San Onofre Nuclear Generating Station (SONGS)

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Leading the Way in Electricity℠

San Onofre Nuclear Generating Station

- San Onofre Nuclear Generating Station (SONGS) Units 2 & 3 have been safely serving California customers since 1983
  - SONGS Unit 1 served customers from 1968-1992
- SONGS:
  - serves 1.4 million customers
  - economic contributor to state
  - avoids 6 – 10 million metric tons (carbon dioxide-equivalent) every year
    - Equivalent to removing 1.2 – 2.0 Million passenger cars/year
  - facilitates grid stability and import capabilities
  - clean, cost-effective source of electricity

SONGS' Seismic Design

- NRC requires that plants must be designed to withstand the effects of natural phenomena including earthquakes, tornadoes, hurricanes, floods, and tsunamis that could credibly occur near the plant's location

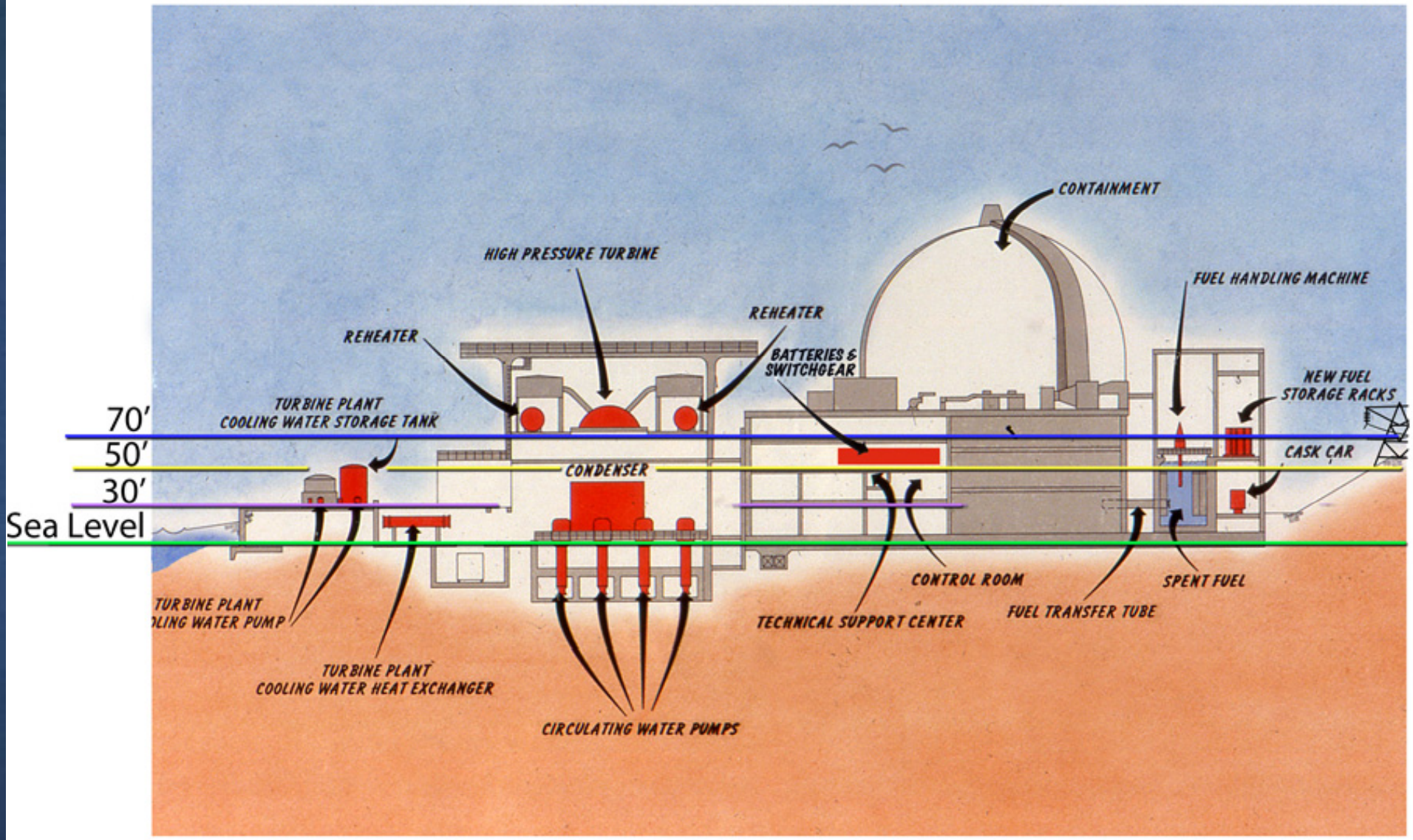
- Seismic design of SONGS is robust
  - based on extensive studies prior to initial construction with periodic updates that evaluate recent scientific data
  - designed to a peak ground acceleration value of 0.67g
  - safety-related structures, systems and components (SSC) must remain functional to maintain the safety of the reactor and prevent release of radioactive material off-site

- On-going Seismic Program
  - periodic evaluations of new information on seismic and tsunami hazards
  - utilizes input from academia, research, and geotechnical professionals
  - independently reviewed by external experts

SONGS' Tsunami Seawall Design

- Seawall has a height of 30 feet
  - model assumed a vertical displacement of a local fault system to generate the tsunami
    - Not credible given the fault system is strike-slip
  - also assumed simultaneous high tide, storm surge, and storm waves

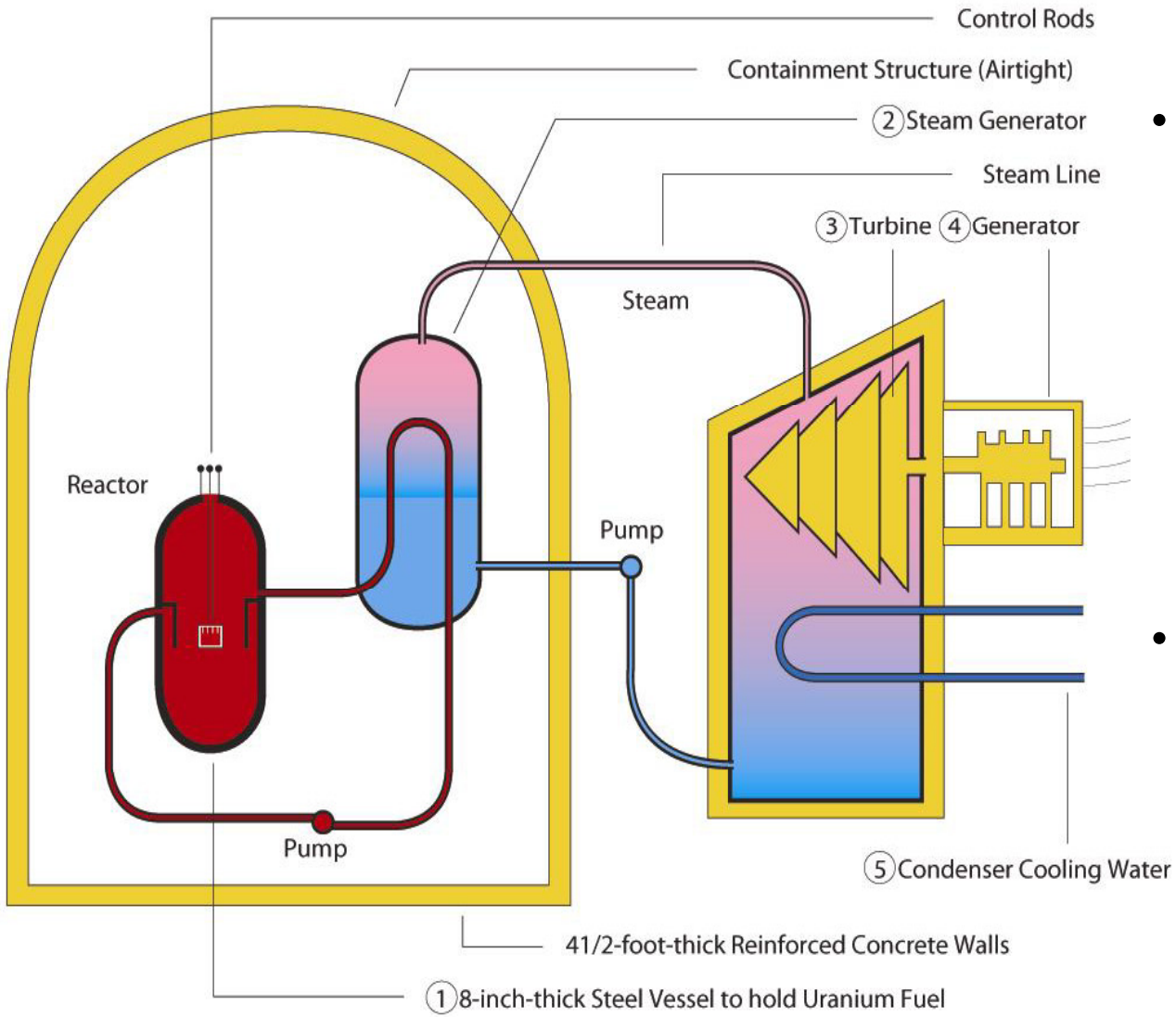
Elevation View



Seismic and Tsunami Studies

Through early 1980s	Deterministic Analysis – extensive geotechnical studies
1995	Probabilistic Seismic Hazard Analysis
2001	Probabilistic Seismic Hazard Analysis – follow-up study
2010 – 2011	Probabilistic Seismic Hazard Analysis – follow-up study
	Evaluated "Tsunami Inundation Map for Emergency Planning" Evaluating Probabilistic Tsunami Hazard Analysis – mid-2011
Future work	Source Characterization: • Additional GPS and seismic monitoring • 2D/3D reflective mapping • Data re-processing and re-analyzing using modern techniques • Seismic source workshops Ground Motion: • Site specific characterization and site response analysis Probabilistic Seismic Hazard Analysis

SONGS Heat Removal



- Critical Function: maintain heat removal from the nuclear fuel
  - Steam generator heat removal
  - Emergency core cooling
- Redundancy by design

Dedicated Water Supplies

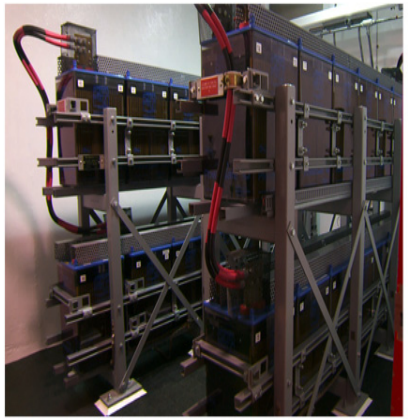
- On-site
  - 3 million gallons in seismically qualified tanks
  - 5.3 million gallons total (seismic + non-seismic)

- Two redundant trains: electrical pumps, valves, and pipes
- One steam-driven pump for heat removal through the steam generators

Emergency Electrical Supplies

- 2 emergency diesel generators/unit
- Ability to cross-connect: only 1 emergency diesel generator needed
- 5000 KW each
- 30 ft elevation, building withstands seismic and flooding

- 7 day supply of diesel fuel
- Subsurface vaults, built to withstand seismic and flooding

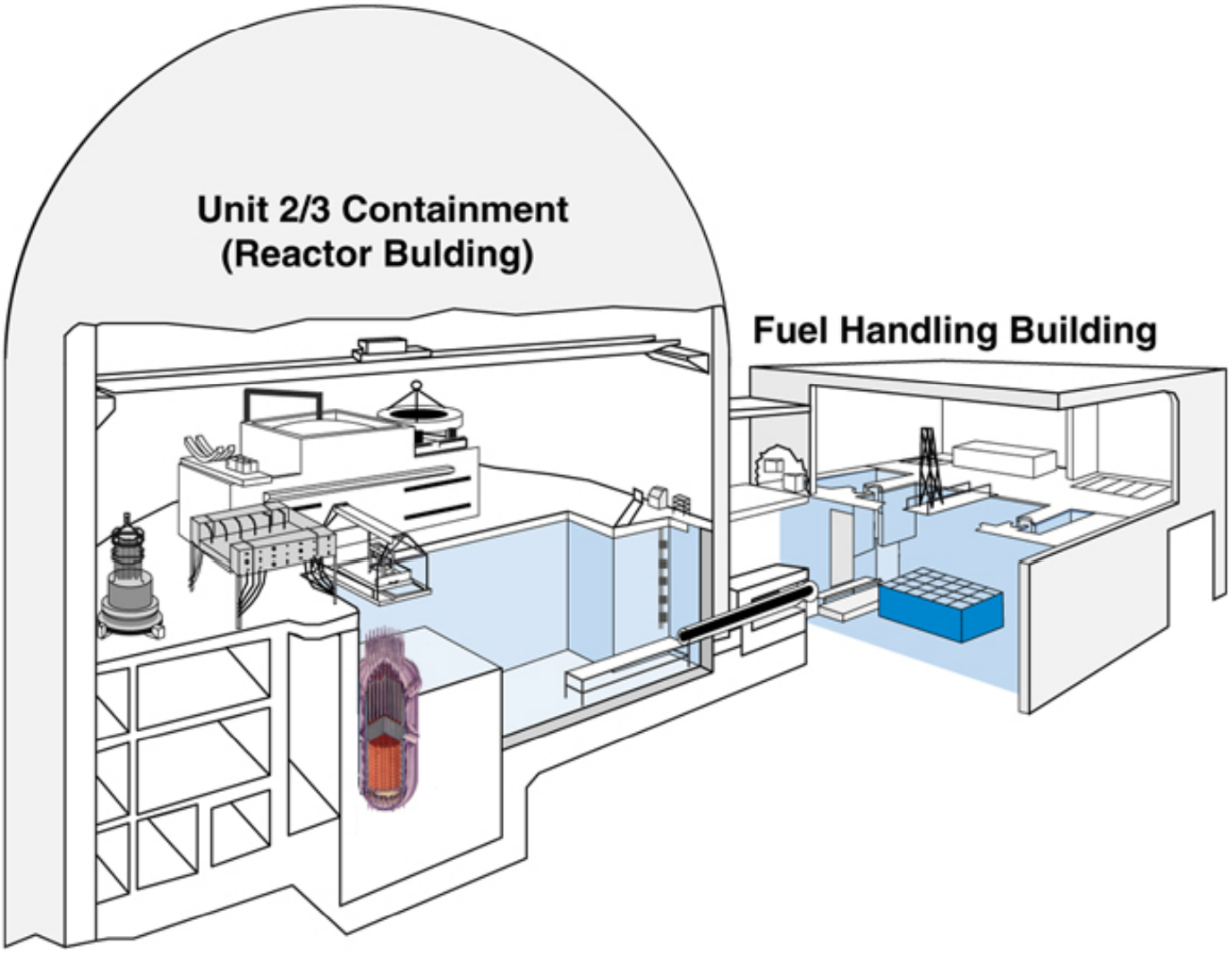


Battery Room

Switchgear Room

- Emergency batteries and switch gears
- 50 ft elevation, building withstands seismic and flooding

Used Fuel Pool

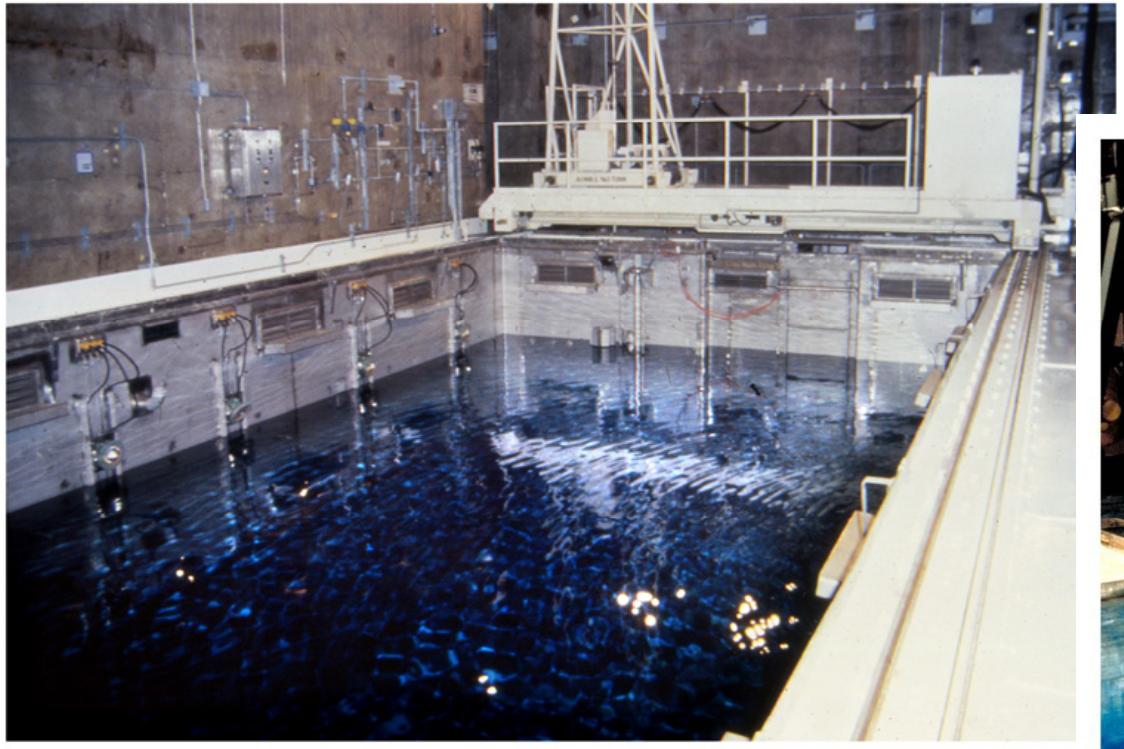


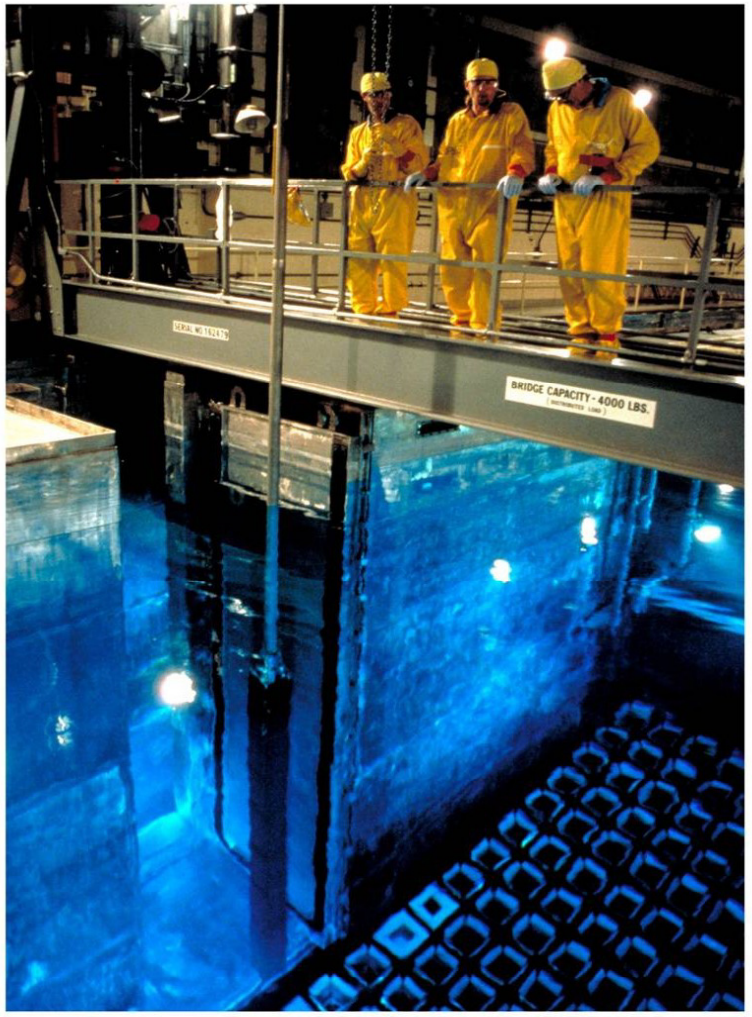
Used Fuel Storage

3421 used fuel assemblies are safely stored on site

- Used Fuel Pool (~1200 assemblies per pool)
  - Seismically designed reinforced concrete structure
  - Stainless steel plate liner
  - >23 ft of borated water over used fuel assemblies
  - Emergency replacement water on-site capability
- Dry Cask Storage (~970 assemblies)
  - Used fuel assemblies are stored in stainless steel canisters and housed in robust reinforced concrete structures
  - Capability to withstand flood and seismic conditions

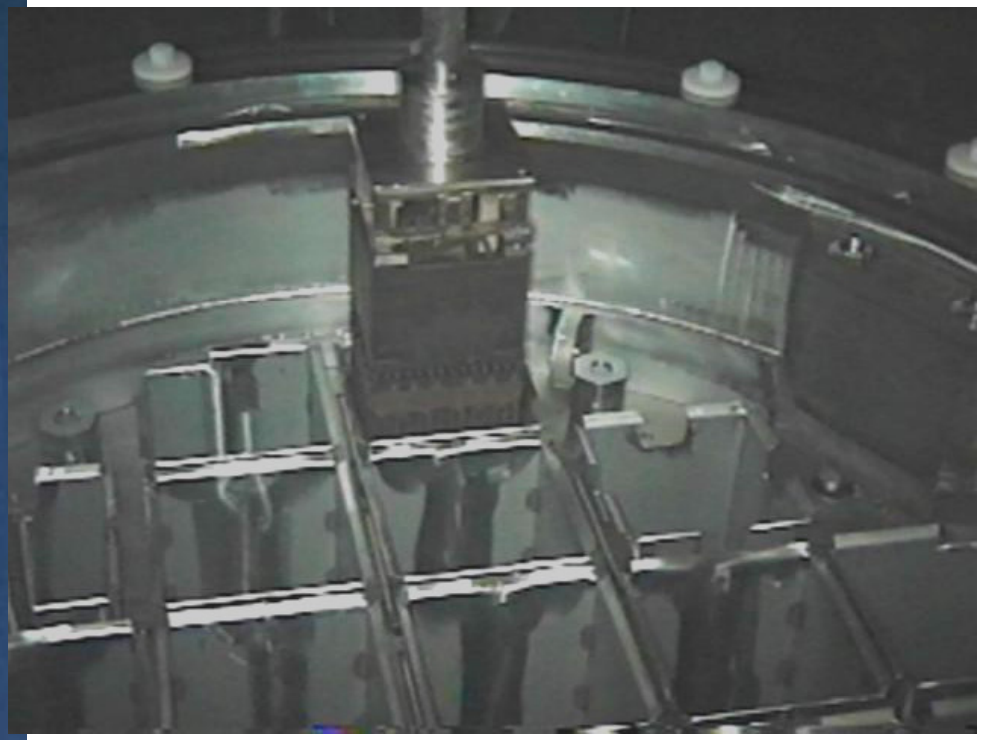
Used Fuel Pool





- Designed to hold used fuel safely and securely
- Top of used fuel assemblies are at ~ 30 ft
- Water depth is ~ 55 ft
- One engineered pool per reactor

Used Fuel Transfer and Storage



- Used fuel assemblies are transferred to robust steel canisters once they have cooled to acceptable levels in the used fuel pool
- Canisters are drained and filled with helium before being sealed
- Sealed canisters are transferred to the secure dry cask storage facility for monitoring and management

Byproducts are Carefully Managed

- Used fuel is:
  - strictly regulated by the NRC
  - safely, securely, and economically stored on-site
    - Initially in used fuel pool
    - Later, in dry cask storage facility
    - Room for storage of all used fuel
- On-site dry cask storage is an interim solution that allows informed planning for long-term safe disposition of used fuel
- Broad consensus that a geologic repository is the appropriate approach for permanent disposition and isolation of used fuel

Severe and Extreme Accident Response

- **B.5B Mitigation Strategies** – Actions to address extensive plant damage, which include:
  - Use of firewater and portable pump (fire truck or skid pumps) to feed steam generators, replace used fuel pool water, or flood containment
  - Depressurizing steam generators using atmospheric dump valves
  - Command and control in the event of loss of control room
  - Manual operation of steam-driven pump without electrical power
- **Severe Accident Management Guidelines** – Actions to address malfunctions beyond design conditions, even core melt, which include:
  - Depressurizing the reactor coolant system
  - Reducing containment hydrogen and control flammability
  - Mitigating fission product releases, regardless of core conditions
  - Providing cooling water into reactor cooling system and steam generators

Additional Organizational Capabilities

- **Onsite Fire Department**
  - Minimum of 5 personnel on site 24/7, typically 6-7
  - 2 Fire Engines, one pumper and one 75-ft aerial ladder truck
  - Hazardous materials response capability with staff of 7
    - Mutual aid from San Diego and Marine Corps

- **Recurring Emergency Preparedness Training**
  - 4 Emergency Response Organization teams
  - Dedicated on-site and off-site Emergency Response Facilities
  - Periodic table top and full-scope drills (minimum of 4 annually)

Current Performance

- SCE is committed to
  - Maintain and strengthen the environment for employees to raise concerns
  - Full compliance with all company and regulatory standards
  - Continuous progress toward excellence

- NRC concluded in their annual review that SONGS 2 & 3 were operated in a manner that preserved public health and safety and met all cornerstone objectives
  - Resolved issues
    - NRC problem identification and resolution cross-cutting issue
    - NRC Confirmatory Order
    - NRC loose battery connections white finding
  - Remaining issues
    - NRC human performance cross-cutting issue
    - NRC chilling effects letter

Summary

- Seismic Event Design Readiness
  - Fault systems offshore in the vicinity of SONGS are strike-slip, not a significant tsunami source
  - Critical equipment is located at elevations above the maximum credible tsunami wave height for San Onofre
  - SONGS has robust and redundant emergency back-up power capabilities
  - SCE stores 5.3 million gallons of water on-site, 3 million of which is in seismically qualified tanks that can provide replacement cooling
- Response Readiness
  - SCE has reconfirmed the capability and resources to respond to “beyond design basis” events
- SCE is committed to learning from the Fukushima Daiichi accident and to identify additional actions that can be taken to further enhance our readiness for severe accidents