

# Decommissioning nuclear power plants in the U.S.

License Transfer: challenges and opportunities



*A contract innovation pioneered by decommissioning specialist companies is gaining traction in the U.S. as operators look for alternatives to traditional strategies that involve hiring a contractor while maintaining an oversight role. The license transfer approach potentially offers a faster, more efficient and cost effective process that simultaneously removes certain decommissioning liabilities from utilities.*

*This white paper examines the license transfer process, exposing some of the challenges and exploring the opportunities open to utilities planning decommissioning projects ahead of a plant shut down.*

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#### **INTRODUCTION**

The recent surge in earlier-than-planned nuclear power plant (NPP) closures across the U.S. has prompted operators to consider innovative strategies that could save time, money and remove some significant liabilities when they plan for decommissioning. As industry experts warn of decommissioning project cost-escalation risks associated with deferred plans, operators are being urged to look ahead to decommissioning while a plant is still operational.

A new approach has evolved that could address many of the challenges facing utilities operating plants that will close in the next few years. Transferring the operating license from the utility to a decommissioning specialist company is set to make the process more efficient with shortened timelines and reduced costs while removing some liabilities from the operator.

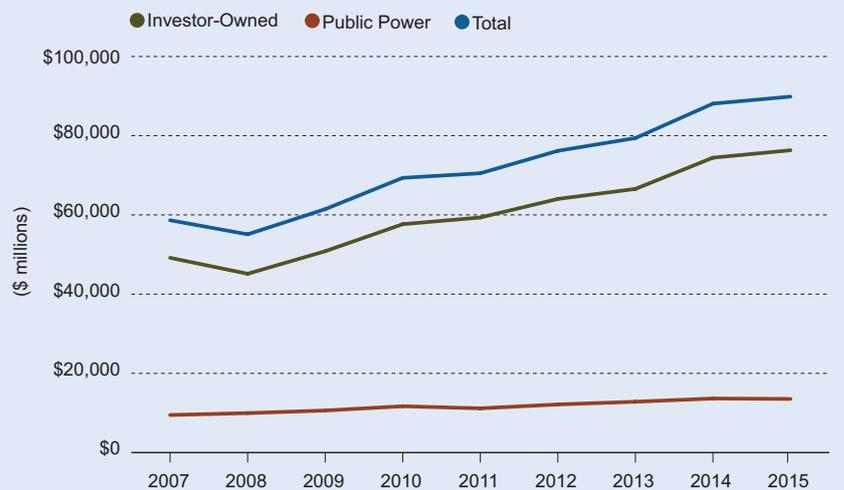
On September 1, 2010, Exelon transferred its license to operate units 1 and 2 of its 1.0 GW Zion plant in Illinois, which were permanently shut down in 1998, to a subsidiary of decommissioning specialist company EnergySolutions (ES). The U.S. Nuclear Regulatory Commission (NRC) approved the license transfer (LT) to

**Cost Estimates**

Total decommissioning cost estimates have risen since a low of \$55 billion in 2008. Decommissioning cost estimates totaled almost \$90 billion in 2015. The \$1.8 billion (2%) increase from 2014 (\$88 billion) is largely due to the use of updated site-specific cost studies by several owners.

Similar to NDT fund balances, investor-owned costs have accounted for over four-fifths of total costs over the past nine years, with public power costs accounting for less than one-fifth of the total cost.

**Cost Estimates of Decommissioning in Current Dollars**



Investor-Owned (\$m)	49,170	45,142	50,831	57,657	59,346	64,028	66,558	74,442	76,318
Public Power (\$m)	9,484	9,959	10,620	11,695	11,163	12,146	12,831	13,647	13,542
<b>Total (\$m)</b>	<b>58,654</b>	<b>55,101</b>	<b>61,451</b>	<b>69,352</b>	<b>70,509</b>	<b>76,174</b>	<b>79,389</b>	<b>88,089</b>	<b>89,860</b>

*Did You Know?*

**Of the U.S. operating nuclear power plants:**

**Largest:** Palo Verde in Arizona

**Smallest:** Fort Calhoun in Nebraska

**Newest:** Watts Bar in Tennessee

**Oldest:** Oyster Creek in New Jersey

Source: Nuclear Energy Institute

Source Callan

ZionSolutions (ZS), which is now responsible for expediting the decommissioning of the site. License termination is scheduled for 2020.

Six years later, ES and Dairyland Power Cooperative (DPC) took a similar approach to decommissioning DPC's 50 MW BWR La Crosse reactor (LACBWR) in Wisconsin, which was shutdown in 1987. The license was transferred from DPC to LaCrosseSolutions (LS) on June 1, 2016, for the purpose of decommissioning LACBWR, with an estimated date for closure of 2019.

The latest application for LT has been submitted by Entergy Corp, which owns the 620 MW Vermont Yankee (VY) plant that shut down in December 2014, and decommissioning specialists NorthStar Group Services Inc. If approved by the NRC, the spent fuel would be moved to dry storage by the end of 2018 and the estimated date for closure would be brought forward to 2030.

**Talisman International**

**Larry W Camper, Senior Nuclear Regulatory Consultant**

*Former Director of the Divisions of Decommissioning, Uranium Recovery and Waste Programs, as well as Waste Management and Environmental Protection at the U.S. Nuclear Regulatory Commission, Camper also served as the U.S representative on the International Atomic Energy Agency's Waste Safety Standards Advisory Committee*

Historically, utilities would hire a contractor to decommission their facilities, while retaining a certain management cadre from operations to oversee the project. However, utilities are in the business of operating a NPP and not in the business of taking them apart for decommissioning. These are remarkably different things to do and the idea that utilities could hire decommissioning expertise, enabling the project to be completed faster, more efficiently, more cost-effectively and also to transfer certain liabilities, was appealing.

The advent of decommissioning units 1 and 2 at Exelon's Zion plant opened the door to an alternative strategy. Exelon and ES approached the NRC with a proposal to implement a turnkey approach involving the transfer of the license from Exelon. The companies submitted the necessary applications under the requirements in Section 184 of the Atomic Energy Act and 10CFR 50.80, which started the LT process. ZS was also created to manage the overall decommissioning and waste disposal process.

One of the cornerstones of ZS' approach was to reduce intensive labor efforts such as scabbling. For the first time the 'rip and ship' technique was used, whereby more bulk material could be removed and transported to the ES disposal facility in Clive, Utah, or to Waste Control Specialists LLC (WCS) in Texas (according to the category of waste). This made economic sense, as ES owned the Clive disposal site.

The trend to transfer a license has emerged from ES showing leadership in its approach with first Zion and then adapting the same model for its contract with DPC in June 2016 to decommission LACBWR. According to ES management, both projects are proceeding on time, within budget and will be completed on schedule although more data will be needed before the industry can assess whether ES has achieved these goals as predicted.

Utilities have since become increasingly interested in ways to decommission more efficiently, faster, less expensively and to rely upon entities that have expertise in decommissioning and are willing to take on certain liabilities. This turnkey approach appears to be proving more favorable compared to the previous model where utilities would use contractors and continue to provide management oversight through their executives.

Other decommissioning entities are following suit and another turnkey model has emerged. NorthStar is proposing to decommission Entergy's VY plant using a teaming approach with other companies including AREVA for fuel management, Burns & McDonnell for engineering support and WCS for waste disposal in Texas, another first for the industry and NRC to consider.

In February, Entergy submitted its application to the NRC for an order consenting to direct and indirect transfer of control of licenses, in addition to an application under 10CFR 72.50 for an independent spent fuel storage installation (ISFSI). The applications are currently under review.

If approved it will set a new precedent where, unlike the Zion approach, NorthStar would own the company that owns the spent fuel, as a result of a limited liability company created for this purpose by Entergy. That is different and has not been done before, as spent fuel ownership was not in play for the approach by ZionSolutions or LaCrosseSolutions.

This model raises two further considerations. First, the transfer of ownership of spent nuclear fuel will prompt NRC staff to liaise closely with the Commission not only because it is the first time such an application has been submitted but also because this model could be proposed for other sites due to be decommissioned.

Secondly, it is likely the NRC staff will confer with the Department of Energy (DoE) to determine if there are any implications for the standard contracts that the DoE has with the utilities to remove their spent fuel from the sites for ultimate disposal at a final repository. Although this is not necessarily an issue, it is a consideration that has to be examined as part of the NRC review, especially as NorthStar plans to seek recovery of funds from DoE.

It is reasonable to assume a significant number of utilities will engage with these turnkey approaches. However, some will not be able to pursue the model because there are certain states in which such license transfer cannot take place. For example, certain California laws prohibit license transfer and the contract for decommissioning the 1.1 GW San Onofre Nuclear Generating Station (SONGS) has been awarded along the classic hired contractor lines to ES and multinational engineering firm AECOM through a teaming approach.

At a national level, the regulatory challenges arising from these turnkey approaches are already being met by the NRC and ES decommissioning Zion and LACBWR. The new NorthStar model is under review because of the unique fuel ownership application, but if it is successful then all the major hurdles will have been overcome.

The U.S. has much experience in decommissioning NPPs, research and test reactors, as well as complex material sites. It is reasonable that the industry and the regulators will continue to build upon this experience and seek innovative ways to ensure successful decommissioning as more NPPs enter decommissioning.

Eventually all of the existing NPPs in the U.S. will need to be decommissioned. The innovation and lessons learned along the way should prove highly valuable in ensuring the adequate protection of public health and safety, as well as ensuring efficient and cost effective decommissioning.

#### **Talisman International**

##### **Thomas E Magette, Senior Nuclear Regulatory Strategy Consultant**

*Former Senior Vice President, Nuclear Regulatory Strategy at EnergySolutions, Magette led the team through negotiations with the U.S. Nuclear Regulatory Commission and obtained approval for novel changes to technical and financial regulations that enabled Exelon to transfer its license to EnergySolutions, which is now decommissioning the Zion 1.0 GW plant in Illinois*

The concept of LT evolved from utilities incurring higher than expected project management costs, which accounted for 30-35% of total costs, when moving from operations to decommissioning.

One issue was the two layers of management working towards conflicting goals, which resulted when a utility hired a decommissioning contractor: the utility's team, used to maintaining an operational plant, would supervise a contractor's team tasked with dismantling the site after the reactor was shut down.

ES believed the Zion decommissioning project would progress more efficiently if it had complete control over decision-making and was answerable only to its own management team.

ES has an additional advantage as owner of the Low Level Radioactive Waste (LLW) disposal site at Clive, Utah. The company can mitigate financial risks associated with unforeseen costs that can materialize and if LLW volumes are greater than projected.

The first step to transferring the license from Exelon to ES involved approaching the NRC. It was a novel proposal as although many applications for license transfers were approved after the deregulation of the U.S. utility industry in the 1990s, these new owners intended to keep the NPP operational. Zion had stopped operating in 1998, long before ES became involved in the decommissioning project in 2007.

The NRC requires new owners to demonstrate technical and financial qualifications to operate a NPP before approving a LT. As ES was not going to be operating Zion, it would comply with the order never to turn the plant back on and so did not have to demonstrate that it was a technically qualified operator. ES also had very strong credentials for carrying out the decommissioning work, including for waste disposal with packaging and transportation, so it also met that technical qualification.

Meeting the financial qualifications took more work, as the NRC had to ensure the new licensee had sufficient funds to complete the work, even if the decommissioning trust fund (DTF) was not sufficient. ES had to create a secondary trust fund that would act as a back up to the DTF. To satisfy this requirement, the new fund had a US\$200 million letter of credit (LoC) in addition to a disposal capacity asset, which guaranteed space at Clive for LLW removed from Zion valued at around US\$145 million.

Exelon is the beneficiary of the secondary fund, enabling them to release the LoC to complete decommissioning and dispose of the LLW in the event of ES coming under financial duress and pulling out before the license was terminated.

Storing the spent fuel was another regulatory anomaly. Exelon retained ownership under a possession-only license, as it receives compensation from the DoE, which remains in breach of a contract to remove spent fuel until a final repository is found. The Part 50 license that NRC transferred to ES gave it the right to 'use' the fuel, as the company was responsible for moving it from the pool into dry storage on the ISFSI.

It took just over a year for the NRC to issue the LT order, although the ES process was delayed by several months due to the impact of the 2008 recession on the LoC value. Later LT agreements such as the ES and DPC deal to decommission LACBWR are unlikely to use LoCs due to their high cost.

There are no disadvantages specifically associated with this approach although uptake by all utilities operating in the U.S. fleet is unlikely to happen due to varying state regulations. NRC approval at federal level does not guarantee approval at state level, which is likely to be more politicized. Different owners will reach different conclusions in part due to state-level requirements. The State of Vermont has different criteria and procedures than the State of California, which led their owners to conclude that LT was feasible for decommissioning the VY plant but was not an option for SONGS.

At the time ES took over Zion the LT was a novel approach, but it was fairly straightforward for the existing regulations to accommodate the applications and approvals. Clearly there are legitimate cost advantages and not only from having just one management team as these decommissioning companies are more agile. They are experts and it is reasonable to expect them to decommission more efficiently than a utility. That is an advantage that can be measured in cost savings.

#### **Entergy Corp**

*Entergy's 620 MW Vermont Yankee plant shut down in December 2014. In November 2016, Entergy agreed to transfer Vermont Yankee licenses to decommissioning specialist NorthStar Group Services Inc. If approved by the US Nuclear Regulatory Commission and the State of Vermont, the time to completion of decommissioning will be accelerated and the site will be restored by 2030.*

#### **Paul Paradis, Director, Nuclear Decommissioning**

A utility definitely has the expertise to complete the first five years of post shut down activities and reach the all-fuel-on-pad stage. In addition, the sooner all the fuel is into dry fuel storage pad the quicker labor costs can be driven down.

The most important consideration from the utility's perspective is that it is very unlikely and very risky for a utility to think they can efficiently and effectively complete all of the decontamination and dismantling (D&D) part of the decommissioning project.

D&D is not an operator's core competency and labor costs become a factor once dry fuel storage is complete and D&D gets underway. A utility will greatly benefit from leaving these activities to the companies that have decommissioning experience and expertise.

There are different options available to an operator considering its role after the plant has closed. The plant could be sold to a company specializing in decommissioning or a Decommissioning Oversight Contractor (DOC) or Decommissioning General Contractor (DGC) could be hired. Both of these options will incur oversight costs to the operator.

Alternatively, an operator could transfer the license to a decommissioning specialist company. This process carries the greatest benefits to the operator although it still carries some risk, as the operator needs to ensure the decommissioning specialist company has the technical abilities and financial viability necessary to finish the D&D. If they are not able to do this, the operator company reputation would be affected and the site could be returned back to the operator under environmental laws.

The benefits include the operator no longer having to manage and own the site to be decommissioned, which is not part of the utility's core business. In addition, the D&D is completed much sooner than if the utility continued to own the site. This benefits the company reputation, as well as opening future opportunities to further enhance the transaction strategy.

**Joseph R Lynch, Senior Government Affairs Manager,  
Decommissioning**

There are a number of NPPs in the northeast U.S. that have already been decommissioned. Some of these operators evolved a strategy from a concept of using someone else, such as a DOC, to do the work while they undertook an oversight role.

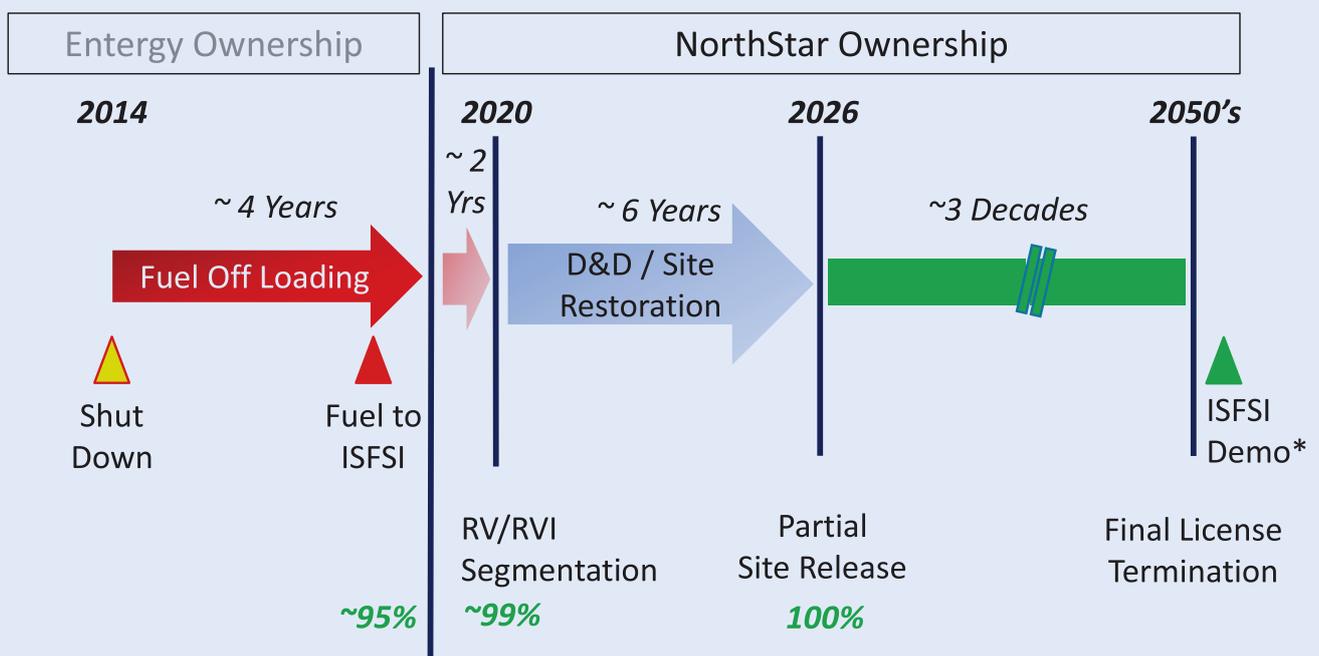
This strategy achieved marginal success because utilities rarely had the expertise necessary to successfully fulfill the oversight role. Bringing in a company to do the D&D work can be very costly and inefficient, especially if the utility does not know if the work is being carried out correctly and results in costly and time-consuming changes having to be made mid-stream in the project.

Licensees learned that, although they employed excellent and appropriately skilled operating personnel, it was essential to bring in companies that have D&D as their core service and expertise. By taking over the license NorthStar will no longer be subject to any oversight by the operator and it takes on the risks of managing the project and the responsibility for meeting the schedule.

NorthStar and its partners can complete the D&D at a much lower cost than Entergy could in an oversight role because they deliver these services every day. That is a major lesson learned for any utility planning the decommissioning of a nuclear power plant.

## Vermont Yankee Contaminated Site Cleanup

*Target ~99% of Radioactive Content Safely Stored / Removed by 2020*



\* Assumes DOE Fuel Pick-Up Complete in 2052

### LIST OF ACRONYMS

<b>DTF</b>	Decommissioning Trust Fund
<b>D&amp;D</b>	Decontamination and dismantling
<b>DoE</b>	U.S. Department of Energy
<b>DPC</b>	Dairyland Power Cooperative
<b>ES</b>	EnergySolutions
<b>ISFSI</b>	Independent Spent Fuel Storage Installation
<b>LACBWR</b>	La Crosse Boiling Water Reactor
<b>LS</b>	LaCrosseSolutions
<b>LoC</b>	letter of credit
<b>LLW</b>	Low Level (Radioactive) Waste
<b>NPP</b>	Nuclear Power Plant
<b>NRC</b>	U.S. Nuclear Regulatory Commission
<b>SONGS</b>	San Onofre Nuclear Generating Station
<b>VY</b>	Vermont Yankee
<b>WCS</b>	Waste Control Specialists LLC
<b>ZS</b>	ZionSolutions

This whitepaper was produced in conjunction with...

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- ✓ Gain valuable insights into cost estimation best practices that will help to form viable trust fund management for future decommissioning and manage costs on current decommissioning projects
- ✓ Understand the work being done by the NRC with the exploration of a rulemaking that would amend NRC regulations, such as 10 CFR Parts 26, 50, 52, 73 and 140, for the decommissioning of nuclear power reactors

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