United States Nuclear Regulatory Commission Post 2011 Fukushima Daiichi Event Actions

Presenter

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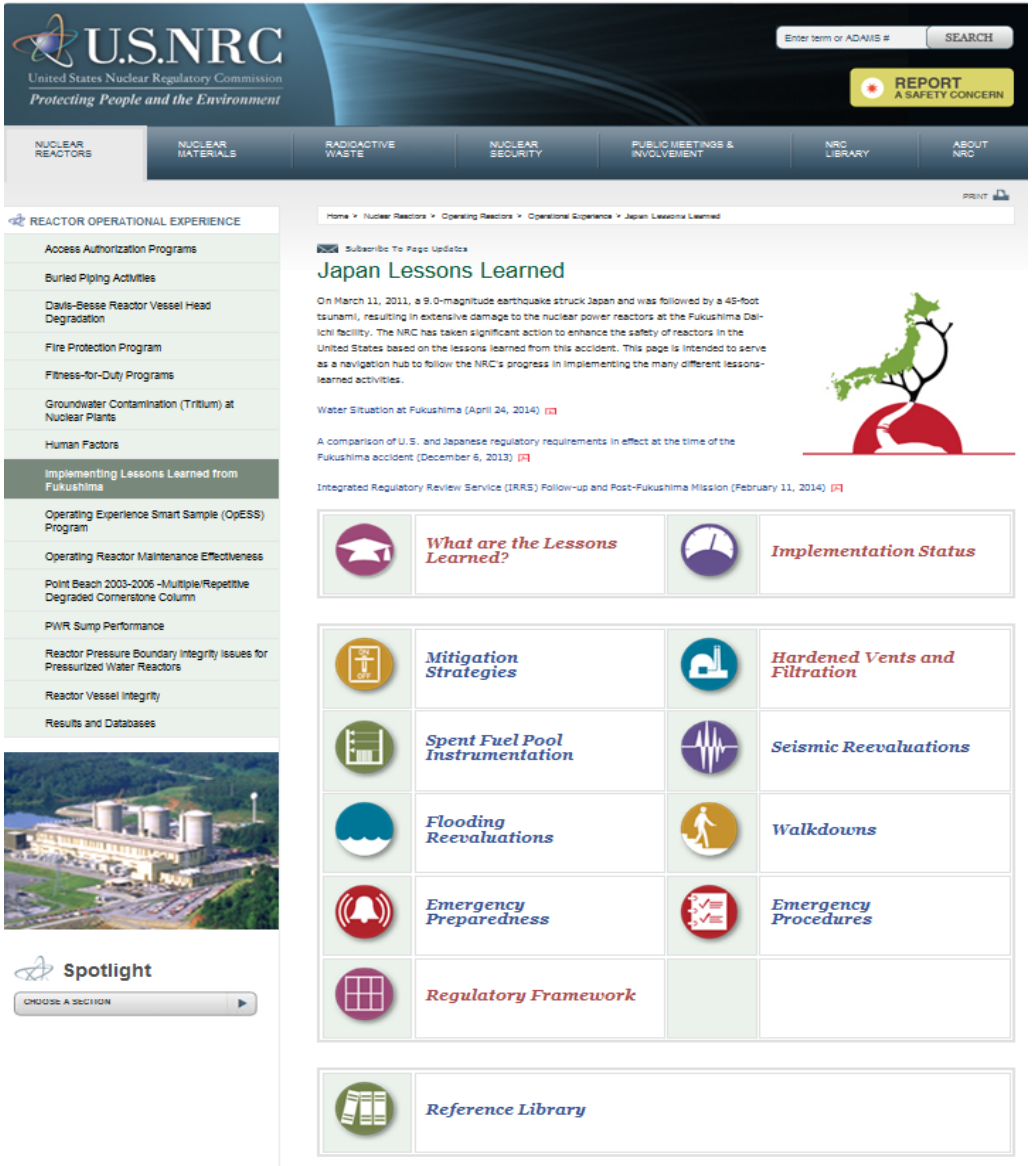
USNRC Post Fukushima Daiichi Actions

- NRC Response included offering technical assistance to the Japanese government and monitoring the event in as helpful and unobtrusive manner as possible.
- The NRC also established a Near Term Task Force (NTTF) to review what was known about the event that started with the earthquake and tsunami on March 11, 2011 and the efforts and effectiveness of the site's equipment and personnel in mitigating the progress and consequences and to provide recommendations for NRC actions to ensure a greater capacity for USA domestic nuclear plants to deal with beyond design basis events.

USNRC Post Fukushima Daiichi Actions



A more complete discussion of what the NRC has done and is in the process of doing or has on a list for future consideration can be found by accessing the NRC Public Website, selecting the “Japan Lessons Learned” option from the “Spotlight” column on the left side of the page. The page shown should then appear:

http://www.nrc.gov/reactors/operating/ops-experience/japan-dashboard.html

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- The NTTF made 12 recommendations (most have been further subdivided) with the following goals in mind:
  - ***Clarifying the Regulatory Framework***
  - ***Ensuring Protection***
  - ***Enhancing Mitigation***
  - ***Strengthening Emergency Preparedness***
  - ***Improving the Efficiency of NRC Programs***

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- NRC Commission approved NRC Staff prioritization recognizing the considerable effort that would be required by all stakeholders to determine specific action requirements, develop implementation guidance and implement the resulting hardware, procedure, training and personnel changes.
- The priority tier grouping of actions reflected in large part the perceived near term need and potential benefit of the actions. Actions to prevent core damage were Tier 1 while actions to mitigate the consequences of a severe accident (core melting, including reactor vessel breach) or were dependent on the outcome of Tier 1 actions were assigned a Tier 2 or Tier 3 priority.

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- Recommendation 1 - establish a logical, systematic, and coherent regulatory framework for adequate protection that appropriately balances defense-in-depth and risk considerations. Initiate action to enhance the NRC regulatory framework to encompass beyond-design-basis events and their oversight
- Recommendation 2 - require licensees to reevaluate and upgrade as necessary the design-basis seismic and flooding protection of SSCs for each operating reactor.
- Recommendation 3 - as part of the longer term review, that the NRC evaluate potential enhancements to the capability to prevent or mitigate seismically induced fires and floods.

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- Recommendation 4 - strengthen SBO mitigation capability at all operating and new reactors for design-basis and beyond-design-basis external events. (SBO 10 CFR 50.63)
- Recommendation 5 - requiring reliable hardened vent designs in BWR facilities with Mark I and Mark II containments.
- Recommendation 6 - as part of the longer term review, that the NRC identify insights about hydrogen control and mitigation inside containment or in other buildings

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- Recommendation 7 -enhancing spent fuel pool makeup capability and instrumentation for the spent fuel pool
- Recommendation 8 - strengthening and integrating onsite emergency response capabilities such as EOPs, SAMGs, and EDMGs
- Recommendation 9 - NRC require that facility emergency plans address prolonged SBO and multiunit events.

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- Recommendation 10 - as part of the longer term review, that the NRC should pursue additional EP topics related to multiunit events and prolonged SBO
- Recommendation 11 - as part of the longer term review, that the NRC should pursue EP topics related to decision-making, radiation monitoring, and public education.
- Recommendation 12 - NRC strengthen regulatory oversight of licensee safety performance (i.e., the ROP) by focusing more attention on defense-in-depth requirements consistent with the recommended defense-in-depth framework.

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- Tier 1 Activities
  - Mitigating strategies to enhance the capability to maintain plant safety during a prolonged loss of electrical power. Order
  - Containment venting system to provide a reliable means of containment pressure control for boiling water reactors (BWRs) with Mark I or Mark II containment designs. Order
  - Spent fuel pool instrumentation to provide a reliable wide-range indication of water level in spent fuel storage pools. Order

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- Tier 1 Activities (Cont'd)
  - Seismic reevaluation using present-day information to determine if safety upgrades are needed. Request for Information
  - Flooding hazard reevaluation using present-day information to determine if safety upgrades are needed. Request for Information
  - Seismic and flooding walk downs to inspect existing plant protection features against seismic and flooding events, and correct any degraded conditions. Request for Information

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- Tier 1 Activities (Cont'd)
  - Emergency Preparedness – Staffing and Communication to assess staffing needs and communications capabilities to effectively respond to an event affecting multiple reactors at a site. Request for Information
  - Station Blackout Mitigation Strategies To enhance the capability to maintain plant safety during a prolonged loss of electrical power. Rulemaking
  - Onsite Emergency Response Capabilities To strengthen and integrate different types of emergency procedures and capabilities at plants. Rulemaking

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- Tier 1 Activities (Cont'd)
  - Filtration and confinement strategies for BWRs with Mark I and Mark II containment designs. Rulemaking
- Tier 2 Activities
  - Spent Fuel Pool Makeup Capability. Order [consolidated into Mitigation Strategies activities)
  - Emergency Preparedness to address three aspects of multi-reactor and loss of power events (training-exercises-drills, equipment-facilities-resources, multi-unit release dose assessment capability). Order (mostly consolidated into Mitigation Strategies activities)
  - "Other" External Hazard Reevaluations. Currently planning starting this with a request for information.

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- Tier 3 Activities
  - Periodic Confirmation of External Hazards – Rulemaking planned.
  - Longer term evaluation
    - Seismically-Induced Fires and Floods
    - Venting Systems for Other (than BWR MK I/II) Containment Designs
    - Hydrogen Control
    - Emergency Preparedness
    - Emergency Response Data System (ERDS) Capability
    - Decision-making, Radiation Monitoring, and Public Education

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- Tier 3 Activities (Cont'd)
  - Emergency Planning Zone
  - Potassium Iodide (KI)
  - Expedited Transfer of Spent Fuel to Dry Cask Storage
  - Reactor and Containment Instrumentation potential upgrades for severe accident conditions
  - Dependent on Tier 1 and 2 activities
    - Reactor Oversight Process (ROP) Updates
    - NRC Staff Training on Severe Accidents

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- **Recommendation 5**
  - *5.1 Order licensees to include a reliable hardened vent in BWR Mark I and Mark II containments.*
  - *5.2 Reevaluate the need for hardened vents for other containment designs, considering the insights from the Fukushima accident. Depending on the outcome of the reevaluation, appropriate regulatory action should be taken for any containment designs requiring hardened vents.*

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- Why BWR Mark I/II containments a priority for reliable hardened venting capability?
- GL 89-16.
  - Suppression pool scrubbing
  - Hinted at AC power independence
  - No suggestion for Mark II vents
- Before core damage versus after core damage (severe accident condition).
- Hardened containment vents had been installed in foreign plants starting in the mid-1980's and included engineered external filters.

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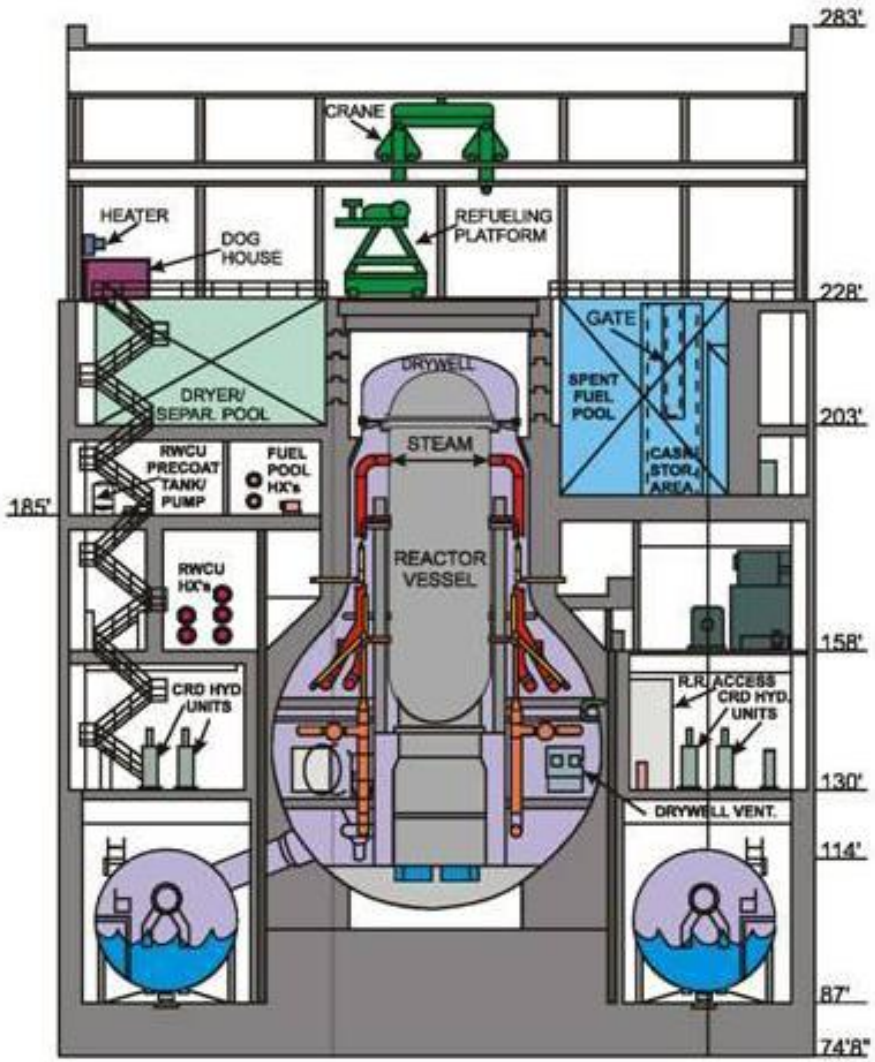

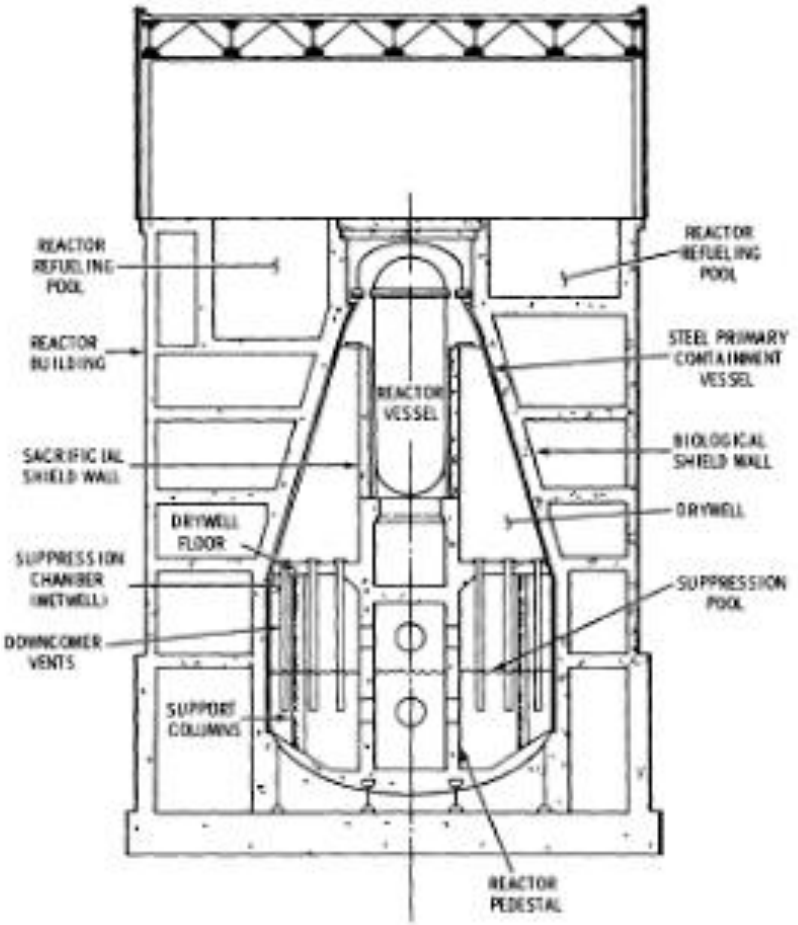

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- Orders
  - EA-12-050
  - EA-13-109
    - Phase I – reliable, hardened, severe accident capable wetwell vent
    - Phase II – drywell vent or if filtration strategies support avoiding flooding the wetwell to where a wetwell vent is not usable
  - Rulemaking
    - Includes assumption of severe accident progression to reactor pressure vessel breach by core debris
    - Analyzing vent configurations and operating schemes effectiveness at limiting off-site releases and avoiding damaging combustible gas deflagrations/detonations
    - Performance criteria options will also be proposed.

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- A filtration strategy can include
  - Enhanced retention of airborne radioactivity within primary containment though holdup, containment sprays, suppression pool scrubbing
  - Including external filter in the vent line
  - Combination

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- Rulemaking includes performing regulatory analysis, establishing regulatory basis by identifying options and assessing their associated costs and benefits
  - The more likely (of the highly unlikely event) sequences are selected given assumed mitigation strategies and modelled in accident progression computer programs
  - Potential radionuclide releases from the site are calculated as are the resulting public dose and land contamination and associated potential costs (avoidance is considered a benefit)
  - Probabilities of event sequences are calculated
  - Costs of potential modifications are estimated

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- Rulemaking is a complicated and involved process involving much stakeholder interaction and considerable time.
- Ultimately the NRC Commissioners will vote and decide on what if any requirements will be included in the regulations. Current schedule for Final Rule issue date is December 19, 2017

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- EXTRA SLIDES FOLLOW

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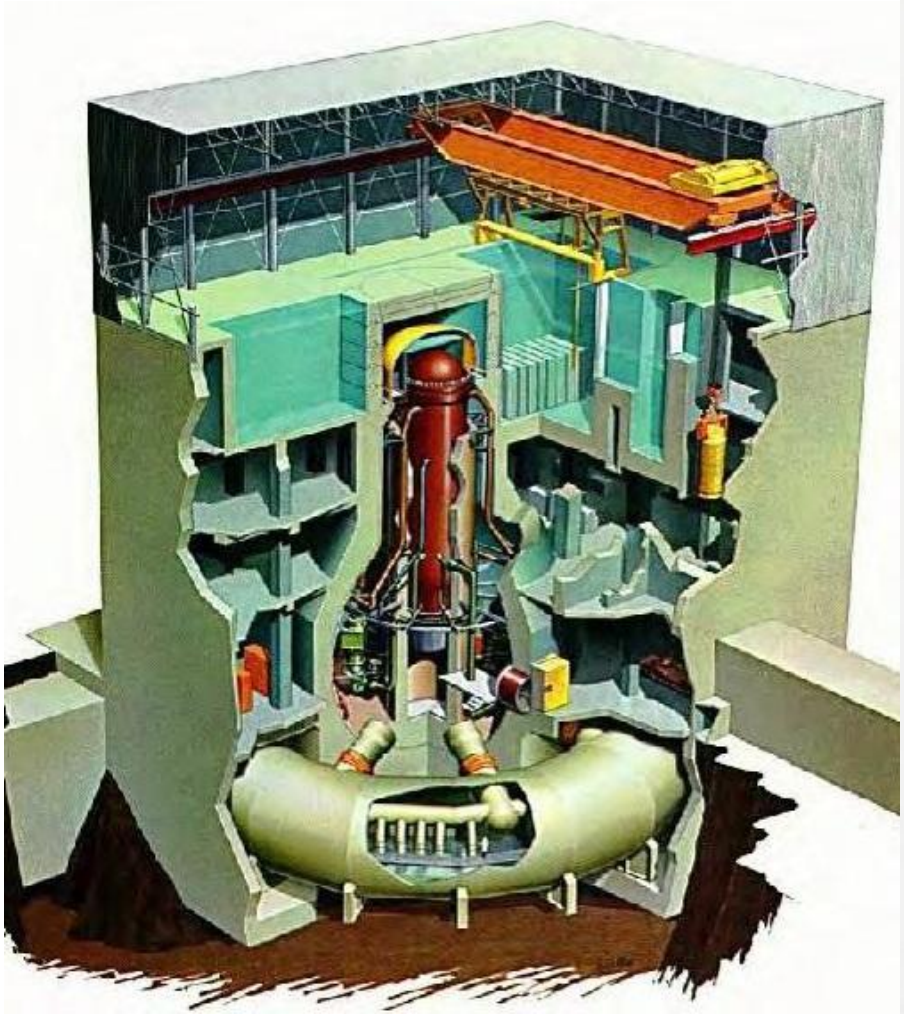

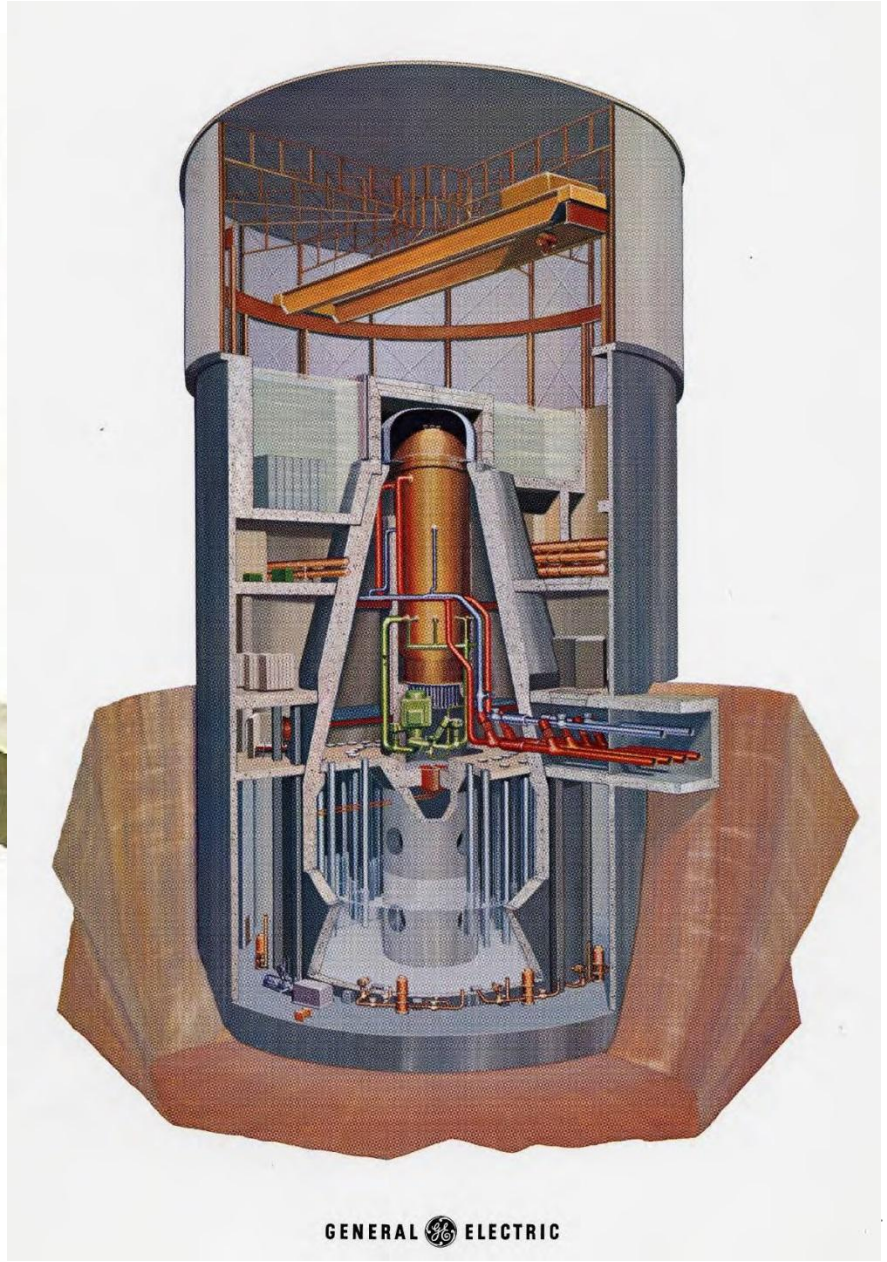

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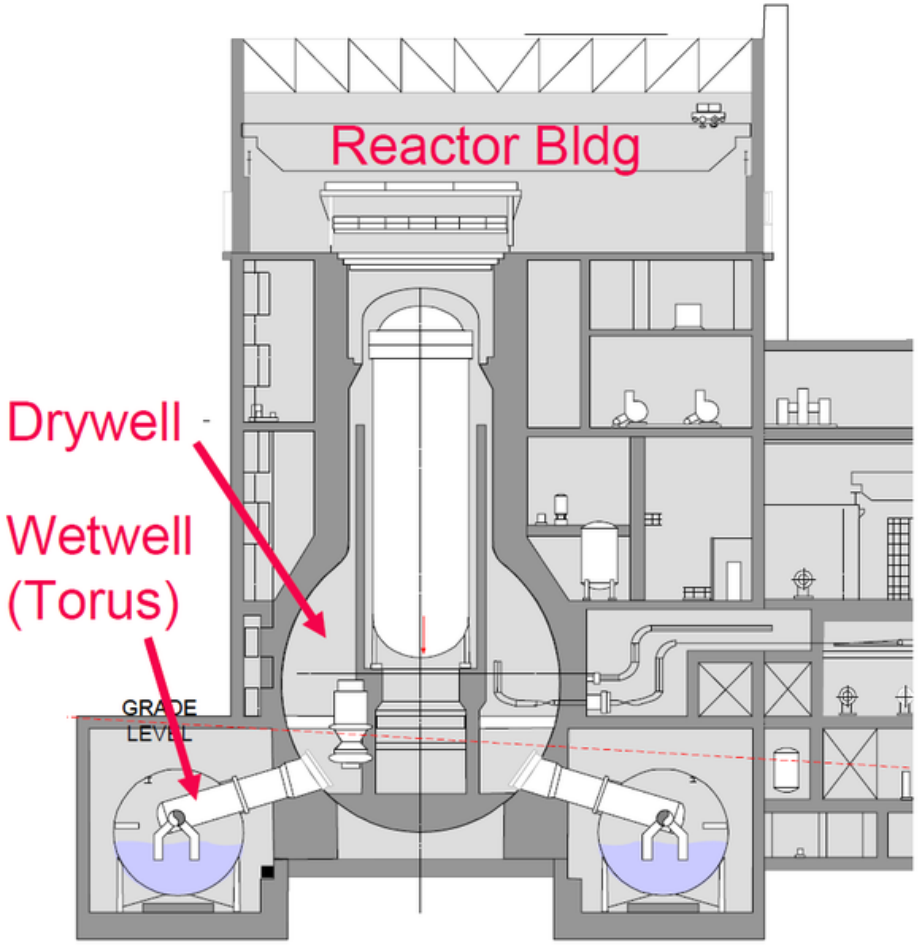

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Scrubber Vessel