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Idaho Site Lessons Learned  
from the  
Fukushima Dai-ichi Nuclear Power Plant  
Earthquake/Tsunami Event

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## *Background*

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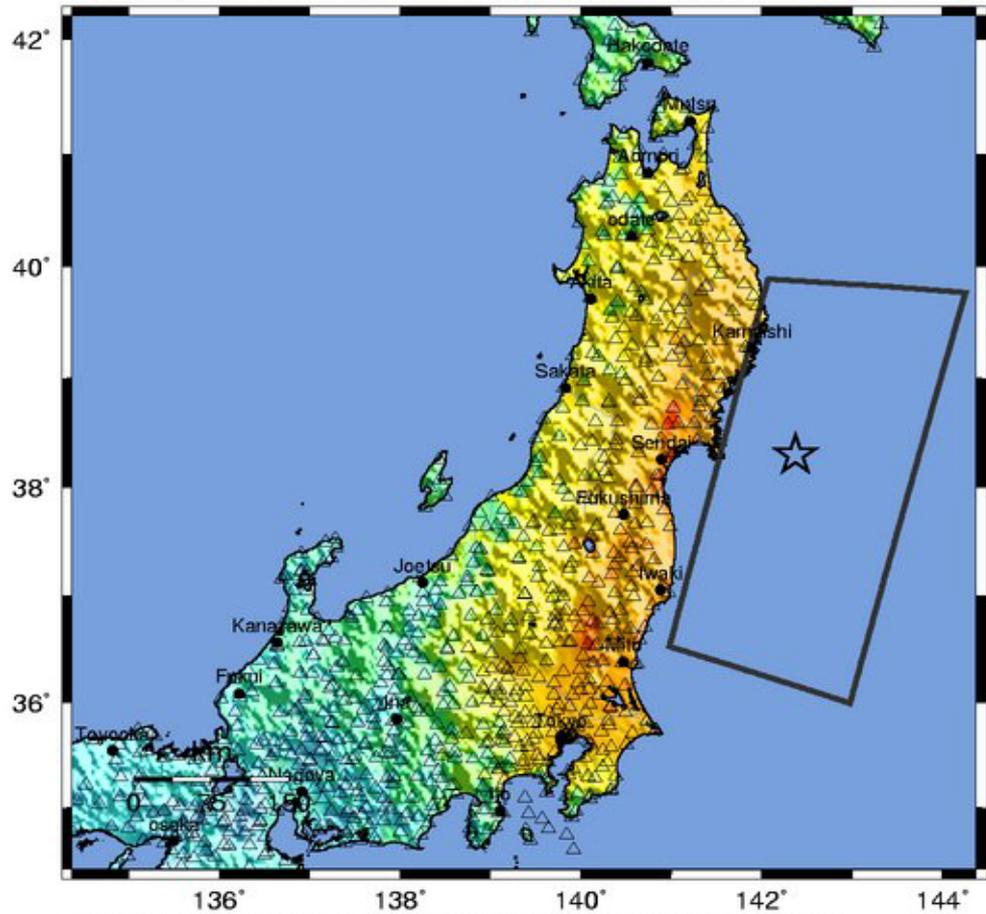
- On March 11, 2011, a major earthquake, magnitude 9.0, occurred off the eastern shore of Japan



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# USGS ShakeMap : NEAR THE EAST COAST OF HONSHU, JAPAN

Fri Mar 11, 2011 05:46:24 GMT M 9.0 N38.30 E142.37 Depth: 30.0km ID:c0001xgp



Map Version 12 Processed Fri Apr 22, 2011 02:42:15 PM MDT – NOT REVIEWED BY HUMAN

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	< 0.17	0.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

## *Background (Cont'd)*

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- The earthquake resulted in the automatic shutdown of three operating reactors at the Fukushima Dai-ichi (“Fukushima”) Nuclear Power Station
  - The earthquake resulted in the loss of all commercial power to the station
  - All backup electrical generators at the station automatically came online and provided power for essential equipment





Source: [asiaworldnews.blogspot.com](http://asiaworldnews.blogspot.com)

## *Background (Cont'd)*

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- The earthquake caused a very large tsunami, which overwhelmed the Fukushima station within an hour of the earthquake
  - Backup electrical generators were lost (diesel generators were flooded, as was the fuel supply)
  - Battery powered systems remained functional until exhausted
  - Defenses in place to protect against a 19 ft high tsunami were useless against the actual tsunami wave which was greater than 46 ft high





Source: [ibtimes.com](http://ibtimes.com)

## *Background (Cont'd)*

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- The complete loss of electrical power resulted in:
  - The loss of reactor and spent fuel pool cooling systems, causing:
    - Fuel damage or meltdown in reactors and spent fuel storage pools
    - Hydrogen generation and explosions in the reactor buildings and one spent fuel pool





Source: [guardian.co.uk](http://guardian.co.uk)

## *DOE Response for DOE Nuclear Facilities*

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- On March 23, 2011, the Secretary of Energy issued Safety Bulletin 2011-01:
  - Evaluate facility vulnerabilities for “beyond design basis events”
  - Ensure appropriate provisions are in place to address them
  - Specifically, the Safety Bulletin required DOE sites to:
    - Review how design basis events have been analyzed and considered
    - Evaluate the ability to safely manage a total loss of power event
    - Confirm safety systems are maintained operable in accordance with requirements
    - Confirm emergency plans, procedures and equipment are current, functional, and tested
      - Including plans and procedures in response to “natural phenomena events”
  - DOE-ID reported the results of the reviews to the DOE Headquarters Office of Health, Safety and Security by May 13, 2011



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## *Definitions*

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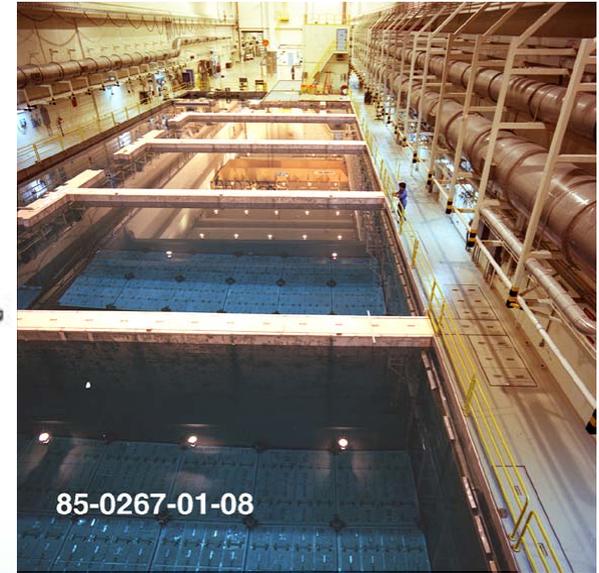
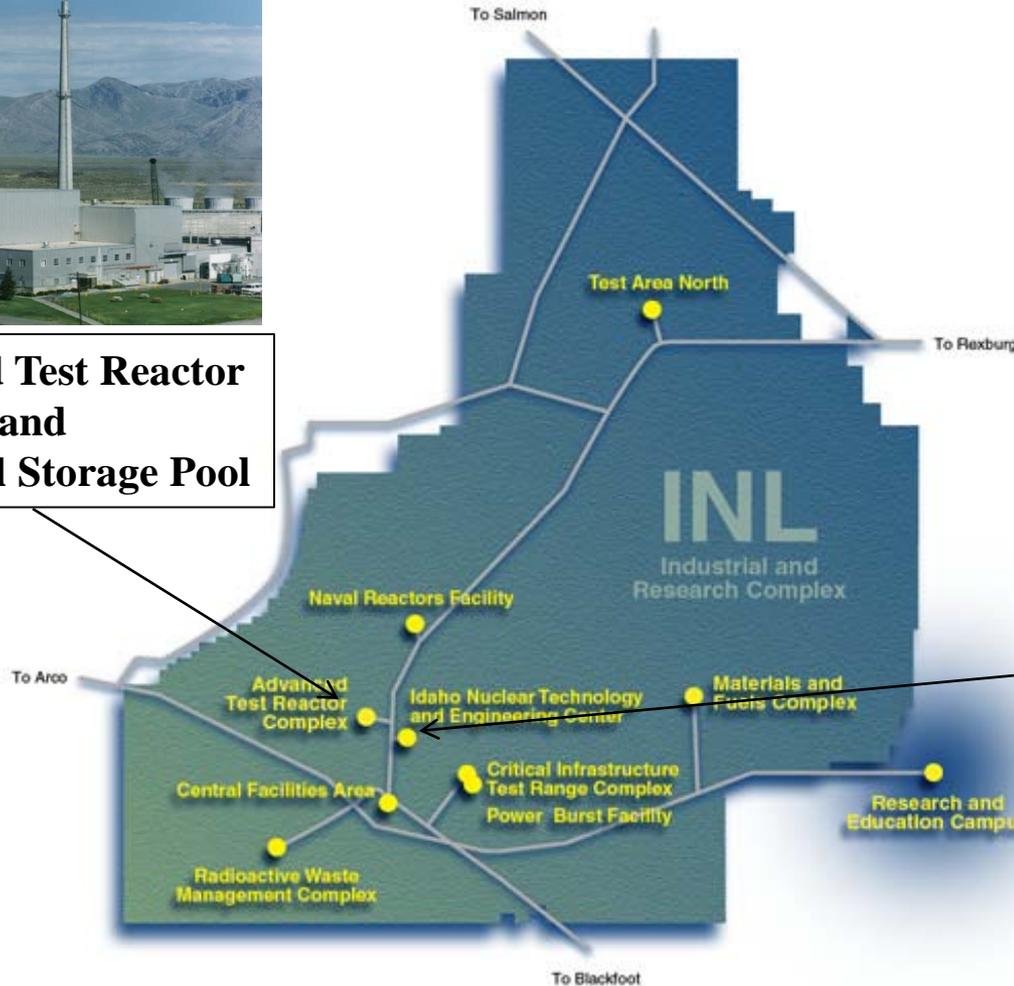
- **Design Basis Event:** Major accidents that can either cause releases at the facility or have a major impact on facility operations. The major categories are:
  - internally initiated operational accidents (e.g., fires, explosions, spills, criticality);
  - natural events for the site (e.g., earthquakes, tornadoes) that could affect the facility;
  - man- made externally initiated events such as airplane crashes, transportation accidents, adjacent facility events, etc.
- **Beyond Design Basis Event:** An accident of the same type as a design basis accident (e.g., fire, earthquake, spill, explosion, etc.) but defined by parameters that exceed in severity the parameters defined for the design basis accident.



# Idaho Site Reactor and Spent Fuel Storage Pools



**Advanced Test Reactor  
and  
Spent Fuel Storage Pool**



**Fuel Storage Area Pool**



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## *Results and Lessons Learned*

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- There are no beyond design basis conditions similar to those that occurred at the Fukushima plant that could occur at the Idaho site:
  - Earthquakes less severe (based on history and modeling)
  - Tsunami's not possible
- Other notable differences:
  - Advanced Test Reactor operates at low temperature, low power, short durations
  - Spent fuel in Advanced Test Reactor fuel pools generate much less heat than commercial reactor spent fuel
  - Advanced Test Reactor fuel is aluminum clad (much less probability to generate hydrogen)
  - All spent fuel stored at the INTEC Fuel Storage Area pool has been out of a reactor > 3 years (very little heat generation)



## *Results and Lessons Learned (cont'd)*

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- Evaluations went beyond the specific nature of the event at Fukushima
  - Considered the following natural phenomena hazards:
    - Earthquake
    - Extreme wind
    - Flooding
  - Also included the following hazards:
    - Snow (loading issues)
    - Volcanic activity
    - Lightning



## *Results and Lessons Learned (cont'd)*

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- The existing safety bases and emergency plans are adequate
  - Emergency drill programs are in place and adequately exercise emergency response capabilities
  - Advanced Test Reactor has developed and implemented simulator training on extended loss of power scenarios
- Improvements are being considered in some safety basis documents to:
  - Better describe some beyond design basis events, including event causes
  - Include discussion of event mitigation based on existing emergency plans and facility design
- Improvements are being considered in emergency planning
  - Evaluate the need for additional portable electrical generators, etc.
  - Planning for multiple events at multiple facilities



## *Conclusion*

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- The existing safety bases and emergency plans are adequate
- Improvements are being considered
- Industry lessons learned are regularly reviewed by DOE as part of our continuous improvement processes
- More lessons learned from the Japanese disaster are expected in the future

Questions?



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