Two Approaches to Reactor Decommissioning: 10 CFR Part 50 License Termination and License Amendment, Lessons Learned from the Regulatory Perspective

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ABSTRACT

Trojan Nuclear Plant (Trojan) and Maine Yankee Nuclear Plant (Maine Yankee) were the first two power reactors to complete decommissioning under the U. S. Nuclear Regulatory Commission's (NRC's) License Termination Rule (LTR), 10 CFR Part 20, Subpart E. The respective owners' decisions to decommission the sites resulted in different approaches to both the physical aspects of the decommissioning, and the approach for obtaining approval for completing the decommissioning in accordance with regulations. Being in different States, the two single-unit pressurized water reactor sites had different State requirements and levels of public interest that impacted the decommissioning approaches. This resulted in significant differences in decommissioning planning, conduct of decommissioning operations, volumes of low- level radioactive waste disposed, and the final status survey (FSS) program. While both licensees have Independent Spent Fuel Storage Installations (ISFSIs), Trojan obtained a separate license for the ISFSI in accordance with the requirements of 10 CFR Part 72 and terminated their 10 CFR Part 50 license. Maine Yankee elected to obtain a general license under 10 CFR Part 50 for the ISFSI and reduce the physical site footprint to the ISFSI through a series of license amendments. While the NRC regulations are flexible and allow different approaches to ISFSI licensing there are separate licensing requirements that must be addressed.

In 10 CFR 50.82, the NRC mandates public participation in the decommissioning process. For Maine Yankee, public input resulted in the licensee entering into an agreement with a concerned citizen group and resulted in State legislation that significantly lowered the dose limit below the NRC radiological criteria of 25 mrem (0.25 mSv) per year (yr) in 10 CFR 20.1402 for unrestricted use. The lowering of the radiological criteria resulted in a significant dose modeling effort using site-specific Derived Concentrations Guideline Levels (DCGLs) that were well below the NRC DCGL screening values. This contributed to a longer than anticipated period to obtain NRC approval of the Maine Yankee License Termination Plan (LTP).

By employing the lessons learned from its first LTP submittal, which was not accepted by the NRC staff, Trojan was able to obtain approval of its revised LTP promptly. While both licensees provided final status survey reports (FSSRs) for NRC approval, the Trojan approach to decommissioning and data management allowed NRC to efficiently review FSS records and supporting documentation. Therefore, NRC was able to review Trojan's FSSR more efficiently than Maine Yankee's FSSR. This paper describes the regulatory impacts of the two different approaches to the decommissioning, the development of licensee required plans, decommissioning operations and records, the differences in licensing processes, and the lessons learned for improving the processes.

BACKGROUND

The NRC regulates the decommissioning and license termination of approximately 80 complex, commercial nuclear facilities, including power, research and test reactors, material sites and fuel cycle facilities. The LTR provides requirements for either unrestricted release or restricted use. Specific requirements for power reactor "Termination of License" are described in 10 CFR 50.82, whereas §50.83 defines the requirements for the "Release of part of a power reactor facility or site for unrestricted use." Portland General Electric Company (PGE) elected to pursue license termination for the Trojan site in accordance with §50.82 and Maine Yankee Atomic Power Company (MYAPC) chose to use §50.83 to release the site backland areas and use §50.90 to reduce the Maine Yankee site footprint through a license amendment request.

Both Trojan and Maine Yankee had public, operational and economic issues that caused the two respective Boards of Directors to elect to close the plants. PGE faced the cost of replacing the Trojan steam generators and the lost power generation, and was affected economically by the less expensive hydro-electric power in the Northwest. Maine Yankee had operational issues with fuel performance and fire protection issues that would be expensive to resolve. These issues, coupled with the on-going opposition to nuclear energy in Maine, caused the MYAPC Board to close the plant.

Trojan was shutdown in November 1992. In January 1993, PGE decided to permanently shutdown the plant in order to begin decommissioning with the intent to terminate the Part 50 operating license with no restrictions on the future use of the site. Trojan proceeded to license its ISFSI in accordance with 10 CFR Part 72, and followed the §50.82 process for license termination. The Trojan LTP called for dismantling the radioactively contaminated steam supply and auxiliary systems while retaining the non- radioactive secondary systems, including the turbine and condenser for future re-use or re-cycling. In addition, all concrete structures including the containment, fuel and auxiliary buildings, were decontaminated for unrestricted release. Since there was no groundwater contamination found during site characterization prior to major decommissioning activities, PGE elected to use the NRC's Screening Level - DCGLs for demonstrating compliance with the 10 CFR Part 20, Subpart E.

Maine Yankee was shutdown in December 1996 with the MYAPC Board of Directors electing to permanently shutdown the plant in August 1997. Unlike Trojan, Maine Yankee had well established intervener groups that solicited the State of Maine to impose lower dose criteria on Maine Yankee. The State of Maine required that Maine Yankee comply with a 4 mrem (0.04 mSv) per year drinking water limit and a 10 mrem (0.1 mSv) per year limit from all sources. The State of Maine also required additional long term monitoring, and the out-of-state disposal of decommissioning concrete waste. In order to fulfill the State requirements, the Maine Yankee LTP called for the removal of all site structures to 3 feet (ft) below grade and the removal of all debris from the State.

DECOMMISSIONING PERFORMANCE

Table I shows general decommissioning information for the Trojan and Maine Yankee projects. A discussion of the information follows:

Trojan: Trojan permanently shutdown in January in 1993. Being one of the first large nuclear plants to start decommissioning, PGE had to address new issues, such as steam generator and reactor vessel removal and disposal, the LTP approval process and its approach to decommissioning. PGE chose to perform the radiological decommissioning while leaving major structures intact, including the containment, auxiliary and turbine buildings, and while leaving the major non-contaminated secondary steam system; turbine, condenser, moisture separators and piping, in place. One objective was to minimize radioactive waste volumes and recycle as much material as practical. Trojan generally has met this goal based on only having to dispose of 12,375 cubic meters (m^3) of radioactive waste, and plans to recycle concrete and metal when the industrial demolition of the site is performed. The total dose for completing the radiological decommissioning was 335 Rem (3.35 Sv) and was well below the decommissioning estimate. The NRC terminated the Trojan 10 CFR Part 50 license on May 23, 2005.

Maine Yankee: Maine Yankee was shutdown in August 1997 and started decommissioning in the same month. To achieve unrestricted use, the decommissioning approach focused on removal of all site structures to 3 ft below grade. All aboveground structures were removed, and approximately 100,000 m^3 of radioactive waste was disposed of offsite. During its eight-year decommissioning period, Maine Yankee had a total dose of approximately 515 Rem (5.15 Sv) and was well below the Generic Environmental Impact Statement goals. It is reasonable that Maine Yankee incurred more dose than Trojan due in part to a higher source term having failed fuel and the shorter time period from the shutdown to the start of decommissioning activities. On September 30, 2005, the NRC amended MYAPC's 10 CFR Part 50 general license reducing the site to a 12-acre parcel of land.

Table I. Comparative Decommissioning Project Data for Trojan and Maine Yankee

Issue	**Trojan**	***Maine Yankee***
Shutdown Date	November 1992	*August 1997*
Decommissioning Started	January 1993	*August 1997*
Decommissioning Completion Date	January 2005	*October 2005*[(1)]
Total Time for Decommissioning	12 Years	*8 Years*
Total Dose	335 Rem (3.35 Sv)	*515 Rem (5.15 Sv)*
Radioactive Waste	12,375 m^3	*100,000 m^3*
Cost	~ $ 422 M	*~ $420 M*
NRC Licensing Action	*Part 50 License Termination May 23, 2005*	*Part 50 License Amendment September 30, 2005*

Note: Contaminated soil/debris from decommissioning stored at ISFSI shipped offsite.

REACTOR DECOMMISSIONING REGULATORY PROCESSES

The decommissioning process for reactor licensees is outlined in Table II. This table compares the decommissioning process for reactors with 10 CFR Part 72 specific ISFSI licenses to the process for 10 CFR Part 50 general ISFSI licenses. The process is principally the same with some minor differences. After the ISFSI is completed and decommissioning activities are complete, licensees with Part 72 specific ISFSI licenses may request to terminate the Part 50

license. On the other hand, licensees with Part 50 general ISFSI licenses may request a license amendment to reduce the boundary of the license to the footprint of the ISFSI. In both requests, the licensee must demonstrate that the §50.82 requirements have been met. The NRC handles both requests by noticing the request in the Federal Register, reviewing the FSSR, issuing a Safety Evaluation Report (SER), and issuing the respective approval, either for the amendment or termination. One additional administrative action required for the Part 72 specific ISFSIs, is that licensees must request an exemption from 10 CFR 72.3(c)(5), to transfer financial assurance methods from the Part 50 to Part 72 license. The NRC staff completes the SER and environmental review (or if required, an Environmental Impact Statement), publishes a Notice of the licensing action in the Federal Register and approves the request. Each licensee must continue to maintain $100 M in nuclear liability insurance for the ISFSI. One final internal action for Part 50 licensees is the transfer of project management responsibilities from the Division of Waste Management and Environmental Protection (DWMEP) to the Spent Fuel Project Office (SFPO). From the NRC perspective, the differences between the two licensing processes are very minor.

Table II. Reactor Decommissioning Licensing Process

Part 72 Specific ISFSI License	**Part 50 General License**
Licensee obtains Part 72 license. Licensee completes decommissioning.	Licensee completes decommissioning.
Licensee submits FSSR to NRC for approval.	Licensee submits FSSR to NRC for approval.
Licensee submits request to terminate Part 50 license. Licensee requests exemption from 10 CFR72.30(c)(5) to transfer financial assurance methods from Part 50 to Part 72. ISFSI is licensed under specific Part 72 license.	Licensee submits license amendment request to shrink boundary of site to the footprint of the ISFSI.
NRC notices licensee's request in Federal Register.	NRC notices licensee's request in Federal Register.
NRC approves FSSR, prepares license termination letter, SER, and Federal Register Notice. - Licensee required to maintain $100 million in nuclear liability insurance until all spent fuel removed from the ISFSI.	NRC approves FSSR, prepares license amendment, SER, and Federal Register Notice. - Licensee required to maintain $100 million in nuclear liability insurance until all spent fuel removed from the ISFSI.
SFPO has project management responsibility for Part 72 ISFSI license.	Project management responsibility for Part 50 generally licensed ISFSI transferred from DWMEP to SFPO.

LESSONS LEARNED

The NRC is always seeking ways to improve the decommissioning process. Because Trojan and Maine Yankee were decommissioning at the same time, the NRC staff was able to compare the decommissioning processes used by both reactors and identify a number of lessons learned that can be used by other licensees to improve the decommissioning process. In the following discussion, the staff offers lessons learned in the areas of communications, LTP development and implementation, and FSS records. Maine Yankee, in conjunction with the Electric Power

Research Institute (EPRI), also documented lessons learned from its entire decommissioning experience which is available from EPRI at www.epri.org and http://www.maineyankee.com/.

Communications

Effective, open communication between the NRC and licensee at the staff level is more efficient for resolving policy and technical issues than efforts to resolve issues at the management level. Differing communication methods were undertaken by Trojan and Maine Yankee during the final stages of their decommissioning projects and are described below.

Trojan: PGE's approach for communicating with the NRC staff relied heavily on communications between the Trojan Licensing Manager and the NRC Project Manager to resolve policy and technical issues. Policy issues addressed during decommissioning (including Price –Anderson insurance issues and issues regarding clearance) were coordinated by the NRC Project Manager. Groundwater monitoring and the potential for contamination behind painted surfaces were technical issues that developed during the course of the decommissioning. These issues were resolved between the NRC and Trojan staffs. In many cases, NRC technical discussions were held with the Trojan staff during inspections, which most importantly lead to an agreement on the content and format of the FSSRs that facilitated the NRC review. Trojan addressed most FSS issues during inspections. The Trojan communication approach was efficient and effective because there was no need to schedule meetings with NRC management to resolve issues. It also resulted in a significant savings in resources for both PGE and the NRC staff.

Maine Yankee: MYAPC elected to use a different communication approach, which relied on frequent discussions between Maine Yankee management and NRC management to resolve policy, scheduling, and technical issues. For example, at Maine Yankee's request, bi-weekly telephone conference calls were held between NRC and Maine Yankee staff and senior management to discuss NRC's schedule for review of the FSSRs. In addition, several meetings, in which the public was invited, were held with Maine Yankee to discuss technical issues. Discussions were held on the content and format of the FSSRs, the LTP requirements for determining contamination at depth in concrete, and MARSSIM guidance. Technical issues were resolved via the formal NRC Request for Additional Information (RAI) process and written responses from Maine Yankee, rather than discussions between the NRC and Maine Yankee staffs. On-site inspections by NRC Region I and headquarters personnel verified the resolution of technical issues.

Maine Yankee management involvement in all aspects of the decommissioning process appears to have been driven by the desire to complete decommissioning as soon as possible. However, management involvement in the resolution of all technical issues actually may have prolonged the decommissioning.

LTP Development and Implementation

Licensees should produce a clear, concise, and detailed LTP because it results in quicker approval of the LTP. Further, a clearly written LTP requires less interpretation and allows the

NRC to easily verify compliance with approved LTP requirements. The following discussion describes how the Trojan and Maine Yankee LTPs affected the decommissioning process.

Trojan: PGE took a straightforward approach to the Trojan LTP and the decommissioning. In the original site characterization, no groundwater contamination was found, so Trojan adopted the NRC Screening level DCGLs versus the development of site specific DCGLs. This simplified the approach for demonstrating that the residual radioactivity would be less than the 25 mrem/yr criteria. Trojan's goal was to release the site for unrestricted use. The Trojan FSS Plan employed a conservatively modified MARSSIM methodology, which required a minimum of 30 samples to be taken in each survey unit. Most radiological measurements did not subtract background. In addition to the MARSSIM beta surface measurements, Trojan recognized the importance of performing gamma surveys to determine the presence of contamination-at-depth on concrete structures and in the floor-wall interfaces. PGE also planned for the future removal of the spent fuel from the site and performed FSSs of the ISFSI footprint prior to construction. The Trojan LTP was approved by the NRC in 18 months and over the course of the decommissioning, there were no major revisions to the LTP.

Maine Yankee: Maine Yankee's LTP was written with very broad and general methods for demonstrating compliance with NRC requirements and guidance. Although licensees generally believe that a less specific LTP allows for greater decommissioning flexibility, the potential for differing interpretations of the LTP commitments by NRC and licensee staffs is increased. The different interpretations during the LTP review lead to numerous meetings and teleconferences to resolve NRC questions, which required 37 months for LTP approval.

As permitted by the NRC in Part 50, licensees can revise the LTP using the 50.59 process. During the course of the decommissioning, the LTP was revised by Maine Yankee three times. Most of the changes were updates to the LTP citing the physical progress in the decommissioning the site. However, there were changes to the technical methods and survey requirements that impacted the staff review of FSSRs.

FSS Records

The FSSR demonstrates that residual radioactive material at the site does not exceed the NRC criteria for release of the site. NRC reviews the FSSR to verify that the results of the FSSs demonstrate that the site meets the radiological criteria for license termination. As part of the FSSR review process, NRC may review a variety of records associated with the FSSR such as actual survey data packages, FSS instrument calibration records, and survey technician qualification and training records.

Resulting from the Trojan and Maine Yankee reviews, there are a number of lessons to be learned regarding FSS records: (1) the licensee and regulator should agree on the format and content of the FSSR; (2) records supporting the FSSR (i.e. FSS data, instrument calibration logs, and technician qualification and training records) should be readily retrievable for inspection; and (3) FSSR supporting records should be of high administrative quality.

As previously discussed, Trojan and Maine Yankee requested input from the NRC staff on the format and content of the FSSRs with the intent of facilitating NRC's review. The discussion below describes the FSSR review process for the two licensees.

Trojan: Trojan submittals followed the original agreed-upon format, were consistent, and of high administrative quality, which allowed the NRC staff to review the information efficiently. Of the 10 FSSR Supplements containing 510 FSS records submitted by Trojan, the NRC staff had two RAIs, which were promptly resolved. Overall, the Trojan staff designed quality survey packages, managed the survey data and documentation, and provided FSSRs that were consistent with the agreed upon format and content. In addition, the records that supported the FSSRs were complete and comprehensive.

Maine Yankee: The content of the FSSR was described in the LTP. However, because the LTP was general in nature, Maine Yankee provided general FSS records. In response to review of the 12 FSSR Supplements, containing 180 FSS records submitted by Maine Yankee, the NRC staff submitted 60 RAIs. In the LTP, Maine Yankee committed to use MARSSIM as the basis for performing the FSSs. However, in some instances the staff questioned Maine Yankee's implementation of the MARSSIM process as discussed below. These areas required additional information from Maine Yankee.

- For several Class 1 survey units, 100% beta surface scans were not performed and documented on all structure surfaces as required. To resolve this RAI, Maine Yankee provided data from remediation surveys to validate the areas missed during the FSS were below the DCGL.

- A pre-requisite to performing beta surface scans was to demonstrate no contamination-at-depth in the concrete structures specifically at floor-wall interfaces. During an inspection Maine Yankee was unable to promptly provide all the gamma survey data demonstrating that no contamination was present at depth. To resolve this RAI, Maine Yankee provided the data that demonstrated that surveys or sampling had been performed at all floor and wall interfaces to ensure there was no contamination at depth. However, the search took time and delayed the staff's review of the FSSR.

In addition, the NRC staff raised questions regarding the quality of the FSS supporting documentation. Maine Yankee was able to resolve these issues but it took time to recover archived information due to data management practices. To facilitate the NRC review, technical reviewers conducted two additional site inspections to specifically review Maine Yankee records that supported their FSSR submittals.

Table III outlines the review of Trojan's and Maine Yankee's FSSRs.

Table III. Final Status Survey Report Data Summary

	Trojan	**Maine Yankee**
FSSR Supplements	10	12
Average No. of FSS Release Records per Report	51	15
Formal RAIs Submitted – Total Comments	1 RAI with 2 Comments	10 RAIs with 60 Comments
Avg. Time to Resolve Issues	0.25 Months	5 Months
FSSR Re-submittals	0	3
Issues Referred to Regional Inspectors as Open Items	0	8
FSSR Review Schedule	3 months ahead of original schedule	8 months behind original schedule
NRC Staff Resources	1 X	~ 6 X

CONCLUSIONS

- From an NRC perspective, there is no significant difference in the two licensing approaches at the completion of decommissioning.
- Technical issues should be resolved at the staff level when possible to ensure most efficient use of resources.
- LTPs should have sufficient detail to allow all stakeholders to understand the process to be followed.
- Data management and quality control is critical to formulating FSSRs.
- A clear, concise, good quality FSSR makes the review process more efficient. In general, a technical writer is recommended.

REFERENCES

1. NUREG 1575, Multi-Agency Radiological Site Survey and Investigation (MARSSIM) Manual, December 1997.
2. NUREG 1757, Consolidated NMSS Decommissioning Guidance, September 2003.
3. NRC Proceedings - Decommissioning Workshop, University of Maryland at Shady Grove, Maryland, April 2005.