License Stewardship Approach to Commercial Nuclear Power Plant Decommissioning – 8404

P. T. Daly, W. J. Hlopak Commercial Services Group, EnergySolutions 1009 Commerce Park Drive, Suit 100, Oak Ridge, TN 37830

ABSTRACT:

The paper explores both the conceptual approach to decommissioning commercial nuclear facilities using a license stewardship approach as well as the first commercial application of this approach. The license stewardship approach involves a decommissioning company taking control of a site and the 10 CFR 50 License in order to complete the work utilizing the established trust fund.

INTRODUCTION:

The license stewardship approach to commercial nuclear power plant decommissioning is envisioned as an innovative method of mitigating risk for both the utility, its rate payers and the company (contractor) performing the decommissioning. The approach involves the transfer of the assets and liabilities of a shutdown nuclear power plant (including management of spent nuclear fuel), the 10 CFR 50 License, and the decommissioning fund from a plant's owner to a company with a core competency in nuclear decommissioning. It is then the contractor's responsibility to decontaminate and decommission (D&D) the plant and terminate the License, or modify the License to cover only the on-site storage location of the spent nuclear fuel (Independent Spent Fuel Storage Installation – ISFSI).

This approach has many advantages, especially to owners of multiple generating plants, as it reduces or caps their risk associated with decommissioning the shutdown facility and allows the utility to focus on their revenue generating plants. The upside for decommissioning contractors is that it allows them to control the work, the schedule, and the management of the trust fund. Ultimately, license stewardship allows all companies to focus on their core competencies and business lines; generating electricity for the utility, and D&D for the decommissioning contractor.

Despite its appeal, the license stewardship approach does not come without its obstacles. A few of the major hurdles that have to be understood or overcome by the parties involved include: verifying the adequacy of the trust fund to complete the scope of work, substantiating the financial assurance of the contractor, corroborating the technical adequacy of the contractor to maintain NRC license conditions, and determining the role of incumbent employees. Schedule drivers also influence the decision on the viability of this approach. Owners wanting a very aggressive D&D schedule negotiated into the transfer agreement may inadvertently limit the D&D options available to the decommissioning contractor due to limiting the years available for trust fund growth. These issues are not insurmountable, though, and most often they are handled early in the process of negotiating the license stewardship.

To date commercial decommissioning projects have suffered from a myriad of problems when they use the typical approach of the utility overseeing the decommissioning contractor. These problems vary by site, and can encompass a wide array of topics such as having a differing understanding of the scope of work, underestimating the volume of low level waste, ineffectively dealing with the technical challenges, not allowing adequate preparation and planning time which leads to staffing problems, or conflicts arising between owners and subcontractors. Although the license stewardship approach does not completely eliminate these problems, it forces both the owner and the decommissioning contractor to take a close look at a majority of the issues while it is still early in the decommissioning planning process. It also allows the owners who want to strictly focus on power generation to bound their decommissioning risks and make the decommissioning contractor responsible for:

- License Termination (10 CFR 50) for the existing fund value plus future interest income;
- Disposal of all low level waste;
- Procuring, fabricating, and packaging the spent nuclear fuel in a dry fuel storage facility (ISFSI);
- Environmental remediation;
- Satisfying future federal and state regulatory changes and;
- Meeting local community expectations.

The options available to the utility and the contractor for use and ownership of the land following completion of the decommissioning must also be taken into consideration while negotiating the license stewardship agreement. In addition to discussing the transfer of the assets and liabilities of the facility and 10 CFR 50 License, the agreement should communicate the transfer or lease of the land, depending on the needs of the owner. The land can be leased and then returned to the utility at the end of the project, once the License has been terminated or amended to include only the ISFSI. Or, the agreement can include transfer of ownership of the land and the spent fuel to the contractor, giving him the responsibility to manage the ISFSI until the DOE begins accepting the fuel for final disposal. There are many intermediate options, and the one chosen is dependent on the owner's desires as well as the adequacy of the trust fund (with expected growth) as compared to the site specific decommissioning and spent fuel management estimate.

As with any regulated activity, the role of the regulatory agency is critically important. In this case, the U.S. Nuclear Regulatory Commission (NRC) was initially briefed on the proposed approach early in its conceptual development. They were most interested in ensuring that the recipient of the transferred license can satisfy regulatory criteria related to financial assurance and technical competence. The latter concern is focused mainly on the technical competence of the decommissioning contractor to maintain the current site licensed conditions while accomplishing the decommissioning. The decommissioning contactor need not demonstrate that it has the technical qualifications to operate the facility.

The NRC's concern in regards to financial assurance focuses on assuring that the new licensee is able to complete the decommissioning project. The main element of financial assurance is the decommissioning trust fund that, in turn, is underpinned by a detailed baseline estimate and schedule. The new licensee must demonstrate financial assurance without relying on the utility customers that backed up the original utility owner, since they are no longer contributing to the

fund. In addition, it may be necessary to provide additional financial assurance in the form of a bond, letter of credit, parent guarantee, or other financial mechanism to assure that adequate finances are available to complete the work.

CASE STUDY ZION NUCLEAR STATION:

Zion*Solutions*, a wholly owned subsidiary of Energy*Solutions*, is using the license stewardship approach at the Zion Nuclear Station, in Zion, Illinois. Exelon, the plant's owner, will transfer the 10 CFR 50 License, all site assets, and the decommissioning fund to Zion*Solutions*, along with leasing the land to Zion*Solutions* for the duration of the project. Considering that this effort is very early in its implementation, we will concentrate on the activities that lead up to transfer of ownership and the start of on-site D&D work, primarily from the decommissioning contractor's viewpoint. As mentioned briefly above, and discussed in detail in later sections, there is much that needs to be done by all parties involved to prepare for and carry out the license stewardship.

The Zion Nuclear Station represents the largest commercial nuclear power plant decommissioning project to date within the US. There are several first-time accomplishments on the Zion project that will add to its complexity. The following are among the firsts for a commercial nuclear power plant decommissioning project:

- The first 10 CFR 50 License stewardship decommissioning project;
- The first two-unit plant to be decommissioned and;
- The largest dry fuel storage campaign to date.

These challenges, however, are among the reasons that Energy*Solutions* selected Zion for its initial license stewardship project. The advantages of controlling the work and the schedule, along with management of the trust fund, while focusing on Energy*Solutions* core competency of D&D significantly outweigh the perceived issues that the size of the project and the first-time accomplishments evoke. Being able to avoid the problems that have arisen on previous decommissioning projects following the traditional approach of the utility managing a D&D contractor is essential for success on a project of this magnitude.



Zion Nuclear Station located 40 miles north of Chicago in the city of Zion, IL

Background:

Zion consists of two essentially identical Westinghouse pressurized water reactors with supporting facilities. Both units were licensed for operation in 1973 and operated until the decision to permanently shutdown the station was made in January 1998 based on an economic analysis of necessary plant upgrades, such as steam generator replacement, and the market conditions at the time. The units were defueled, permanent shutdown was certified to the NRC, and the Licenses amended. Since then the station has been in a state of SAFSTOR with all fuel located in the spent fuel pool, while continuing to utilize the main electrical generator(s) as synchronous condensers to provide stability to the electrical grid in northern Illinois.

Exelon's original plan was to commence D&D planning in 2013 and start D&D operations in 2015 using the typical approach of the utility overseeing the decommissioning contractor, with site restoration scheduled for completion in 2028. As seen in Figure 1, Zion*Solutions* Project Level One Schedule, under the license stewardship approach the project is expected to start in 2008 and be completed in 2018 when the final milestone, the amendment to the 10 CFR 50 License, is met.

The License Stewardship Process:

A workforce with a broad knowledge base is an important component of the license stewardship process, since there are a wide variety of topics and issues that have to be understood and handled during the process. Energy*Solutions* assembled a team with a broad experience base by primarily drawing on employees from various divisions within the company, and supplementing them with selected subcontractors and consultants with specific expertise in key areas. The experience base of the employees that were used on the team included those who had worked on Big Rock Point, Connecticut Yankee, East Tennessee Technology Park Three Building D&D Project, plus numerous smaller D&D projects. This team worked together to complete the scheduled activities, prepare the transfer documentation and agreements, and conduct negotiations to finalize the license stewardship approach.

In order to control the time and cost of implementing this novel approach, Energy*Solutions* planned and executed the license stewardship process as a project itself. The various activities were scheduled and budgeted, and then tracked on a monthly basis in order to ensure that progress was being made and the costs were within budget. Although some activities extended past their scheduled duration due to the involvement of multiple organizations with differing priorities, the overall project proceeded on time and within budget.

The following activities that were performed during the license stewardship process are discussed in more detail in later sections:

- Due Diligence of the Zion Station and records
- Baseline Schedule and Estimate to complete decommissioning
- License Transfer Process
- Agreement Structure
- Back Up Financial Agreement

Due Diligence:

Obviously, one of the first things that the decommissioning contractor wants to know before proceeding too far with the license stewardship approach is whether the plant is in an acceptable financial and physical condition for transitioning the License and assets, whether all required documentation and records are being adequately maintained, and whether there are any liabilities that would preclude a company from taking ownership. To make these determinations, a due diligence process was undertaken. This review process required the involvement of both Energy Solutions personnel and their subcontractors/consultants, and multiple departments within Exelon. Making this task challenging, the activities were conducted while a majority of the Exelon personnel at the Zion Nuclear Station and in their corporate office were unaware that a license stewardship approach was under consideration. Only a few, top-level Exelon employees were even being told about the license stewardship. Therefore, visits to the plant were limited, personnel interviews were restricted to a select few Exelon individuals, and requests for information or documentation were not always fulfilled expeditiously. However, a few, key, knowledgeable individuals from Exelon were available to answer questions and obtain information for the due diligence team, and EnergySolutions was able to gather sufficient information, present the findings to top level management and the board of directors, and make the determination to proceed with the license stewardship approach.

In addition to Energy*Solutions* performing a due diligence of the Zion Station, Exelon also conducted a review of the financial strength and the technical expertise of Energy*Solutions*. This was a necessary step for them, since they would ultimately be turning over the decommissioning fund, and needed to assure themselves that the company receiving it would be able to not only complete the decommissioning, but would be able to do it within the amount of the decommissioning fund plus expected interest earned, and have enough funds remaining to manage the ISFSI until the DOE begins accepting the fuel for final disposal.

Baseline Schedule and Estimate:

The Baseline Schedule and Estimate is another important piece of information that a decommissioning contactor and the utility need to know before continuing too far with the license stewardship approach. Besides knowing that the estimate to perform the work is within the value of the decommissioning fund plus expected interest earned, the contractor and utility also need to know what period of time is required to perform the decommissioning. The schedule and estimate is not only important for determining the cash flow, but also for negotiating a completion date should the utility want an aggressive schedule to completion.

The baseline schedule and estimate was also developed before most of the Exelon personnel at the Zion Nuclear Station and in their corporate office knew that a license stewardship approach was being considered. Therefore, obtaining information from sources that would typically be done during development of a baseline schedule and estimate was limited to what Exelon would allow. To complete the schedule and estimate, Energy*Solutions* relied on information that was readily available from previous decommissioning estimates that had been developed for the Zion Station, along with a limited number of engineering drawings. The previous decommissioning

estimates were primarily utilized to determine the quantity of material in the buildings, along with the anticipated radiological status. Energy*Solutions*' approach to D&D of the buildings was applied to the information obtained from the previous estimates, and a cost estimate and schedule were developed. Exelon had a third-party review of the schedule and estimate performed to check for accuracy and reasonableness.

Figure 1, Zion*Solutions* Project Level One Schedule, is a roll-up of a detailed schedule that was developed along with the Baseline Cost Estimate starting early in the process of license stewardship. The schedule shows that Zion*Solutions* expects the project to take 120 months, with the end state criteria defined as the site being restored to greenfield status, the 10 CFR 50 License amended to release the land with the exception of the ISFSI, and the land and the License returned to Exelon.



Figure 1. ZionSolutions Project Level One Schedule

The critical path activities are not highlighted in the Zion*Solutions* Project Level One Schedule, but in the early years of the project they include removing the Unit 1 reactor vessel and internals while major component removal takes place in Unit 2. In parallel with these activities, the preparation for the dry fuel storage campaign also begins; including the selection of a canister vendor, design of the ISFSI, and characterization/inspection of the fuel assemblies. To keep these activities on track while the license stewardship was being negotiated, engineering studies and initial planning work was performed, with the focus on the critical path activities and the dry fuel storage campaign.

Zion*Solutions* plans to move all major components and debris by rail for disposal at a low level waste (LLW) disposal facility. This will require the addition of a significant amount of rail spur line, loading enclosures, and logistical controls. Figure 2 depicts the conceptual approach for handling a large number of rail cars on site and the loading enclosures that are envisioned for each containment structure.



Conceptual Site Modifications

Figure 2. Rail Spur Layout for Bulk Handling of Waste Material

Cost and schedule efficiencies are achieved by utilizing large gondola rail cars (see Figure 3) and the rip and ship approach. This approach seeks to benefit from taking contaminated or potentially contaminated material out in bulk and shipping it by rail to a LLW disposal facility. This eliminates the labor intensive survey and decontamination methods used to segregate waste streams. This acknowledges one of the most significant lessons learned from previous commercial power plant decommissioning projects – which is the difficulty of successfully implementing the surgical decontamination approach. It also reduces schedule duration (thus cost) and eliminates the risk for inadvertent release of radiological material to a local landfill.



Figure 3. EnergySolutions Super Gondola Cars

License Transfer Process:

The transfer of a 10 CFR 50 License between generating companies is a process that has been undertaken numerous times with the NRC in conjunction with the sale and transfer of operating nuclear power plants. The case of license stewardship provides a variation to the normal license transfer, since the license is not being transferred to a company with a background in generating electricity or operating nuclear power plants. However, given the SAFSTOR condition of the plant at the time of the transfer, and the expertise required to safely decommission the plant, it is fully justifiable for the NRC to authorize the transfer from the utility to the decommissioning contractor.

The NRC had two areas of concern early in their process of reviewing and approving the application for transfer of the 10 CFR 50 License; 1) financial assurance, since Zion does not have a path back to rate payers for cost overruns or unknown liabilities; and 2) technical competence, since Energy*Solutions* has never owned or operated a nuclear power plant before. To help them address these concerns, Energy*Solutions* provided several documents along with the License transfer application, and held frequent discussions with the NRC.

The primary document used by Energy*Solutions* to justify transfer of the license was the revision to the Zion Nuclear Station Post-Shutdown Decommissioning Activities Report (PSDSAR), which included the site specific cost estimate and baseline schedule. The estimate and schedule were developed to provide assurance to Energy*Solutions* and Exelon that the decommissioning could be completed as planned, and when combined with the PSDAR, they provided a sound basis for the NRC to evaluate the adequacy of the fund and the technical approach to completing the decommissioning.

The concern with Zion*Solutions*' technical competence was also addressed in communications with the NRC. Zion*Solutions* reassured the NRC that they would maintain the current site licensed conditions by capturing key incumbent employees to the extent possible to continue performing their duties per the License, or subcontracting with Exelon to provide License-related services. Additionally, it is important to note that the Zion Nuclear Station has been in SAFSTOR for a period of 10 years, with the 10 CFR 50 License amended to cover the defueled, permanently shutdown condition. Thus it is reasonable and prudent to transfer the License and the assets to a company with a core competency in decommissioning and fuel management.

The NRC's concern with Energy*Solutions*' financial assurance was also addressed by a letter of credit that was obtained by Zion*Solutions*. Although this is not required by any of the NRC's regulatory or guidance documents, it was put in place as a provision to assure that the end state would be met.

Agreement Structure:

The Asset Sale Agreement provided the means for transferring the site's assets; including all structures, equipment, tools and fixtures; the decommissioning trust fund; license interests including the License to possess Spent Nuclear Fuel; and all documentation associated with Zion Nuclear Station. The Agreement excluded the transfer of the land, which was covered under a Lease Agreement, and the ownership of the Spent Nuclear Fuel, which is retained by Exelon under a general license of ownership.

In consideration for obtaining the above assets, Zion*Solutions* assumed all liabilities associated with decommissioning the two units, managing the spent fuel during the project, restoring the site at project completion, dealing with any environmental issues, and handling other liabilities that are detailed in the Asset Sale Agreement or arise during the course of the project. Closing on the agreement was contingent upon the NRC approval of the 10 CFR 50 License transfer.

The license stewardship approach used at Zion incorporates leasing the land to Zion*Solutions* and then returning it to Exelon at the end of the project. This approach was selected by Exelon since they wanted to retain ownership for possible future use of the property. They also have not determined what the final disposition of the land will be once it is returned to them. The location on the shores of Lake Michigan, with a state park immediately north and south of the station, gives Exelon several viable options for use or sale of the land once it has been restored to greenfield status and released from License conditions with the exception of the ISFSI.

The Lease Agreement covers the terms and conditions for use of the land to complete the decommissioning, defines the end state criteria for the project, and outlines the cures for failure to meet the end state criteria or certain milestones, including dry fuel storage and major component removal. The Lease Agreement also imposes a maximum project and lease duration of 120 months. This duration was negotiated with Exelon, and is a compromise of Exelon's desire to complete the project quickly and have the land returned to them, and Zion*Solutions*' need to let the decommissioning fund grow in order to complete the project within the amount of the decommissioning fund plus expected interest earnings.

In addition to assets that are turned over to Zion*Solutions*, the Lease Agreement also covers the terms and conditions associated with assets that Exelon will maintain for all, or a portion, of the project, such as the switchyard and synchronous condensers. The expectation is that the synchronous condensers will operate until the end of 2009, and then will be turned over to Zion*Solutions* for D&D along with the remainder of the Turbine Building. The switchyard will remain under Exelon's ownership and control for the duration of the project. These requirements have been known by Energy*Solutions* from the start of the license stewardship process, and the baseline schedule has been adjusted, where necessary, to account for Exelon controlling these systems while the decommissioning is in progress.

Back Up Financial Agreement:

The concept of using the license stewardship approach to decommission the Zion Nuclear Station involves transferring the risk to Zion*Solutions*, the decommissioning contractor, from the utility and the rate payers. There is no path back to the rate payers for any unknown or undisclosed liabilities, so they are not exposed to any risk. To protect the interest of the owner, additional considerations were given in the form of financial guarantees and protection in case of default that provide risk mitigation for Exelon and ensure adequate resources are available to complete the work should Zion*Solutions*' parent company run into financial difficulty. The financial assurances include a letter of credit, LLW disposal guarantees, parent guarantees, and other contractual agreements.

CONCLUSION:

The license stewardship approach is a novel way to approach the decommissioning of a retired nuclear power plant that offers several key advantages to all parties. For the owner and regulators, it provides assurance that the station will be decommissioned in a safe, timely manner. Ratepayers are assured that the work will be completed for the price they already have paid, with the decommissioning contractor assuming the financial risk of decommissioning. The contractor gains control of the assets and liabilities, the license, and the decommissioning fund. This enables the decommissioning contractor to control their work and eliminates redundant layers of management, while bringing more focus on achieving the desired end state – a restored site.