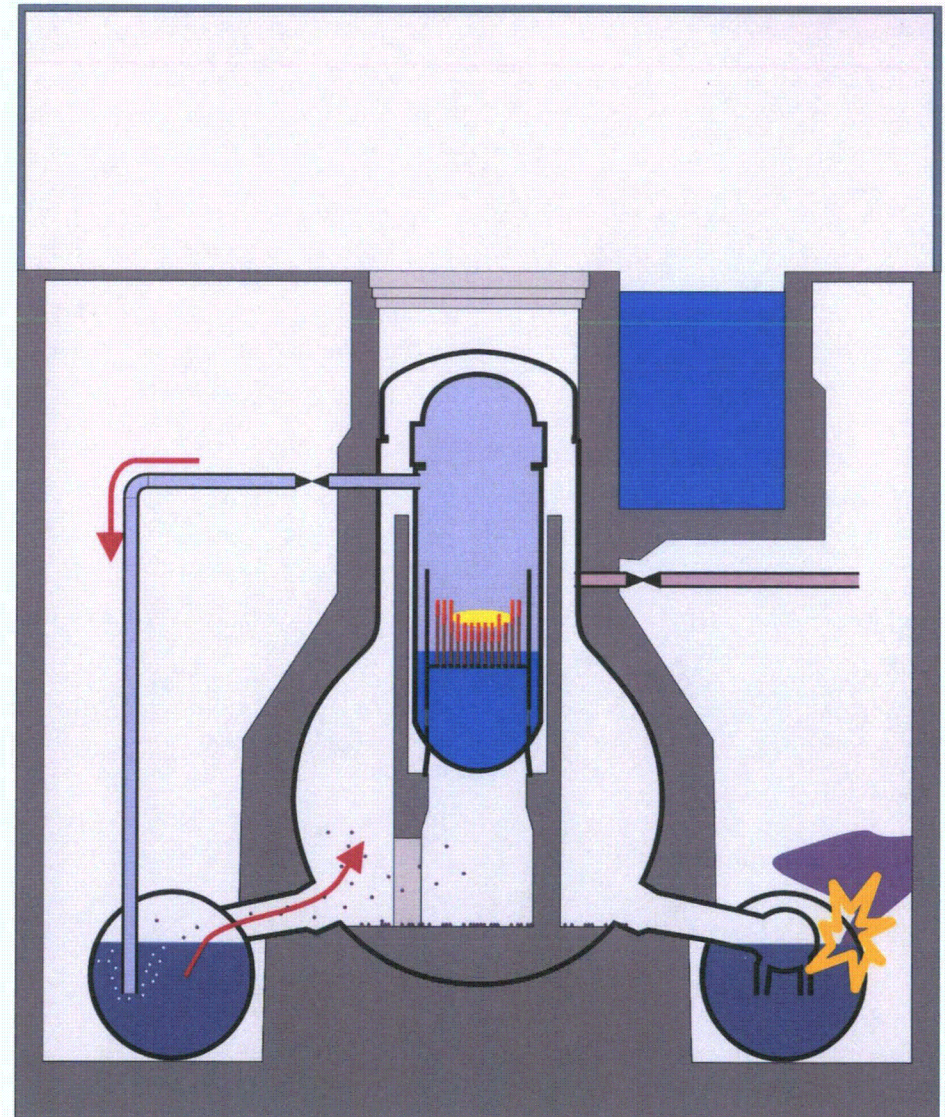
2. Accident progression



► Unit 2

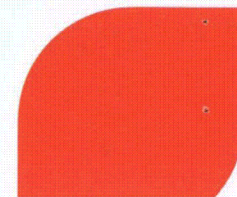
- ◆ Hydrogen burn inside the reactor building
- ◆ Probably damage to the condensation chamber (highly contaminated water)
- ◆ Uncontrolled release of gas from the containment
- ◆ **Release of fission products**
- ◆ Temporal evacuation of the plant
- ◆ High local dose rates on the plant site due to wreckage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

- No clear information on why Unit 2 behaved differently

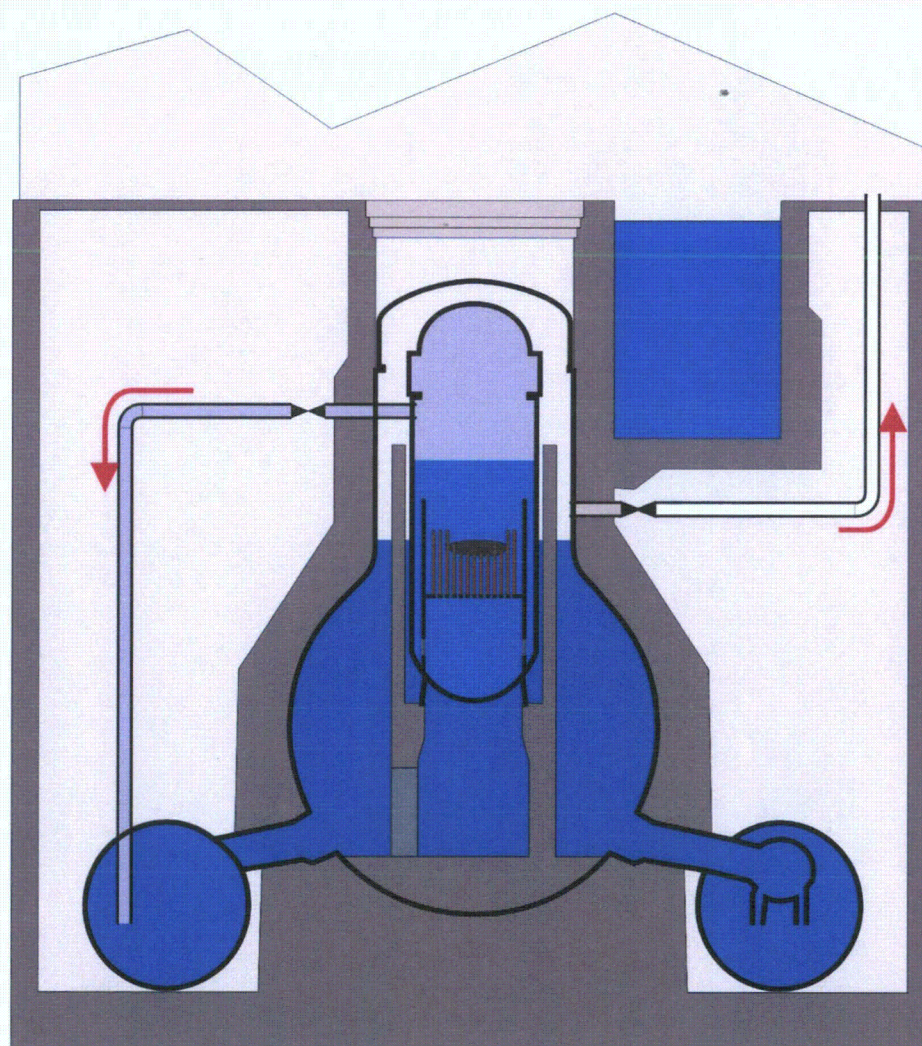


The Fukushima Daiichi Incident

2. Accident progression

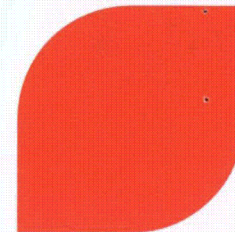


- ▶ Current status of the Reactors
 - ◆ Core Damage in Unit 1,2, 3
 - ◆ Building damage due to various burns Unit 1-4
 - ◆ Reactor pressure vessels flooded in all Units with mobile pumps
 - ◆ At least containment in Unit 1 flooded
- ▶ Further cooling of the Reactors by releasing steam to the atmosphere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

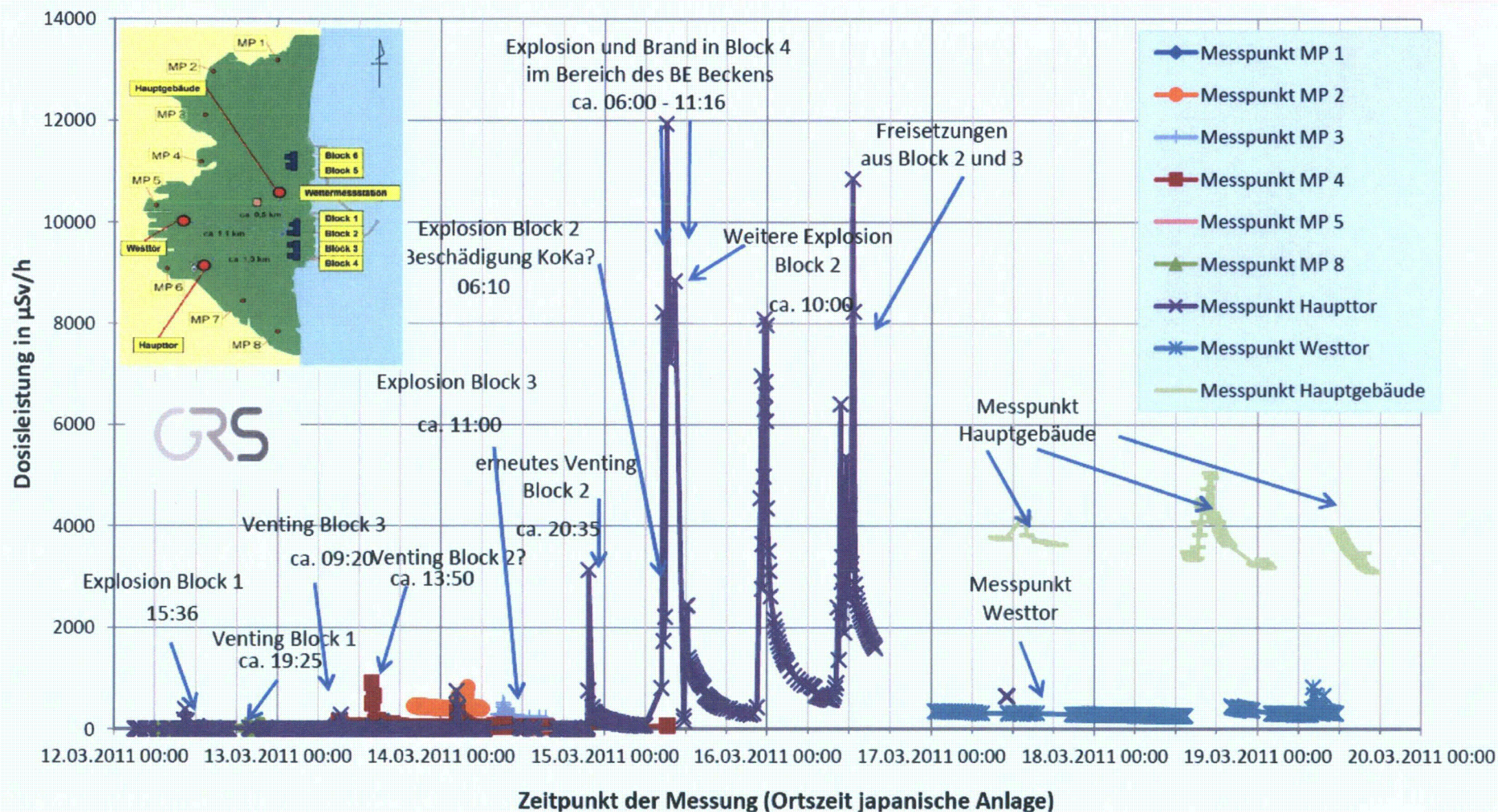
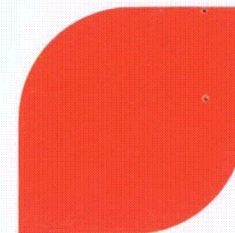
◆ After Explosion in Unit 2 (Damage of the Containment)

- 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

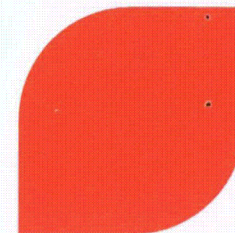
The Fukushima Daiichi Incident

3. Radiological releases



The Fukushima Daiichi Incident

3. Radiological releases

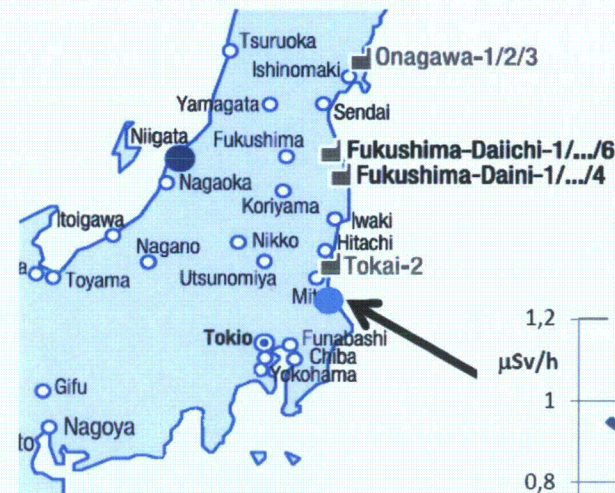
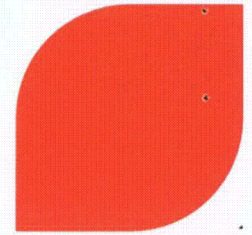


- ▶ Outside the Plant site
 - ◆ As reactor building mostly intact
 - => reduced release of Aerosols (not Chernobyl-like)
 - ◆ Fission product release in steam
 - => fast Aerosol grows, large fraction falls down in the proximity of the plant
 - ◆ Main contribution to the radioactive dose outside plant 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

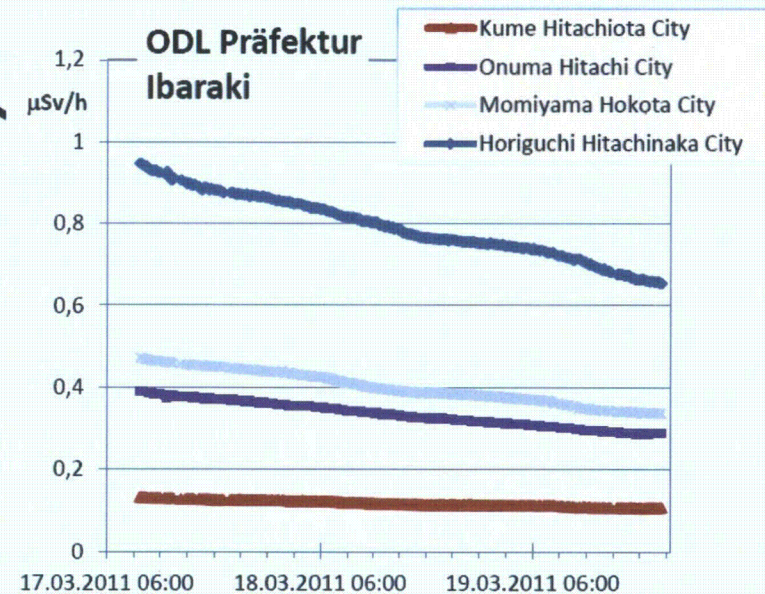
- ▶ ~20km around the plant
 - ◆ Evacuations were adequate
 - ◆ Measured dose up to 0.3mSv/h for short times
 - ◆ Maybe destruction of crops / dairy products this year
 - ◆ Probably no permanent evacuation of land necessary

The Fukushima Daiichi Incident

3. Radiological releases



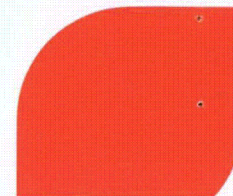
GRS.de



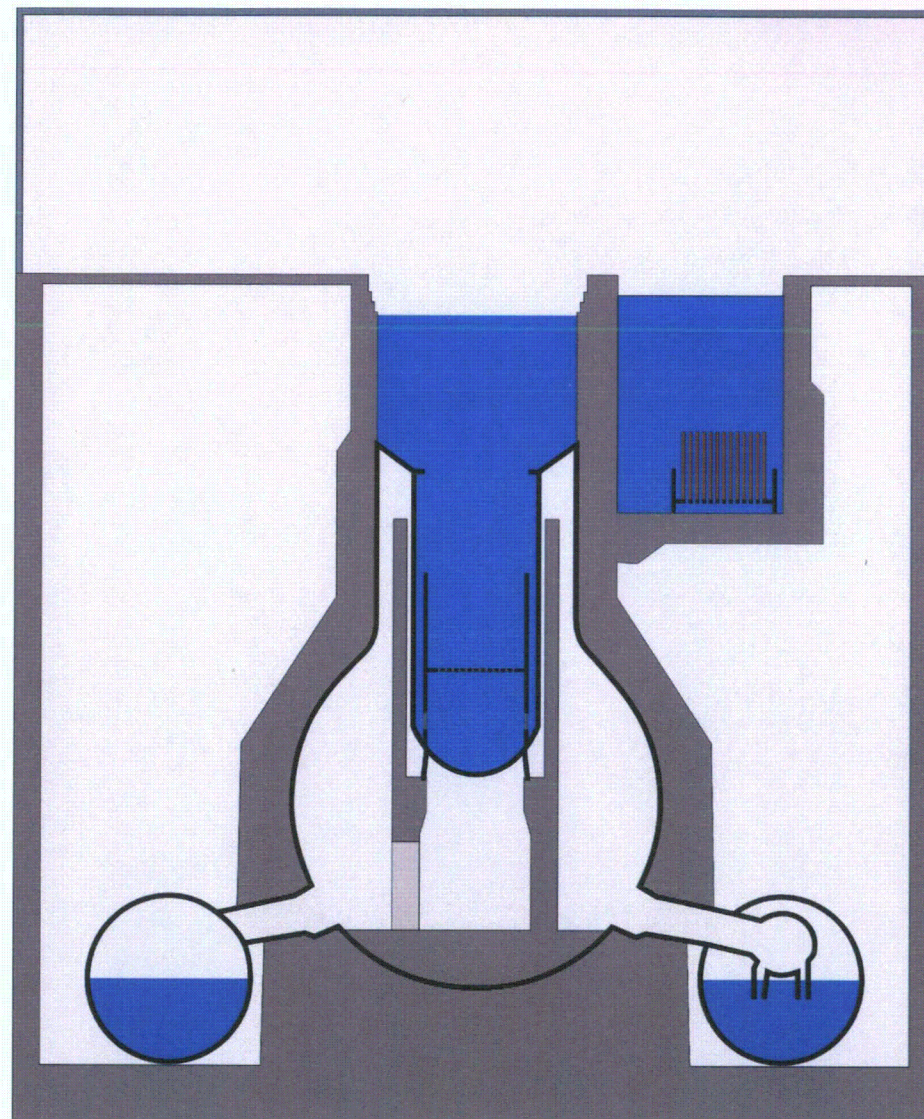
- ▶ ~50km around the plant
 - ◆ Control of Crop / Dairy products
 - ◆ Usage of Iodine pills (Caution, pills can interfere with heart medicine)

The Fukushima Daiichi Incident

4. Spent fuel pools

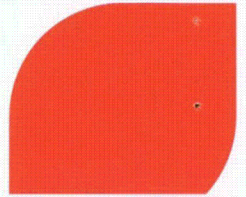


- ▶ Spent fuel stored in Pool on Reactor service floor
 - ◆ Due to maintenance in Unit 4 entire core stored in Fuel pool
 - ◆ Dry-out of the pools
 - Unit 4: in 10 days
 - Unit 1-3,5,6 in few weeks
 - ◆ Leakage of the pools due to Earthquake?
- ▶ Consequences
 - ◆ Core melt "in fresh air"
 - ◆ Nearly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

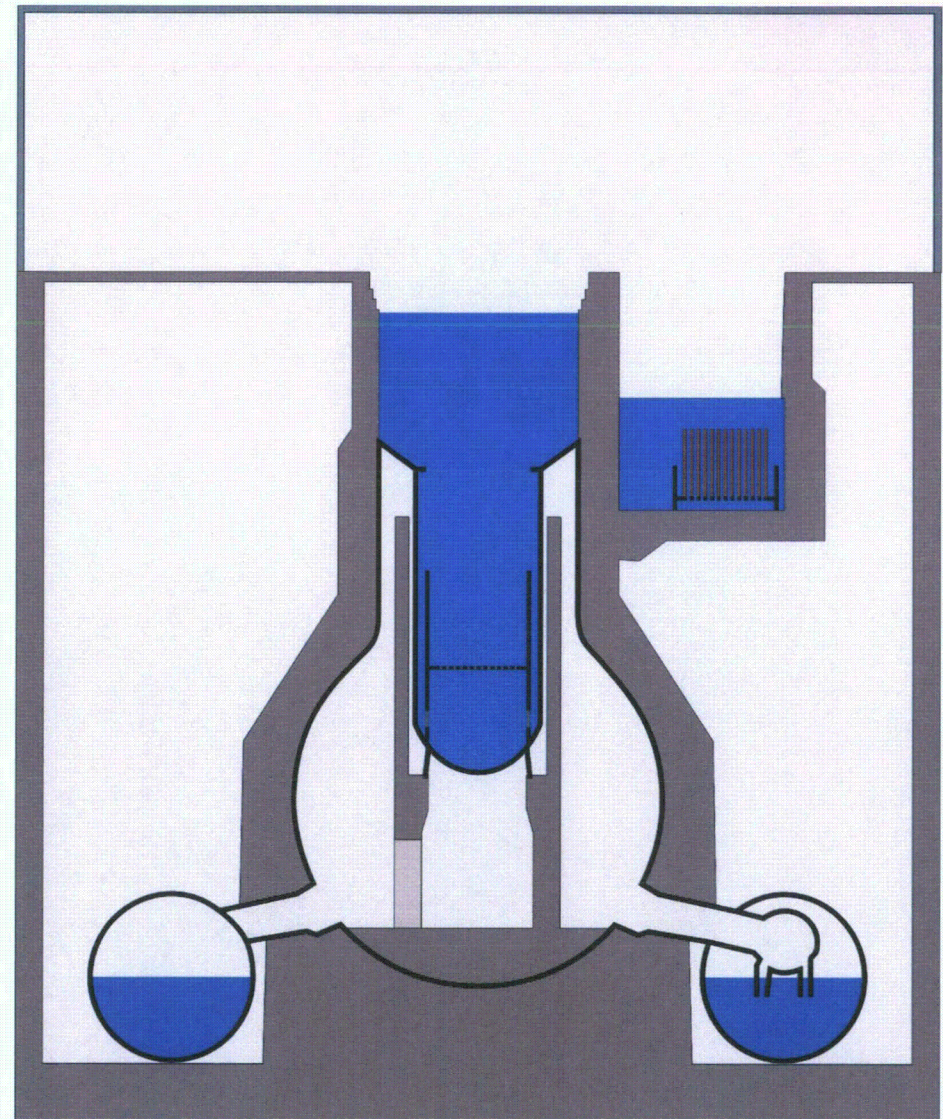


The Fukushima Daiichi Incident

4. Spent fuel pools

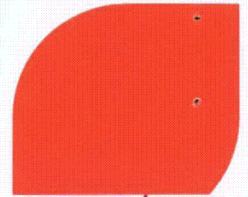


- ▶ Spent fuel stored in Pool on Reactor service floor
 - ◆ Due to maintenance in Unit 4 entire core stored in Fuel pool
 - ◆ Dry-out of the pools
 - Unit 4: in 10 days
 - Unit 1-3,5,6 in few weeks
 - ◆ **Leakage of the pools due to Earthquake?**
- ▶ Consequences
 - ◆ Core melt "in fresh air"
 - ◆ Nearly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

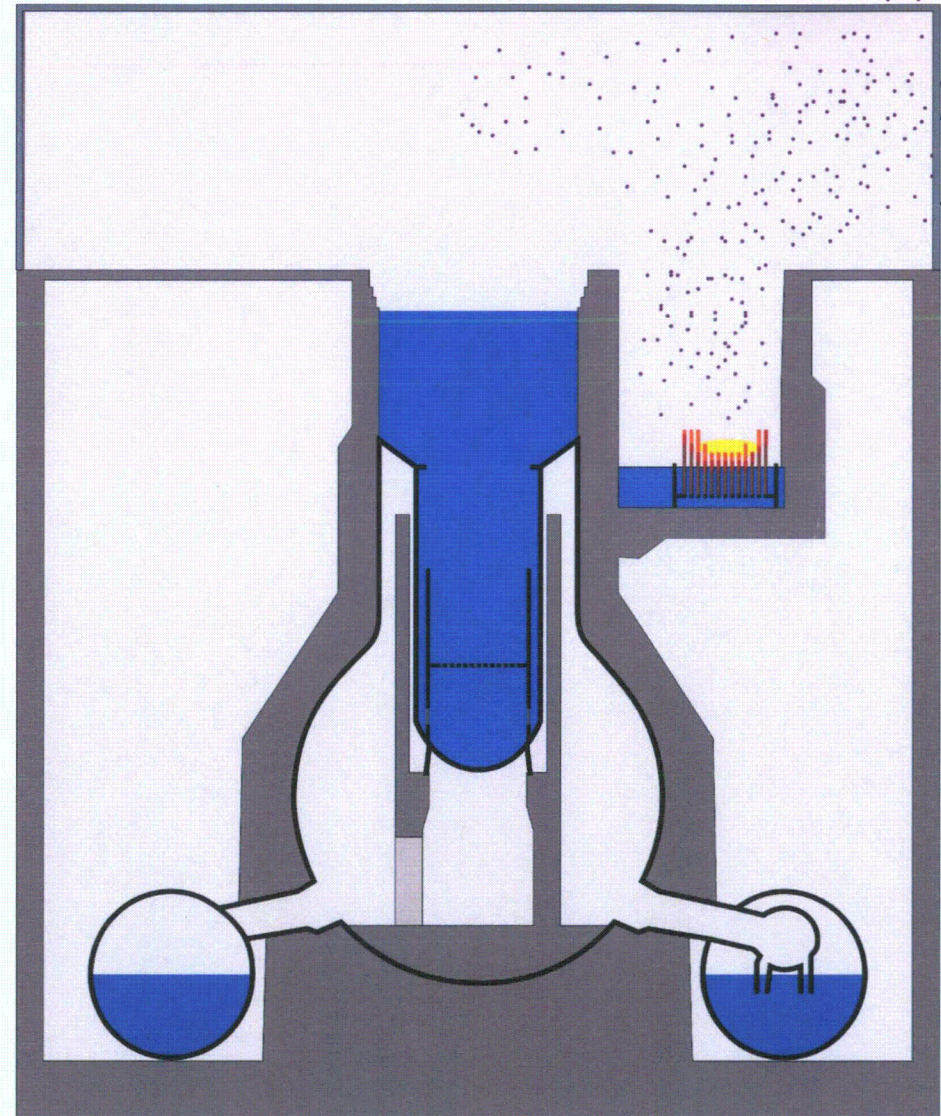


The Fukushima Daiichi Incident

4. Spent fuel pools

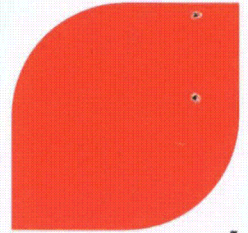


- ▶ Spent fuel stored in Pool on Reactor service floor
 - ◆ Due to maintenance in Unit 4 entire core stored in Fuel pool
 - ◆ Dry-out of the pools
 - Unit 4: in 10 days
 - Unit 1-3,5,6 in few weeks
 - ◆ Leakage of the pools due to Earthquake?
- ▶ Consequences
 - ◆ Core melt "in fresh air"
 - ◆ Nearly 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

Wilson, Peter

From: Wilson, Peter
Sent: Thursday, March 24, 2011 2:36 PM
To: Henderson, Pamela
Subject: Fw: Background 3rd team to Japan .docx

Pete Wilson
Sent by NRC BlackBerry

From: Lew, David
To: Roberts, Darrell; Wilson, Peter; Lorson, Raymond; Collins, Daniel; Dean, Bill
Cc: Clifford, James; Weerakkody, Sunil
Sent: Thu Mar 24 13:25:20 2011
Subject: FW: Background 3rd team to Japan .docx

Below is the request for the third team (I cut and paste for easier blackberry reading). From the call, we are looking for a commitment from around April 2nd to April 16th. There appears to be a shift in skill sets, which now competes with the skills needed for the completion of the temporary instruction. Please provide any recommendations/proposals. Note that those proposals will require a description of their background and how he/she meets the criteria desired. Also, regional management needs to endorse the individuals. This was apparently a challenge with some proposals by other offices, in which only the name was provided. It may explain why a number of Region I staff were selected over other proposals from other offices.

(Bill) The team had a short discussion and agreed that we need not feel compelled to offer up an individual given what we have already contributed and the current impact/workload in Region I.

Background Information for Third Team to Japan

Overall:

We are planning to replace the current site team with a six person team that would include four members with a collective, good understanding of severe accident management, B5b and accident recovery, and two members with the management and political savvy to deal with the ambassador and Japanese regulators, military and cabinet. (One of these will be an Executive SES level to replace Dan Dorman) The next phase would be to replace that 6 person team with a two person team. (Composition TBD)

Specific Request of OD/RAs:

1. Identify staff with all or some of following skill sets who are willing to travel to Japan on or about April 2. The staff would return on about April 16.
 - a. Severe Accident management knowledge
 - b. B5b knowledge
 - c. Accident Recovery knowledge
 - d. Political Savvy

Please provide nominees to Michele Evans by noon on Monday, March 28. Brief summary of staff's background as it applies to the above skill sets and any endorsement by OD/RA will be greatly appreciated.

2. Not immediately needed would be nominees for the 4th team of two who may depart USA on or before April 13. Composition is TBD.

Please Note: Identification of the Next Executive to send to replace Dan Dorman, is being made by DEDOs, and is not part of this request.




Patel, Amar

From: Cline, Leonard
Sent: Thursday, March 24, 2011 9:45 AM
To: Rosebrook, Andrew; Torres, Edgardo
Cc: Patel, Amar; Dodson, Douglas
Subject: Sharepoint
Attachments: image001.gif; image002.gif; image005.gif; image006.gif; image008.png; image009.png; image010.png

Could you (Andy, Edgar) please divide up and review the information for the following folders on sharepoint. We are trying to identify what information is available to help answer questions about why we know the US plants are safe. Also thought that it would be worthwhile to see what types of questions we are getting asked. The link for the sharepoint is here:

(if you did not already have it)

FAQ Related to Events Occurring in Japan

Actions							
View: All Documents							
Type	Name	Modified	Modified By	OPA Approved?	EP (NSIR) Approved?	Notes	NRR Mgmt Review
	Fukushima Daiichi Aerial Photos	3/24/2011 1:42 AM	Stone, Rebecca				
	Items that May Be Useful in Answering Questions - Contains THOROUGH SEISMIC ANALYSIS!	3/16/2011 8:20 AM	Nguyen, Quynh				
	RAW Questions that We Have Received	3/15/2011 1:45 PM	Nguyen, Quynh				

Leonard M. Cline
leonard.cline@nrc.gov
610-337-5375
Region I/PB3
SPE

Y1253

Bozin, Sunny

From: Franovich, Mike
Sent: Thursday, March 24, 2011 7:20 AM
To: Ostendorff, William
Cc: Nieh, Ho; Warnick, Greg; Kock, Andrea; Zorn, Jason
Subject: UPDATE from 2000 Telecon on Fukushima Daiichi Events

Zimmerman led the call (Virgilio participated)

- ☐ No significant change in the units' status. Focus is less on SFP conditions across the site.
- ☐ Power restored to Unit 1, 2, and 3. Unit 3 main control room is powered. Tepco released public photos of operators in the plants including inside the main control room for one of the units.
- ☐ OIS is following up on my request through the Chairman's office to post on a limited access SharePoint site the high res photos of the site damage. Roy indicated that some hard copies will be walked around the 18th floor and that a few of these photos will be shared with the White House.
- ☐ Earlier report of 5 individuals receiving lethal dose may be credible. NRC is hearing of possibility that those individuals may have succumbed to their rad exposure or other injuries (unconfirmed).
- ☐ Casto and team have more access to Tepco. More telecons with Tepco and RST.
- ☐ Casto sat in Prime Minister's Cabinet meeting. Has more access and he was the only rep for the international community to sit in on this meeting.
- ☐ Regarding use of seawater in the reactor and that through evaporation in the core there could be a concentration of salt. The DOE (KAPL, Bettis) and NRC analysis issue looks to be getting resolved. DOE was going to provide their analysis separately to the Japanese but NRC objected. DOE was making recommendations on accident management strategies and they were not in alignment with NRC. Reports that fresh water is being used now and that the water levels in the RPVs may be increased to cool the RPVs (report of RPV wall temps from 650 to 700 F for Unit 1, 2, 3 RPVs).
- ☐ Dose rates continue to trend downward around the site.
- ☐ NRC, NARAC, DOE, other have agreed to a sources term for modeling the plausible bounding scenario with now no issue of SFP pool fire but more of a "super core" approach using 33% for Unit 1, 2, and 3 cores with fixed leak rate assumption. Effort done thru interagency working group. Will provide write-up in next LIA report.
- ☐ Bechtel pumping system is in country ready to be shipped to the site if the Japanese request it. Additional trains arriving from Australia.
- ☐ INPO held called with consortium team. Still looking for Federal lead. Leanings toward US Pacific Command.

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

Andersen, James

From: Sanfilippo, Nathan
Sent: Thursday, March 24, 2011 11:09 AM
To: Rihm, Roger; Andersen, James
Subject: RE: Japan que

As in the NRC? I don't think we have supplied anything other than brain power. The U.S. government has provided some KI – and potentially some military heavy equipment. And the industry has put a consortium together and is supplying some pumping equipment and perhaps some robotics.

Stop by if you'd like to chat.

From: Rihm, Roger
Sent: Thursday, March 24, 2011 10:25 AM
To: Andersen, James; Sanfilippo, Nathan
Subject: Japan que

Can either of you tell me (generally or specifically) what types of equipment we have supplied to Japan and when we did this? I want to put a sentence or two in Bill's testimony. Thx.

Rihm, Roger

From: Rihm, Roger
Sent: Thursday, March 24, 2011 11:21 AM
To: Schmidt, Rebecca; Powell, Amy; Riley (OCA), Timothy
Cc: Landau, Mindy
Subject: Draft Statement for Bill's Tuesday Testimony
Attachments: Testimony_March29_2011.docx

Importance: High

Attached is our draft of Bill's "statement for the record" for Tuesday's appearance. It has been reviewed by Bill and others in OEDO. I plan to proceed to prepare a shorter oral statement from the attached. I anticipate that statement will include information on the current status of things in Japan that is not included here as events continue to evolve.

Should I assume you will take it from here? If so, please let me know if you have any major concerns as I will be proceeding to prepare the oral statement.

NRC Response to Recent Nuclear Events in Japan and the Continuing Safety of the U.S. Commercial Nuclear Reactor Fleet

The staff of the RC is deeply saddened by the tragedy in Japan. I and many of my colleagues on the NRC staff have had many years of very close and personal interaction with our regulatory counterparts and we would like to extend our condolences to them.

Introduction

The NRC is mindful that our primary responsibility is to ensure the adequate protection of the public health and safety of the American people. We have been very closely monitoring the activities in Japan and reviewing all available information. Review of this information, combined with our ongoing inspection and licensing oversight, allows us to conclude that the U.S. plants continue to operate safely. There has been no reduction in the licensing or oversight function of the NRC as it relates to any of the U.S. licensees.

We have a long history of conservative regulatory decision-making. We have been intelligently using risk insights to help inform our regulatory process, and, over more than 35 years of civilian nuclear power in this country, we have never stopped making improvements to plant designs as we learn from operating experience.

Notwithstanding the very high level of support being provided as a result of events in Japan, we continue to maintain our focus on our domestic responsibilities.

I'd like to begin with a brief overview of our immediate and continuing response. I then want to spend the bulk of my time discussing the reasons for our continuing confidence in the safety of the US commercial nuclear reactor fleet, and the path forward for the NRC in light of the events in Japan.

The NRC's immediate and Continuing Response to Events in Japan

On Friday, March 11th an earthquake hit Japan, resulting in the shutdown of more than 10 reactors. From what we know now, it appears that the reactors' response to the

earthquake went according to design. The ensuing tsunami, however, caused the loss of normal and emergency AC power to six units at the Fukushima Daiichi site; and it is those six units that have received the majority of our attention since that time. Units One, Two, and Three at that six unit site were in operation at the time. Units Four, Five, and Six were in previously scheduled outages.

Shortly after 4:00 AM on Friday, March 11th, the NRC Emergency Operations Center made the first call, informing NRC management of the earthquake and the potential impact on U.S. plants. We went into the monitoring mode at the Emergency Operations Center and the first concern for the NRC was possible impacts of the tsunami on U.S. plants and radioactive materials on the West Coast, and in Hawaii, Alaska, and U.S. Territories in the Pacific.

On that same day, Friday, March 11th, we began interactions with our Japanese regulatory counterparts and dispatched two experts to Japan to help at the embassy. By Monday, we had dispatched a total of 11 staff to Japan. We have subsequently rotated in additional staff to continue our on-the-ground assistance in Japan. The areas of focus for this team are: 1) to assist the Japanese government and respond to requests from our regulatory counterpart, NISA; 2) to support the U.S. ambassador and his understanding of the nuclear impacts of this event; and 3) to facilitate the information flow from Japan to the U.S. so that we can assess the implications for U.S. citizens and the U.S. reactor fleet in as timely a manner as possible.

We have an extensive range of stakeholders with whom we have ongoing interaction, including the White House, Congressional staff, our state regulatory counterparts, a number of other federal agencies, and the international regulatory bodies around the world.

The NRC response in Japan and our Emergency Operations Center continue 24/7. This has involved the efforts of over 250 NRC staff on a rotating basis. The entire agency is coordinating and pulling together in response to this event so that we can provide assistance in Japan while continuing the normal activities necessary to fulfill our domestic responsibilities.

Let me also just note here in concluding this section of my remarks that the U.S. government has an extensive network of radiation monitors across the country. Monitoring at nuclear power plants and EPA's system has not identified any radiation levels of concern in this country. In fact, natural background from things like rocks, the sun, and buildings, is 100,000 times more than doses attributed to any level that has been detected to date. We feel confident that there is no reason for concern in the United States regarding radioactive releases from Japan.

Continuing Confidence in the Safety of U.S. Nuclear Power Plants

I will now turn to the factors that assure us of ongoing domestic reactor safety. We have, since the beginning of the regulatory program in the United States, used a philosophy of Defense-in-Depth, which recognizes that nuclear reactors require the highest standards of design, construction, oversight, and operation, and does not rely on any single level of protection for public health and safety. We begin with designs for every individual reactor in this country that take into account site-specific factors and include a detailed evaluation for any natural event, such as earthquakes, tornadoes, hurricanes, floods, and tsunamis, as they relate to that site.

There are multiple physical barriers to fission product release at every reactor design, and beyond that, there are both diverse and redundant safety systems that are required to be maintained in operable condition and frequently tested to that ensure that the plant is in a high condition of readiness to respond to any scenario.

We've taken advantage of the lessons learned from previous operating experience, to implement a program of continuous improvement for the U.S. reactor fleet. We have learned from experience across a wide range of situations, including most significantly, the Three Mile Island accident in the late 1970s. As a result of those lessons learned, we have significantly revised emergency planning requirements and emergency operating procedures. We have addressed many human factors issues regarding how control room employees operate the

plant, we added new requirements for hydrogen control to help prevent explosions inside of containment, and we also created requirements for enhanced control room displays of the status of pumps and valves.

We have a post-accident sampling system that enables the monitoring of radioactive material release and possible fuel degradation. And, one of the most significant changes after Three Mile Island was expansion of the Resident Inspector Program, which has at least two full-time NRC inspectors on site at each facility who have unfettered access to all licensees' activities 24 hours a day, seven days a week.

As a result of operating experience and ongoing research programs, we have developed requirements for severe accident management guidelines. These are components and procedures developed to ensure that, in the event all of the above precautions failed and a severe accident occurred, the plant would still protect public health and safety. The requirements for severe accident management have been in effect for many years and are frequently evaluated by the NRC inspection program.

As a result of the events of September 11, 2001, we identified important pieces of equipment that, regardless of the cause of a significant fire or explosion at a plant, we want to have staged in advance, as well as new procedures and policies that would help deal with a severe situation.

Our program of continuous improvement based on operating experience will now include evaluation of the significant events in Japan and what we can learn from them. We already have begun enhancing inspection activities through temporary instructions to our inspection staff, including the resident inspectors and the region-based inspectors in our four Regional offices, to look at licensees' readiness to deal with both the design basis accidents and the beyond-design basis accidents.

We've also issued an information notice to the licensees to make them aware of the events in Japan, and the kinds of activities we believe they should be engaged in to verify their

readiness. Specifically, we have directed them to verify that their capabilities to mitigate conditions that result from severe accidents, including the loss of significant operational and safety systems, are in effect and operational. They are verifying the capability to mitigate a total loss of electric power to the nuclear plant. They also are verifying the capability to mitigate problems associated with flooding, and the impact of floods on systems both inside and outside of the plant. And, they are identifying the equipment that's needed for the potential loss of equipment due to seismic events appropriate for the site, because each site has its own unique seismic profiles. The information that we gather from this temporary inspection will be used to evaluate the industry's readiness for similar events, and will aid in our understanding of whether additional regulatory actions need to be taken in the immediate term.

The industry also is independently performing many verification activities at this time to confirm that all of these processes and procedures and rules that have been implemented are still valid.

Over the last 15 or 20 years, there have been a number of new rulemakings that have enhanced the domestic fleet's preparedness against some of the problems we are seeing in Japan. The station blackout rule requires every plant in this country to analyze what the plant response would be if it were to lose all alternating current so that it could respond using batteries for a period of time, and then have procedures in place to restore alternating current to the site and provide cooling to the core.

The hydrogen rule requires modifications to reduce the impacts of hydrogen generated for beyond-design basis events and core damage. There are equipment qualification rules that require equipment, including pumps and valves, to remain operable under the kinds of environmental temperature and radiation conditions that you would see under a design basis accident. And then, regarding the type of containment design used by the most heavily damaged plants in Japan, we have had a Boiling Water Reactor Mark I Containment Improvement Program since the late 1980s, which has required installation of

hardened vent systems for containment pressure relief, as well as enhanced reliability of the automatic depressurization system.

The final factor I want to mention with regard to our belief in the ongoing safety of the U.S. fleet is the emergency preparedness and planning requirements in place that provide ongoing training, testing, and evaluations of licensees' emergency preparedness programs. In coordination with our federal partner, FEMA, these activities include extensive interaction with state and local governments, as those programs are evaluated and tested on a periodic basis.

The Path Ahead

Beyond the initial steps to address the experience from the events in Japan, we have received direction from the Commission to establish a senior level agency task force to conduct a methodical and systematic review of our processes and regulations to determine whether the agency should make additional improvements to our regulatory system and make recommendations to the Commission for its policy direction. This activity will have both near-term and longer-term objectives.

For the near term effort, we are beginning a 90-day review. This review will evaluate all of the currently available information from the Japanese events to identify immediate or near-term operational or regulatory issues potentially affecting the 104 operating reactors in the U.S., including their spent fuel pools. Areas of investigation will include the ability to protect against natural disasters, response to station blackouts, severe accidents and spent fuel accident progression, radiological consequence analysis, and severe accident management issues regarding equipment. Over this 90-day period, we will develop recommendations, as appropriate, for changes to inspection procedures and licensing review guidance, and recommend whether generic communications, orders, or other regulatory requirements are needed.

This 90-day effort will include a 30-day Quick Look Report to the Commission to provide a snapshot of the regulatory response and the condition of the U.S. fleet based on

information we have available at that time. Preparing a Quick Look Report also will ensure that the Commission is both kept informed of ongoing efforts and prepared to resolve any policy recommendations that surface. I believe we will have limited stakeholder involvement in the first 30 days to accomplish this, but over the 90-day and longer-term efforts we will seek additional stakeholder input. These near-term activities will be carried out independent of any industry efforts that might be ongoing. At the end of the 90-day period, a report will be provided to the Commission.

The task force's longer-term review will begin as soon as the NRC has sufficient technical information from the events in Japan.

The task force will evaluate all technical and policy issues related to the event to identify additional potential research, generic issues, changes to the reactor oversight process, rulemakings, and adjustments to the regulatory framework that should be pursued by the NRC. We also expect to evaluate potential interagency issues, such as emergency preparedness, and examine the applicability of any lessons learned to non-operating reactors and materials licensees. We expect to seek input from all key stakeholders during this process. A report with appropriate recommendations will be provided to the Commission within 6 months of the start of this evaluation. Both the 90-day and final reports will be made publicly available in accordance with normal Commission processes.

Conclusion

In conclusion, I want to reiterate that we continue to make our domestic responsibilities for licensing and oversight of the U.S. licensees our top priority and that the U.S. plants continue to operate safely. In light of the events in Japan, there is a near-term evaluation of their relevance to the U.S. fleet underway, and we are continuing to gather together the information necessary for us to take a longer, more thorough look at the events in Japan and their lessons for us. Based on these efforts, we will take all appropriate actions necessary to ensure the continuing safety of the U.S. fleet.

Rihm, Roger

From: Rihm, Roger
Sent: Thursday, March 24, 2011 11:25 AM
To: Powell, Amy
Subject: RE: Draft Statement for Bill's Tuesday Testimony

What length (double spaced pages) should I shoot for on the oral statement?

From: Powell, Amy
Sent: Thursday, March 24, 2011 11:23 AM
To: Rihm, Roger; Schmidt, Rebecca; Riley (OCA), Timothy
Cc: Landau, Mindy
Subject: RE: Draft Statement for Bill's Tuesday Testimony

Thanks Roger –

We will review from here before getting it up for Commission review. We will let you know if we have any concerns.

Thanks
Amy

From: Rihm, Roger
Sent: Thursday, March 24, 2011 11:21 AM
To: Schmidt, Rebecca; Powell, Amy; Riley (OCA), Timothy
Cc: Landau, Mindy
Subject: Draft Statement for Bill's Tuesday Testimony
Importance: High

Attached is our draft of Bill's "statement for the record" for Tuesday's appearance. It has been reviewed by Bill and others in OEDO. I plan to proceed to prepare a shorter oral statement from the attached. I anticipate that statement will include information on the current status of things in Japan that is not included here as events continue to evolve.

Should I assume you will take it from here? If so, please let me know if you have any major concerns as I will be proceeding to prepare the oral statement.

Rihm, Roger

From: Rihm, Roger
Sent: Thursday, March 24, 2011 11:52 AM
To: Merzke, Daniel; Sanfilippo, Nathan; Andersen, James; Wittick, Brian
Subject: Looking for some assistance
Attachments: Testimony_Japan Insert.docx

Was wondering if one of you is sufficiently in the know to be able to help me on this, or if you can suggest someone who is.

Bill is testifying before Senate Energy Comm on Tuesday. I drafted his "statement for the record" and am now beginning to craft from that a shorter oral statement that he will make. In the longer statement I don't include a chronology/status of Japanese events as that statement is now out of my hands (gone to OCA/Commission) and it would be out of date by Tuesday. However, Bill does want to be able to give a brief overview and current status in his oral presentation. Attached is what Bill said when he testified before the Commission. It only gets me thru the first few days. I would like to add probably not more than an additional paragraph or two (at the most) that provides a couple of key highlights since then and then gives a current status. I would need this text on MONDAY.

Are any of you following events sufficiently closely to provide this or can you suggest who might be able to?

Thanks a lot!

Y/258

On Friday, March 11th an earthquake hit Japan, resulting in the shutdown of more than 10 reactors. It appears that the reactors' response to the earthquake went according to design. The ensuing tsunami, however, caused the loss of normal and emergency AC power to six units at the Fukushima Daiichi site; and it is those six units that have received the majority of our attention since that time. Units One, Two, and Three, at that six unit site, were in operation at the time. Units Four, Five, and Six were in previously scheduled outages.

Hours after the tsunami, it appears that operators at the site lost capability to inject cooling water into the reactor vessels on Units One, Two, and Three and into the spent fuel pools in several units. On Saturday, March 12th, a hydrogen explosion occurred in Unit One; and then the following Monday, March 14th, a hydrogen explosion in Unit Three. On Tuesday, the 15th of March, there were explosions in Unit Two and in Unit Four from hydrogen originating, we believe, from overheated fuel in the spent fuel pool. [Briefly summarize period of March 16 – 29/provide current status]

Rihm, Roger

From: Rihm, Roger
Sent: Thursday, March 24, 2011 1:39 PM
To: Brock, Kathryn; Andersen, James
Subject: RE: Looking for some assistance

That would be great. VERY BRIEF is important (just the most important of the most important events/activities) and we ultimately will need to ensure on Monday that, however we describe the current situation, it is still accurate. Thanks!

From: Brock, Kathryn
Sent: Thursday, March 24, 2011 1:35 PM
To: Andersen, James; Rihm, Roger
Subject: RE: Looking for some assistance

If it is ok, I will take this action with me to the Ops Center tomorrow and get the input and write something up for you.

From: Andersen, James
Sent: Thursday, March 24, 2011 1:24 PM
To: Brock, Kathryn
Subject: FW: Looking for some assistance

Do you have time this afternoon?

From: Rihm, Roger
Sent: Thursday, March 24, 2011 11:52 AM
To: Merzke, Daniel; Sanfilippo, Nathan; Andersen, James; Wittick, Brian
Subject: Looking for some assistance

Was wondering if one of you is sufficiently in the know to be able to help me on this, or if you can suggest someone who is.

Bill is testifying before Senate Energy Comm on Tuesday. I drafted his "statement for the record" and am now beginning to craft from that a shorter oral statement that he will make. In the longer statement I don't include a chronology/status of Japanese events as that statement is now out of my hands (gone to OCA/Commission) and it would be out of date by Tuesday. However, Bill does want to be able to give a brief overview and current status in his oral presentation. Attached is what Bill said when he testified before the Commission. It only gets me thru the first few days. I would like to add probably not more than an additional paragraph or two (at the most) that provides a couple of key highlights since then and then gives a current status. I would need this text on MONDAY.

Are any of you following events sufficiently closely to provide this or can you suggest who might be able to?

Thanks a lot!

Ellmers, Glenn

From: Ellmers, Glenn
Sent: Thursday, March 24, 2011 1:53 PM
To: Weber, Michael
Cc: Landau, Mindy; Muessle, Mary
Subject: Ops Center, Phone calls, etc.

I hadn't planned another EDO Update for this week, and I don't really have anything else to include, so could we send this out as a Network Announcement?

Mike, I'm not sure whether this wording captures exactly the message you wanted to get out:

"Reminder about the Role of the Operations Center"

Regular NSIR staff, volunteers, and senior managers have been working around the clock to keep track of the latest developments at Fukushima—11 times zones away. But that difficult job is made even harder when stakeholders, members of the public, and even NRC staff direct ordinary questions through the Ops Center switchboard. Please remember that nearly all agency functions—including licensing, inspections, and other regulatory actions—are being conducted as normal. Inquires from the media and general public should go to the Office of Public Affairs. Inquiries from government officials should go to the Office of Congressional Affairs or Regional Offices, as appropriate. *Please direct all non-emergency questions through regular channels, and not through the Ops Center.*"

Glenn Ellmers
Senior Communications Specialist, OEDO
301-415-0442
OWFN - 17F03
Mail stop: 016E15

Bozin, Sunny

From: Ostendorff, William
Sent: Friday, March 25, 2011 11:05 PM
To: Franovich, Mike
Cc: Nieh, Ho; Kock, Andrea; Zorn, Jason
Subject: Re: UPDATE from 2000 Telecon on Fukushima Daiichi Events

Thanks Mike.

From: Franovich, Mike
To: Ostendorff, William
Cc: Nieh, Ho; Kock, Andrea; Zorn, Jason
Sent: Fri Mar 25 21:36:31 2011
Subject: UPDATE from 2000 Telecon on Fukushima Daiichi Events

Zimmerman led the call

- The LIA/sit report provides significant update on plant parameters/conditions which are stable. Transitioning to fresh water. I have attached a NISA report I found on the NISA website; perhaps the first decent overview of each unit and timeline of the events.
- One of two Navy fresh water barges on its way to the site. ETA tomorrow.
- Lot of media discussion on Unit 3 and possible core slump/RPV breach. Media coverage on worker dose in Unit 3 turbine building.
- Asked for the saltwater report again as a follow-up to the morning telecom. The ET on evening shift was not aware of the request but will provide a copy once it is corrected. This report will be shared with Tepco. WDM office wanted a copy also.
- Pacific Command will be the lead logistical/coordination USG organization for long-term support but still needs NRC technical support. NRC sending Vincent Holahan (liaison) to assist Admiral Willard by providing tech support, conduit to NRC, and insight on NRC organization.
- Japanese interested in DOE robotics.
- SDF began training on Bechtel pumping system. Additional training tomorrow and then the system will be moved to the Daiichi site.
- Secure call with numerous USG agencies to discuss situation in Japan. HHS has one million liquid dose of KI available and INPO has one million tablets ready

to be delivered if requested. NRC message to attendees/call participants is that situation appears to be stabilizing but prognosis with site still a challenge.

- NRC PMT/NARAC plume modeling to be shared with Amb. Roos.
- Bottled water hoarding still an issue in Tokyo. Costco and Coca Cola offered and Japanese accepted bottle product/water donation.

Rihm, Roger

From: Rihm, Roger
Sent: Friday, March 25, 2011 8:46 AM
To: Milligan, Patricia
Cc: Landau, Mindy
Subject: RE: ACTION: Task NSIR to support preparation of testimony

Importance: High

Thank you!

Mindy and I have reviewed and only have one significant suggestion. Before you launch into the discussion on the 50 mile zone in Japan, are there other elements of EPP program that should be mentioned, e.g., the fact that we do drills? Sort of "round out" that discussion on pages one and two.

Mike WOULD like you to prepare him a backgrounder along the lines you suggested.

Would you be available to accompany him on Weds AM if he decides that is what he would like?

I am going to pass along your testimony to OCA for their review (they're anxious to see it), but suggest to them that you may be providing another paragraph or so addressing the first point above.

Thanks again.

From: Milligan, Patricia
Sent: Thursday, March 24, 2011 5:15 PM
To: Rihm, Roger
Cc: Landau, Mindy
Subject: RE: ACTION: Task NSIR to support preparation of testimony

I think that Mike/Marty ought to be prepared to answer any questions about the planning basis and its application for multi unit sites ; questions about NRC KI program; questions about the adequacy of the current EP requirements given that "you can't evacuate"; why EP is not in license renewal.

Should I prepare a backgrounder for them?

From: Rihm, Roger
Sent: Tuesday, March 22, 2011 2:11 PM
To: Milligan, Patricia
Cc: Landau, Mindy
Subject: FW: ACTION: Task NSIR to support preparation of testimony
Importance: High

Please also give consideration to what background materials/briefing Marty or Mike might need in order to be able to respond to questions.

From: Rihm, Roger
Sent: Tuesday, March 22, 2011 1:59 PM
To: RidsEdoMailCenter Resource; Clayton, Kathleen
Cc: Milligan, Patricia; Landau, Mindy; Evans, Michele; Jaegers, Cathy
Subject: ACTION: Task NSIR to support preparation of testimony
Importance: High

Please prepare a green ticket to NSIR to accomplish the following:

Prepare testimony for Marty Virgilio (or Mike Weber) to give before the House Transportation and Infrastructure Committee, Subcommittee on Economic Development, Public Buildings, and Emergency Management on March 30, 2011. The subject is emergency planning and preparedness for commercial nuclear reactors. It should reference/briefly address our 50-mile evacuation recommendation for the ongoing Japanese events. It should be approximately 2 – 3 double-spaced pages in length. A draft should be provided electronically to Roger Rihm, OEDO, NLT COB March 24th to allow time for OEDO, OCA, and Commission review. Testimony will need to be finalized by COB March 28th.

Rihm, Roger

From: Rihm, Roger
Sent: Friday, March 25, 2011 7:53 AM
To: Weber, Michael
Cc: Landau, Mindy
Subject: FW: ACTION: Task NSIR to support preparation of testimony
Attachments: Congressional Hearing March 30 2011.docx

Importance: High

Mike, I'm about to review this, do you want to weigh in too? Mindy has taken a quick look and suggests adding something about drills. I know OCA is anxious to get their hands on this.

See Trish's thoughts on questions below. Do you want her to prepare a backgrounder as she suggests? Brief you? Please advise so I can give her direction.

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Sent: Thursday, March 24, 2011 5:15 PM
To: Rihm, Roger
Cc: Landau, Mindy
Subject: RE: ACTION: Task NSIR to support preparation of testimony

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Rel

Good afternoon, Mr./Ms Chairman and members of the Subcommittee. I am pleased to appear before you on behalf of the United States Nuclear Regulatory Commission (NRC) to discuss our emergency planning and preparedness programs at nuclear power facilities in the United States and to discuss the protective action guidance recently issued by the NRC to American citizens in Japan in response to the serious problems at the Fukushima 1 nuclear power plant site.

NRC's primary mission is to regulate nuclear reactors, materials and waste facilities in a manner that protects the health and safety of the public and promotes the common defense and security. Emergency preparedness is a key element of the "defense in depth" safety philosophy we employ for nuclear power plants. This philosophy: ensures high quality in design, construction, and operation of nuclear power plants; requires redundant safety systems that reduce the chances that malfunctions will lead to accidents; and recognizes that in spite of all these precautions, accidents could occur. That is why, for example, containment structures and other safety features are required to minimize the potential for the release of fission products off site. Through emergency planning and preparedness, additional mechanisms are in place to protect the public in the unlikely event that these barriers were to fail.

For planning purposes, we define two planning zones around nuclear power plant sites. The

planning zones are based on a study of accidents, known as the WASH 1400 report, that examined a range of events from design basis accidents to catastrophic severe accidents. The study made a number of very conservative assumptions regarding the performance of safety equipment, the radionuclides in the core that could be released as well as the timing of the release. The first zone is an area covering about 10 miles in all directions around nuclear power plants where the greatest potential for radiological effects from a release exists. Planning for this area is comprehensive and includes such protective actions as evacuation, sheltering and potassium iodide, as appropriate, for members of the public. Consideration of these protective actions is prompted at very low projected dose levels. A second extended planning zone of about 50 miles is also established around each plant to deal with potential lower-level, long-term risks primarily due to exposure from consumption of contaminated food, milk, and water. This comprehensive planning within the 10 and 50 mile EPZ provides a substantial basis for expansion of response efforts in the event that this is necessary.

Let me now address the NRC's recent protective action recommendation for U.S citizens in Japan evacuate out to 50 miles from the Fukushima Daiichi site. That decision was based on best information available at that time. The information flow from the Fukushima site was

often confusing and conflicting. The NRC was receiving its information from the same open sources available to everyone; such as CNN. We based our assessment on the conditions as we were able to determine; Units 1, 2, and 3 appeared to have suffered significant damage as a result of reported hydrogen explosions, Unit 4 was in a refueling outage and its entire core had been transferred to the spent fuel pool a little more than 3 months earlier so there was fresh fuel in the spent fuel pool that was in danger of overheating if level dropped, and there were indications that was happening. Additionally, there were some radiation monitors that were showing very high levels of radiation on the plant site which would pose challenges to plant crew attempting to stabilize the reactors and there were some offsite readings indicating that fuel damage had occurred. This situation was unprecedented. This is a 6 unit site and 4 of the units were facing extraordinary challenges. The staff performed a series of calculations to assess possible offsite consequences. We understood that some of our assumptions were conservative. However, we were unable to discuss or verify our assumptions with the licensee or our Japanese counterparts. In the United States, the NRC has resident inspector staff at the plants that can report back to the Region and Headquarters on conditions as they are evolving, we are able to readily access "live-time" plant parameters and radiation monitors, as well as talk directly to plant staff and emergency management officials which enables us to refine our

understanding and consequence assessments. With the Fukushima event we had to make our best decision with what we had available. The Emergency Preparedness framework provides for the expansion of the emergency planning zones as conditions require. Acting in accordance with this framework and with the best information available at the time, the NRC determined that evacuation out to 50 miles for U.S. Citizens was an appropriate course of action.