U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

The US NRC's Power Reactor Decommissioning Process

Larry W. Camper, CIPM CEP

Director

Division of Waste Management and Environmental Protection

Office of Federal and State Material Safety and Environmental Management Programs

U.S. Nuclear Regulatory Commission

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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.

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and 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"

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

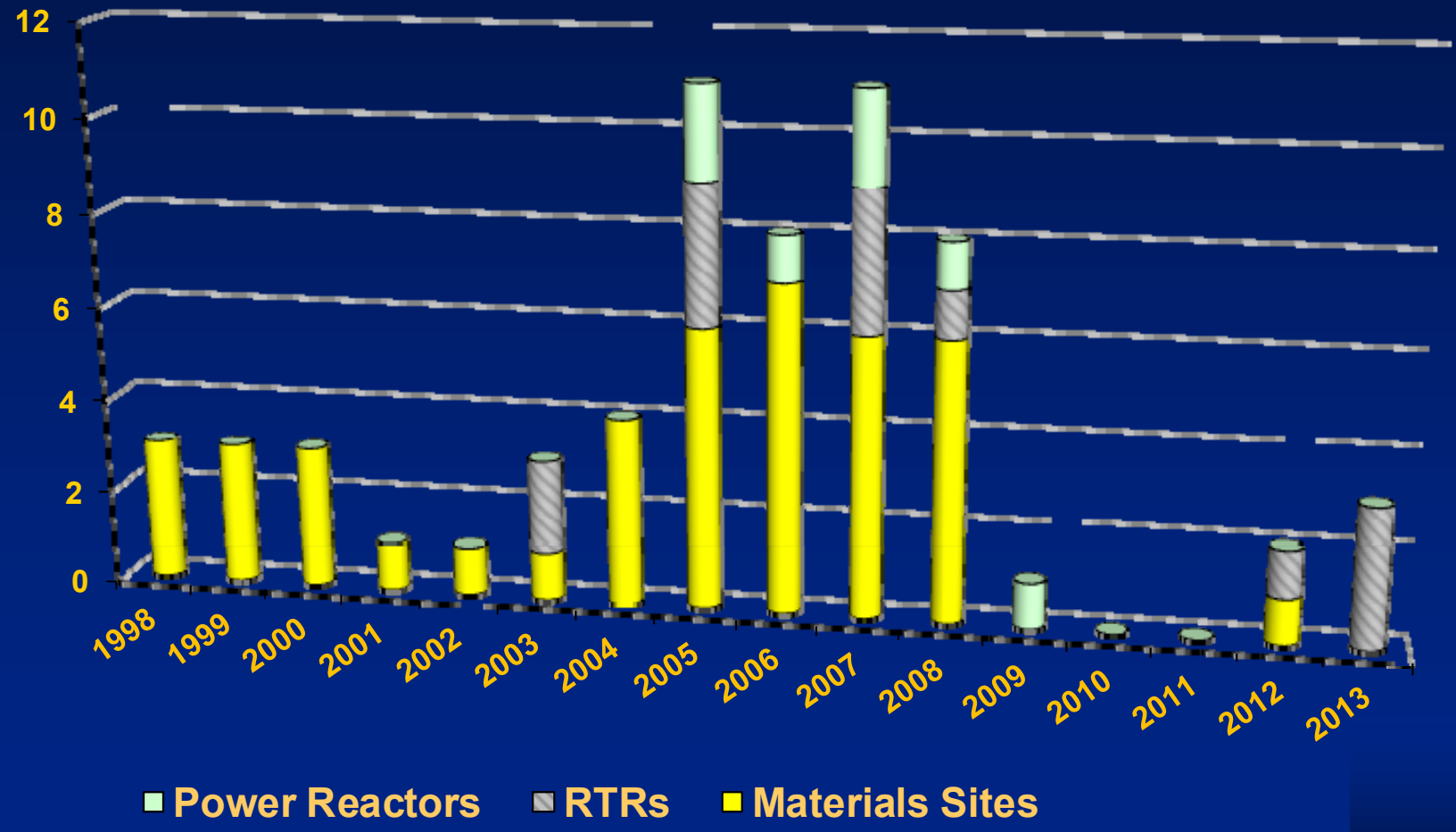
Decommissioning Staff Expertise

- 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

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Decommissioning Completions



U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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
- For Saint Vrain, 1997
- Shippingport, 1988

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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**

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Public Meeting Agenda

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

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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

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)

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)**

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
- Coincidently, corresponds well with 20 year life extension for multi-unit sites

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

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

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.

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

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

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

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.

Power Reactor Decommissioning Process

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

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

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***

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

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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**

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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**

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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**

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

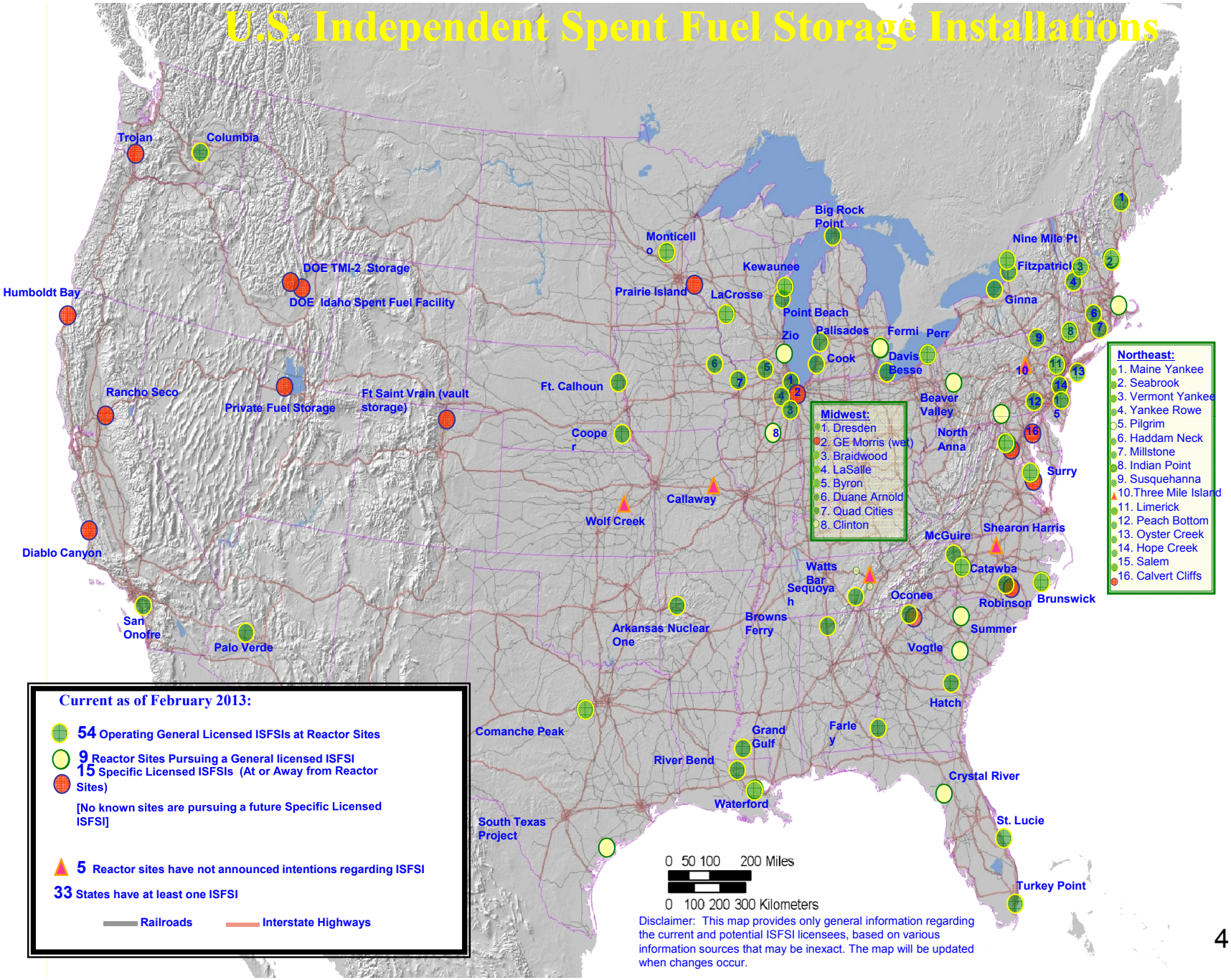
Spent Fuel at SONGS

- 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.

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

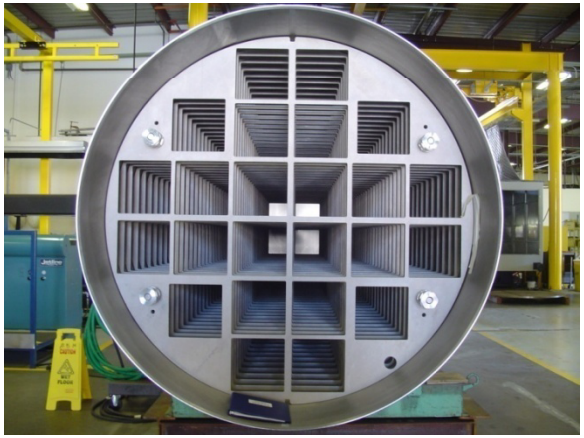
Need for an ISFSI

- 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
Trojan
Columbia
Humboldt Bay
DOE TMI-2 Storage
DOE Idaho Spent Fuel Facility
Rancho Seco
Private Fuel Storage
Ft Saint Vrain (vault storage)
Diablo Canyon
San Onofre
Palo Verde
Monticello
Prairie Island
Big Rock Point
Kewaunee
LaCrosse
Point Beach
Zio
Palisades
Fermi
Perr
Cook
Davis Besse
Ft. Calhoun
Cooper
Callaway
Wolf Creek
Midwest:
1. Dresden
2. GE Morris (wet)
3. Braidwood
4. LaSalle
5. Byron
6. Duane Arnold
7. Quad Cities
8. Clinton
Nine Mile Pt
Fitzpatrick
Ginna
Beaver Valley
North Anna
Surry
Northeast:
1. Maine Yankee
2. Seabrook
3. Vermont Yankee
4. Yankee Rowe
5. Pilgrim
6. Haddam Neck
7. Millstone
8. Indian Point
9. Susquehanna
10. Three Mile Island
11. Limerick
12. Peach Bottom
13. Oyster Creek
14. Hope Creek
15. Salem
16. Calvert Cliffs
McGuire
Shearon Harris
Catawba
Robinson
Brunswick
Watts Bar
Sequoyah
Oconee
Summer
Vogtle
Hatch
Arkansas Nuclear One
Browns Ferry
Comanche Peak
Grand Gulf
River Bend
Waterford
Farley
Crystal River
St. Lucie
Turkey Point
South Texas Project
Current as of February 2013:
54 Operating General Licensed ISFSIs at Reactor Sites
9 Reactor Sites Pursuing a General licensed ISFSI
15 Specific Licensed ISFSIs (At or Away from Reactor Sites)
[No known sites are pursuing a future Specific Licensed ISFSI]
5 Reactor sites have not announced intentions regarding ISFSI
33 States have at least one ISFSI
Railroads
Interstate Highways
0 50 100 200 Miles
0 100 200 300 Kilometers
Disclaimer: This map provides only general information regarding the current and potential ISFSI licensees, based on various information sources that may be inexact. The map will be updated when changes occur.

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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.

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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.

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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.

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

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.