



The US NRC's Power Reactor Decommissioning Process

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U.S. Nuclear Regulatory Commission

Mission

- The NRC licenses and regulates the Nation's civilian use of radioactive materials to protect public health and safety, promote the common defense and security, and protect the environment.

Decommission (10 CFR 20 Subpart E)

“To remove (as a facility) safely from service and reduce radioactivity to a level that permits:

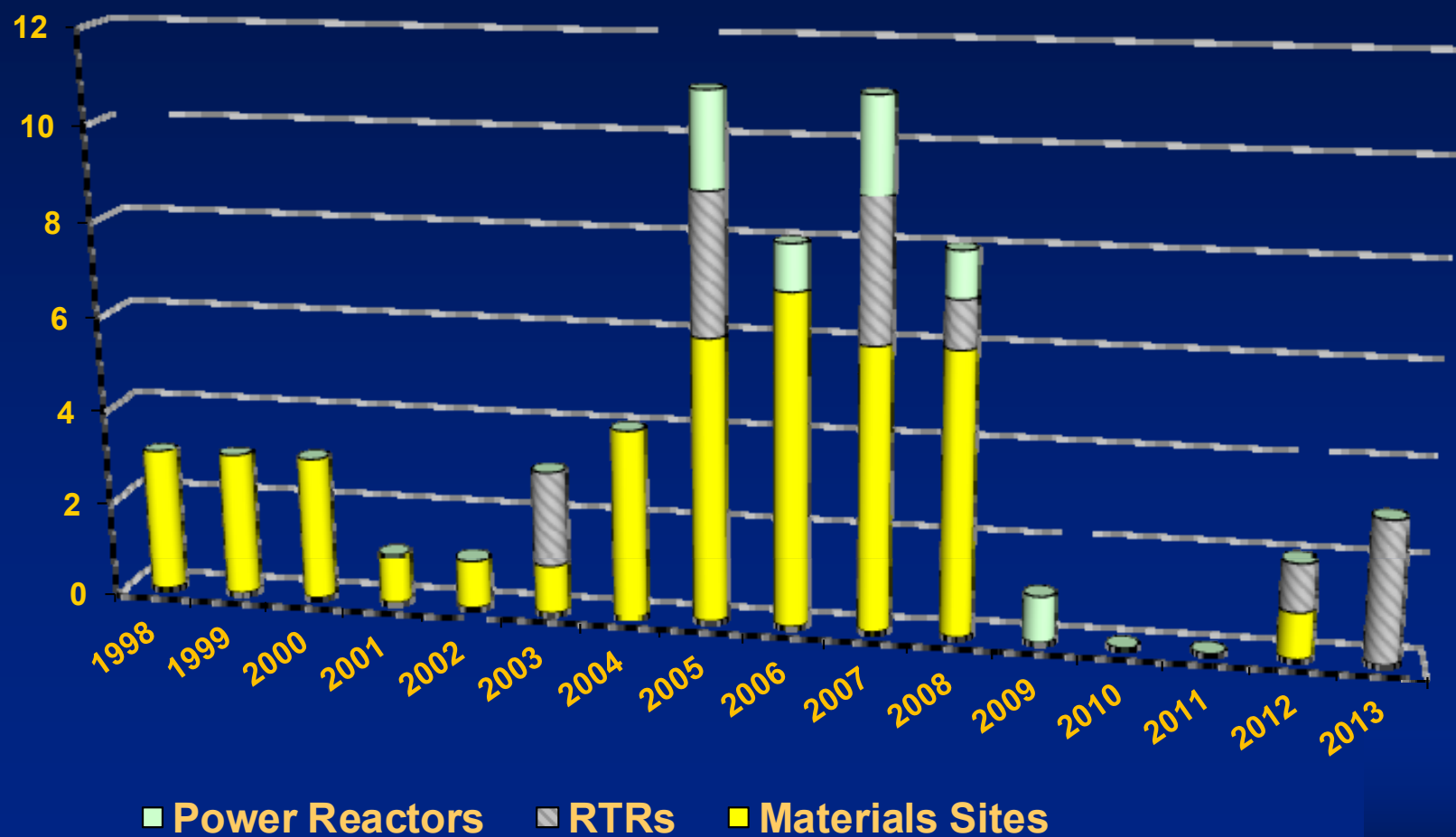
- 1. Release of the property for unrestricted use and termination of the license; or**
- 2. Release of the property under restricted conditions and termination of the license”**

Decommissioning Staff Expertise

- Mechanical Engineers
- Civil Engineers
- Chemical Engineers
- Nuclear Engineers
- Geotechnical Engineers
- Industrial Engineers
- Health Physicists
- Environmental Engineers
- Environmental Scientists
- Hydrogeologists
- Geologists
- Mathematicians
- Biologists
- Chemists

Over 300 cumulative years of experience

Decommissioning Completions



Decommissioned Reactors

- Rancho Seco, 2009
- Big Rock Point, 2007
- Connecticut Yankee, 2007
- Pathfinder, 2007
- Yankee Rowe, 2007
- Trojan, 2005
- Maine Yankee, 2005
- Saxton, 2005
- Shoreham, 1995
- Fort St. Vrain, 1997
- Shippingport, 1988

Key Decommissioning Milestones

- Certification - Permanent Ceasing of Operations
Certification - Nuclear Fuel permanently removed from the Reactor
- Post Shutdown Decommissioning Activities Report (PSDAR)
- Decommissioning/Environmental Remediation
- License Termination Plan
- Final Status Survey
- NRC Confirmatory Survey
- Termination/Reduction of Part 50 License

Release Criteria

- **Unrestricted Release**
 - Total Effective Dose Equivalent (TEDE) ≤ 25 mrem (0.25 mSv/a) and As Low As is Reasonably Achievable (ALARA)
 - Average member of the critical group
 - All pathways
 - Period of performance - 1000 years
- **Restricted release**
 - ≤ 25 mrem (0.25 mSv/a) TEDE and ALARA, with institutional controls in effect
 - Legally enforceable institutional controls
 - If institutional controls fail, doses do not exceed 1 mSv/a, or 5 mSv/a, under specific circumstances
 - Financial assurance - independent third party
 - Licensee and NRC public input/outreach requirements

Public Meeting Agenda

- NRC Decommissioning Overview
- Reactor Decommissioning Process
- Decommissioning Inspection Program
- Decommissioning Funding
- Spent Fuel Management
- Q & A

Public Involvement

- **Process Meeting**
- **Post Shutdown Decommissioning Activities Report (PSDAR) Meeting**
- **License Termination Plan Meeting**
- **Opportunity for Hearing**



United States Nuclear Regulatory Commission

The US NRC's Power Reactor Decommissioning Process

Bruce A. Watson, CHP
Chief, Reactor Decommissioning Branch
Office of the Federal, State, Materials Safety and
Environmental Protection
U.S. Nuclear Regulatory Commission

September 26, 2013
Carlsbad, California



United States Nuclear Regulatory Commission

NRC Regulations

- 10 CFR Part 20 Subpart E “License Termination Rule” was implemented in 1997
- 10 CFR Part 50 – Power Reactor License
- 10 CFR Part 72 - Independent Spent Fuel Storage Installation License (ISFSI)



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Reactor Decommissioning Options

- **DECON:** Equipment, structures, etc. removed or decontaminated to a level that permits radiological release
- **SAFSTOR:** Plant placed in a safe, stable condition and maintained in that state until it is subsequently decontaminated to levels that permits radiological release
- **ENTOMB:** Plant is encased in a structurally long-lived substance to allow decay until levels permit unrestricted release (not currently available)



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Reactor Decommissioning - 10 CFR 50.82

- Reactor Decommissioning is required to be completed in 60 years.
- Bases: 50 y in SAFSTOR + 10 y DECON
- Radiation Dose Rates reduced to 1 - 2 %
- Radioactive Waste Volumes reduced to 10%
- Allows Decommissioning Fund to increase
- Coincidentally, corresponds well with 20 year life extension for multi-unit sites



United States Nuclear Regulatory Commission

Decision Factors for Licensees in Determining the Decommissioning Strategy

- Multi-Unit Site Safety
- Financial – Decommissioning Funds Availability
- Access to Radioactive Waste Disposal Capacity
- Future use of the Site
- Stakeholders
- New Business Model
- Special Circumstances



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Power Reactor Decommissioning Process

- **Licensee notifies (certifies) NRC within 30 days of permanently ceasing operations**
- **Certification also required once the fuel has been permanently removed from the reactor vessel**
- **Licensee submits Post-Shutdown Decommissioning Activities Report (PSDAR) prior to or within 2 years of cessation of operations**



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Post Shutdown Decommissioning Activities Report (PSDAR) Contents

- **A description and schedule for the planned decommissioning activities**
- **An estimate of the expected decommissioning costs**
- **A discussion that provides the means for concluding that the environmental impacts associated with the decommissioning activities will be bounded by appropriately issued Environmental Impact Statements.**



United States Nuclear Regulatory Commission

Power Reactor Decommissioning Process

- **NRC notices the PSDAR in the *Federal Register***
- **NRC holds a Public Meeting to discuss the PSDAR and solicit comments**
- **NRC does not approve the PSDAR**
- **Licensee may begin decommissioning 90 days after NRC receives the PSDAR**



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Power Reactor Decommissioning Process

- **Licensee performs site decommissioning**
- **NRC continues to conduct on-site inspections**
- **Licensee submits License Termination Plan (LTP) at least 2 years prior to requesting license termination**
- **NRC notices LTP in the *Federal Register***
- **NRC holds a Public Meeting to discuss LTP**



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License Termination Plan Contents

- **Site radiological characterization information**
- **Identification of remaining dismantlement activities**
- **Plans to complete the site remediation**
- **Detailed plans for the final radiation survey**



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License Termination Plan Contents

- **A description of the end use of the site, only if restricted release is requested**
- **An updated site-specific estimate of remaining decommissioning costs**
- **A supplement to the environmental report describing any new information or significant environmental change associated with the licensee's proposed termination activities.**



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Power Reactor Decommissioning Process

- **NRC review of the LTP**
 - **Acceptance and Technical Review**
 - **Requests for Additional information, if necessary**
 - **Public Meetings/Opportunity for Hearing**



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Power Reactor Decommissioning Process

- **NRC approves LTP by amending the license**
- **Licensee performs remaining decommissioning activities**
- **NRC performs inspections, including independent in-process and confirmatory surveys to verify licensee survey results**



United States Nuclear Regulatory Commission

Power Reactor Decommissioning Process

- **Licensee submits Final Status Survey Report (FSSR)**
- **NRC performs confirmatory surveys and approves the FSSR**
- **NRC terminates the license by letter and notices the action in the *Federal Register***



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SONGS Decommissioning Milestones

- **June 7, 2013 - SCE certification of permanent cessation for SONGS Units 2 & 3**
- **June 28, 2013 - Unit 3 defueled certification**
- **July 22, 2013 - Unit 2 defueled certification**
- **Deadline for the SONGS PSDAR is June 7, 2015**
- **Public notice of PSDAR, and public meeting ~60 days after PSDAR submittal**
- **LTP required within 2 yrs of license termination**



NRC Inspection Program for Decommissioning Reactors

D. Blair Spitzberg, Ph.D., Chief, Fuels Safety & Decommissioning Branch, NRC Region IV

Public Meeting on Nuclear Power Reactor Decommissioning Process

Carlsbad, California

September 26, 2013

How to safely get from this to this



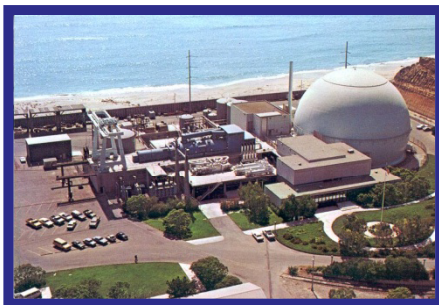
Connecticut Yankee, CT



Maine Yankee, ME



Trojan, OR



San Onofre Unit 1, CA



How NRC Ensures Safety

- **Establish and ensure compliance with requirements contained in:**
 - **Regulations**
 - **Safety standards**
 - **License (License Conditions, Technical Specifications)**
- **Perform licensing reviews and safety evaluations**
- **Inspection and enforcement**

Inspection Activities

- **Inspections of Spent Fuel Pool Safety**
- **Inspections of Decommissioning Activities**
 - **Generally scheduled during periods of higher risk activities**
 - **During and after remediation activities, NRC conducts independent radiological measurements to confirm licensee survey methodologies**
- **Inspections of the Independent Spent Fuel Storage Installation (ISFSI)**
- **Inspection of Physical Security**

Objectives of the NRC Inspection Program

- **Objectively verify safe conduct of licensee activities**
- **Verify adequacy of licensee controls**
- **Ensure safety problems and violations are promptly identified and corrected and effective actions are taken to prevent recurrence**
- **Examine trends in licensee safety performance**

Examples of Core Inspection Procedures for Decommissioning

- **Organization, Management and Cost Controls**
- **Safety Reviews, Design Changes and Modifications**
- **Self Assessments, Audits and Corrective Actions**
- **Safety of spent fuel**
- **Occupational Radiation Exposure**
- **Inspection of Final Surveys**
- **Radwaste Treatment, Effluent & Environmental Monitoring**
- **Transportation of Radioactive Material**
- **Maintenance and Surveillance**
- **Physical Security**
- **Contingency response procedures**

Inspection Planning and Communications

- **Routine inspection schedule**
 - Planned about a year in advance
 - Coordinated with the program office in FSME
 - Adjustments to schedule made throughout the year as needed
- **Inspection planning and execution**
 - Inspections may be announced or unannounced
 - Approved Inspection Plans
 - Exit Meetings
- **Issue Inspection Report**
 - 30 day goal for normal inspection reports (post exit)
 - 45 day goal for team inspections (post exit)
- **Enforcement**
 - NRC enforcement policy**
<http://pbadupws.nrc.gov/docs/ML0934/ML093480037.pdf>

Post Inspection Activities

- **Prompt NRC management debrief**
- **Determination of any significant findings and enforcement**
- **Issue inspection report**

Most NRC inspection reports are publicly available. To locate reports, go to ADAMS web page (<http://www.nrc.gov/reading-rm/adams.html>), use advanced search feature with docket numbers 05000361, 05000362, and 07200041

- **Track and follow up on safety issues**

Decommissioning Funding NRC Requirements & Expectations

Michael Dusaniwskyj

Economist

Financial Analysis & International Projects Branch

Division of Inspection & Regional Support

Office of Nuclear Reactor Regulation

Decommissioning Funding Assurance

NRC regulates Safety not Commerce

The NRC has determined that the requirement to provide **reasonable assurance** of decommissioning funding is necessary to ensure the adequate protection of public health and safety. Pursuant to 10 CFR 50.75(b), a reactor licensee is required to provide decommissioning funding assurance by one or more of the methods described in 10 CFR 50.75(e) as determined to be acceptable by the NRC.

Decommissioning Funding Assurance

Decommissioning Funding is an obligation that is taken on when an NRC license is issued

The NRC has a comprehensive, regulation-based decommissioning funding oversight program in place to provide **reasonable assurance** that sufficient funds will be available for decommissioning and radiological decontamination for each US commercial nuclear facility to NRC standards and regulations. (Note: Site restoration or “GREEFIELD” is not under the NRC’s jurisdiction.)

San Onofre Nuclear Generating Station

- Funds are in a dedicated external decommissioning trust
- As of December 31, 2012 trust funds:
 - **Unit 2** - \$1,666,100,000
 - **Unit 3** - \$1,890,800,000
- **SONGS Unit 1** as of December 31, 2012:
 - Remaining trust funds - \$295,700,000
 - (Est.) remaining costs - \$206,500,000



NRC REGULATION OF SPENT FUEL AT SAN ONOFRE

D. Blair Spitzberg, Ph.D., Chief, Fuels Safety & Decommissioning Branch, NRC Region IV

Public Meeting on Nuclear Power Reactor Decommissioning Process

Carlsbad, California

September 26, 2013

Spent Fuel at SONGS

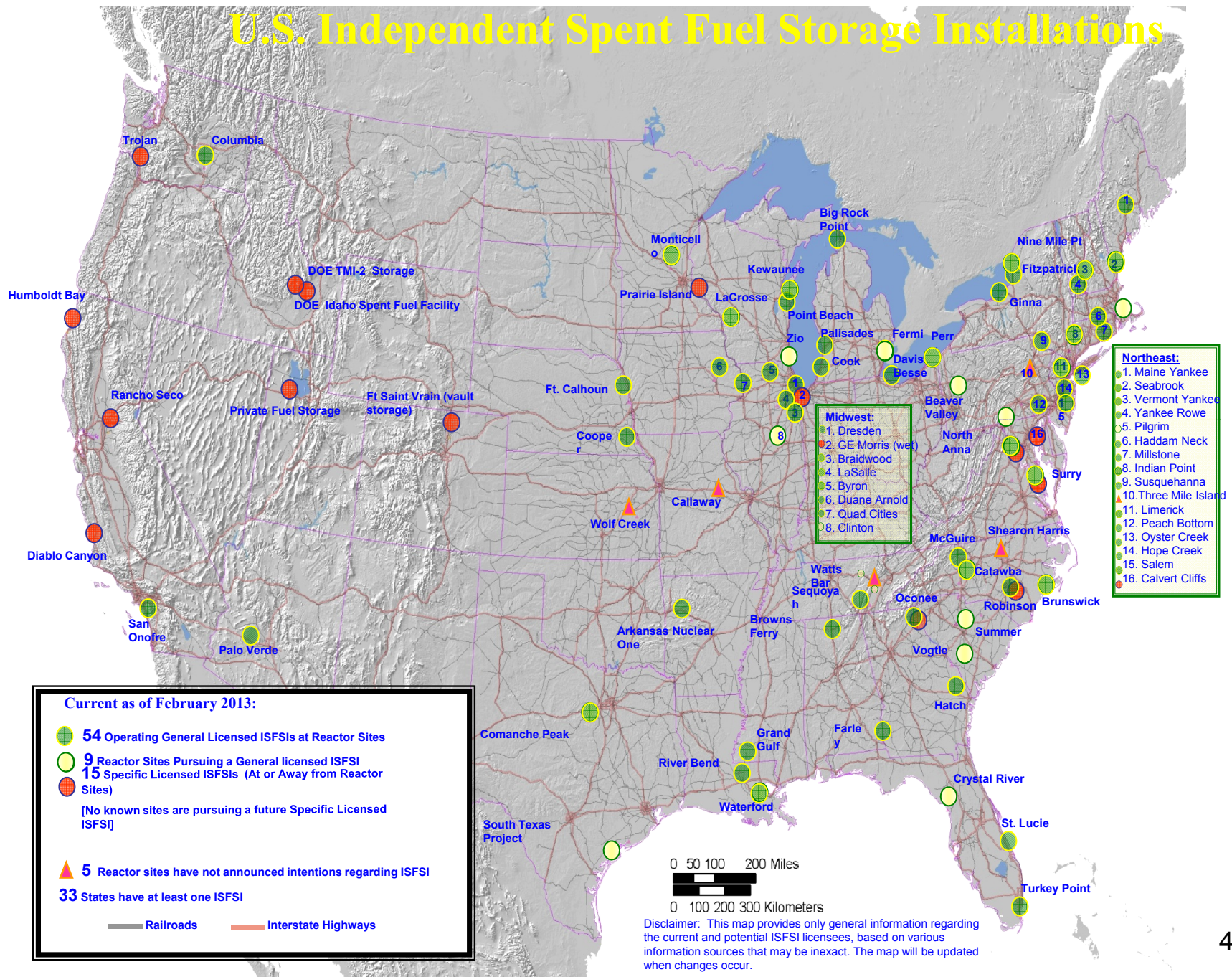
- Spent fuel must have active heat removal in a pool for several years after leaving the operating reactor. After this period, it can be passively cooled by air.
- Spent fuel is being safely stored at San Onofre in fuel pools and in the onsite Independent Spent Fuel Storage Installation (ISFSI).
- Spent fuel pools are able to withstand the same environmental hazard conditions as the reactors, and will be operated by certified fuel handlers who are on shift around the clock.
- Each spent fuel pool has redundant and independent cooling systems, power supplies, pool water sources, and other safety and emergency equipment.
- Both the spent fuel pools and the ISFSI are protected by the San Onofre Physical Security force and its associated security systems.

Need for an ISFSI

- The need for alternatives to spent fuel pool storage emerged in the 1970s.
- The Nuclear Waste Policy Act of 1982 and Amendments Act of 1987 laid out a process for licensing a geological repository.
- A geologic repository is still decades away
- Dry cask storage was developed to meet the need for expanded onsite storage of spent fuel due to the lack of a national repository available for use.
- SONGS ISFSI became operational in October 2003.



U.S. Independent Spent Fuel Storage Installations



SONGS ISFSI



Dry Shielded Canister



Horizontal Storage Module under construction



- SONGS uses the Transnuclear Advanced NUHOMS Horizontal Modular Storage System.
- Major components are the **Dry Shielded Canister (DSC)** and the **Horizontal Storage Module (HSM)**.
- Each DSC has an outer shell consisting of 5/8 inch thick stainless steel with steel internal spacer discs.
- The DSC has a welded internal confinement boundary and separate welded lid.

SONGS ISFSI



- The DSC is placed horizontally inside each AHSM module, into a steel support structure.
- The AHSM has thick steel reinforced concrete walls (>4 feet thick) and roof slabs (~5 feet thick) which provide additional structural protection to the canister and radiation shielding.
- The ISFSI pads are steel reinforced concrete with a minimum thickness of 3 feet.

SONGS ISFSI

Seismic Design Considerations

- The SONGS ISFSI is designed for high seismicity sites.
- The Design Basis Earthquake (DBE) used to analyze the SONGS ISFSI is 2.24 times higher than that used in the licensing of the San Onofre reactors.

Flooding/Tsunami Considerations

- The SONGS ISFSI is located 19.75 feet above sea level.
- The maximum flood condition of 29 feet was evaluated for the ISFSI which would potentially put the ISFSI pad under 9 feet under water. The design basis flood for the AHSM design is to withstand a submersion of 50 feet of water.
- The maximum tsunami, including storm height of the waves was evaluated at 27 feet for the SONGS ISFSI. This is less than the maximum flood conditions evaluated for the site.
- All evaluations do not take credit for the 28 foot tall sea wall which exist between the ocean and ISFSI.
- If the ISFSI were to get temporarily flooded during a tsunami, no adverse thermal effects would occur.

Inspection of Spent Fuel Storage

Spent Fuel Pool inspection

- Inspections of spent fuel pool safety will continue semi-annually using Inspection Procedure 60801 – “Spent Fuel Pool Safety at Permanently Shutdown Reactors.”

ISFSI inspection

- Routine ISFSI inspections are normally performed every 2 years following guidance contained in NRC Manual Chapter 2690 “Inspection Program for Dry Storage of Spent Reactor Fuel at Independent Spent Fuel Storage Installations and For 10 CFR Part 71 Transportation Packaging.”
- This Manual Chapter references the Inspection Procedures to be implemented.
- NRC attempts to schedule routine inspections during ongoing cask loading operations.

How to find NRC inspection guidance and reports

- NRC inspection guidance can be found on the NRCs website at <http://www.nrc.gov/reading-rm/doc-collections/#insm>
- Most NRC inspection reports are publicly available. To locate reports, go to ADAMS web page (<http://www.nrc.gov/reading-rm/adams.html>), use advanced search feature with docket numbers 05000361, 05000362, and 07200041.