

Decommissioning Planning for Nuclear Units at the Oskarshamn Site

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ABSTRACT

This paper will describe the process that OKG is now in and how the regulatory framework in Sweden is set out with EIA preparation, SAR updates, decommissioning plans etc. and how OKG plans to meet some of the challenges that need to be considered in front of the decommissioning. There will be a discussion on which strategic decisions will have priority and why. The paper will also discuss some of the difficulties with having a site with two units in decommissioning and one unit in power operation.

Introduction

The Oskarshamn NPP is located on the south-east coast of Sweden and has 3 operating BWR's. Their net electrical output is 491 MWe (unit 1), 620 MWe (unit 2) and 1450 MWe (unit 3). Unit 1 and 2 are closely linked with several common systems and the two units are housed in the same building. Figure 1 shows the three units at the Oskarshamn nuclear power plant.



Figure 1: The Oskarshamn site with unit 3 at the front and units 1 and 2 in the background

The three units had until recently a planned operating lifetime until 2032, 2034 and 2045. In October 2015 it was decided by the majority owners E.ON that unit 1 would be permanently shut down between 2017 and 2019. Unit 2, which has been under an extensive modernization program, would not operate again and was to be considered already permanently shut down. This means that the decommissioning planning work will have to be rapidly accelerated.

In order to start the pre-decommissioning planning immediately, a decommissioning project (Decommissioning Preparation Project, DPP) with focus on preparatory activities has been initiated with five initial sub-projects: “Strategies and Planning”, “HR and Regulatory Acceptance”, Licensing EC Permit”, “Licensing Nuclear Regulator Permit” and “Decommissioning Preparation Activities (Operative)”. This project reports directly to the President of OKG due to both the sensitivity and magnitude of the outputs of this project, and due to the international lessons learned to separate the decommissioning work from the operational work.

Decommissioning Process

The decommissioning process in Sweden is divided into four regulatory phases: Power operation, Defueling operation, Shutdown operation and Dismantling operation according to the principle schedule in Figure 2. The Site Restoration phase is often considered an own phase, but from a regulatory point of view it belongs to the dismantling operation.

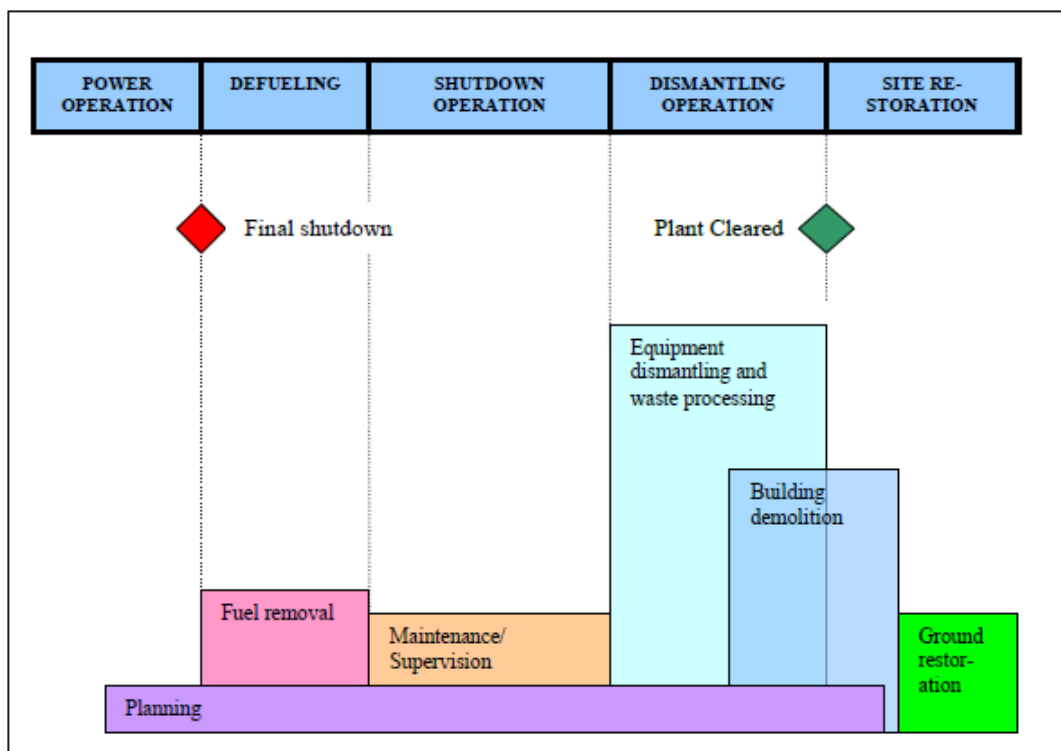


Figure 2: Principle figure of the decommissioning phases according to the Swedish licensing process [1]

Before the nuclear power plant can enter the defueling operation, an Environmental Impact Assessment (EIA) needs to be approved by the environmental court. As an economical incentive, before entering the shutdown operation the utility want a new Safety Analysis Report (SAR) to be

approved by the nuclear regulator since with no fuel present on the site, some of the restrictions can be lifted and this is economically beneficial with less security and monitoring arrangements etc.

Prior to entering the dismantling operation, an EIA needs to be approved by the EC and a new SAR for decommissioning needs to be approved by the nuclear regulator. The utility also need to specify the waste flows and treatment during the dismantling in a waste management plan, which needs to be approved by the nuclear regulator prior to entering the dismantling phase.

Before entering decommissioning the Euratom Article 37 also needs to be approved by the European Council.

Strategic Options for OKG

There are many things to consider, and difficult strategic decisions to be taken and prioritized by the utility, OKG, some of them being:

The organizational model

How to use the utility personnel effectively and identify which competences are critical

The challenge will be to identify the many different activities during each phase of the decommissioning and to decide and list what competences are needed and when, and whether to use the utility personnel or contractors for these activities.

Having a large presence of contractors and smaller utility organization or vice versa

Should the utility use its own personnel to execute the decommissioning work, or be an “intelligent procurer” with a smaller utility organization that is specialized in managing many different contractors. Experience from previous decommissioning projects is that using personnel from operations to do decommissioning work is slower than using professional decommissioning staff, but on the other hand the utility have access to many employees that they want to utilize as much as possible.

Contractual models and strategies

There are many alternatives for contractual arrangements for the decommissioning work. The utility can do everything with its own personnel; it could have a partner for decommissioning, put out larger or smaller packages for competitive bid or even put the whole decommissioning on one contractor as a turn-key contract. An extreme variant of this is to move the nuclear license to a contractor.

How to maintain competence for the units in operation at the site

The main priority of the utility is to run a safe operation of the unit that is still in power operation on site, maximizing the remaining operation time. In order to do this, a challenge for the utility will be to maintain the competences and personnel needed in key positions.

The waste management strategy

On-site or off-site treatment

There will be a lot of waste generated during the decommissioning project; how to manage, treat or free release it, and where, is something that needs detailed investigation. The waste could be treated entirely on-site in dedicated facilities. The question then is where, since the existing waste

management facilities probably are not fit to receive the amount of waste that the decommissioning generates. The option then is whether to erect a new waste management building that is purposefully built for decommissioning, or to make some fit-for-purpose solution in other existing facilities on site. See Figure 3 for an illustration of how a waste management facility on site could be organized. Regardless, what is erected during decommissioning will be a waste in the end.

Alternatively, the waste could be shipped off-site to a dedicated waste treatment company with melting, incineration and advanced decontamination options for example. This way, the waste could be dismantled, packed and shipped off-site quickly and the risk of interruption in waste treatment will be transferred to another site. The waste management facilities, which are a liability on site, would actually be an asset off-site.

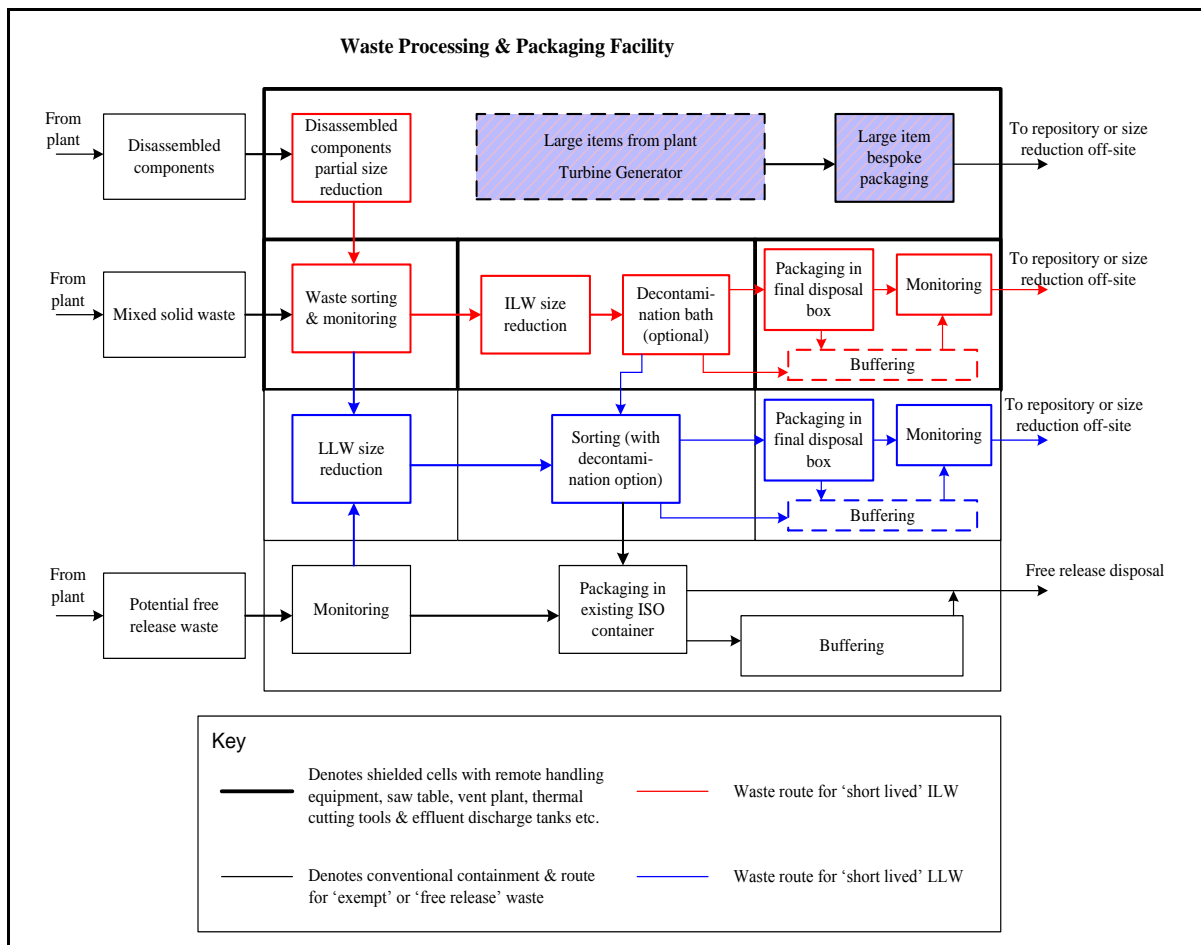


Figure 3: Illustration of how a waste management facility on site could be organized [1]

Handling of large components

How should the large components such as the RPV, internals, and turbine be handled? The internals could be segmented either under water in the containment or in a dry environment elsewhere. The RPV could either be segmented on site or off-site, or treated as one piece and removed intact for disposal. The turbine is suitable to be removed intact early on in the project and transported to a dedicated facility for size reduction.

Waste logistics

The dismantling work could be described as one large logistic problem. To clearly define and plan, in advance, the waste logistics is one of the key issues of getting fast and cost effective dismantling. The waste logistic analysis should define the different waste routes, transportation capacity in the corridors and for the handling equipment that will lift the containers, whether or not new doors or openings need to be created in order to transport the waste out of the plant and how the material flow should circulate to the different waste management facilities. One of the main purposes of the logistics analysis is to avoid bottle necks and the risk for interruptions in the dismantling work.

Dependency on the final repository

There is a final repository for low and intermediate level waste in Sweden, but it is currently only for operational waste. There are plans to extend this repository to be able to receive decommissioning waste, but the realization of this is still some years away. Therefore OKG need to take into account the possibility of not being able to send decommissioning waste to the final repository, as has been assumed in previous decommissioning planning.

If the final repository is not available, plans for buffer storage on site or at another location need to be investigated.

Timing between the decommissioning of unit 1 and 2

Unit one will be finally shut down between 2017 and 2019, while unit 2 is already permanently shut down. How to time the defueling operation, shutdown operation and dismantling between the units will affect the overall decommissioning program and time schedule.

Shared systems and buildings between the units in decommissioning and the unit in operation

The three units at the Oskarshamn site have several shared systems, such as the waste treatment systems, cooling water intake, security central, mechanical workshops etc. What to do with them, how to continue sharing them, when to decommission them or which of them that need to be rebuilt at the operating unit needs to be defined early in the decommissioning process.

Stakeholder engagement

How should the utility interact with the stakeholders and authorities in order to facilitate a smooth and uninterrupted decommissioning process? Frequent information meetings with the municipality and people living closest to the nuclear power plant have shown to be an effective way of communicating the intentions and reasons behind different decommissioning decisions and to get the acceptance to run the project without interruptions.

Many studies, site works etc. that need to be prepared and planned

It needs to be determined what systems and functions that have to be reconfigured or rebuilt for the purpose of decommissioning. Some of these reconfigurations might be: ventilation, power supply, handling equipment, and waste treatment systems, transport routes etc.

Discussion

One of the challenges with the decision for early shutdown is to manage the short timeframe to get the legal and regulatory approval for the necessary documents (EIA, SAR etc.) in order to be allowed to go into the different phases of the decommissioning. Both the development of the documents and the interaction and communication with the environmental court and regulators has to be well planned.

The final repository for short lived low and intermediate level waste in Sweden (Figure 4) is in the planning phase for being extended to receive decommissioning waste. This work, however, is delayed and foreseen to be ready at the earliest in 2028. It will be a challenge for OKG to find or build buffer storage capacity for the large amount of decommissioning waste that will be generated before the final repository for decommissioning waste is finished.

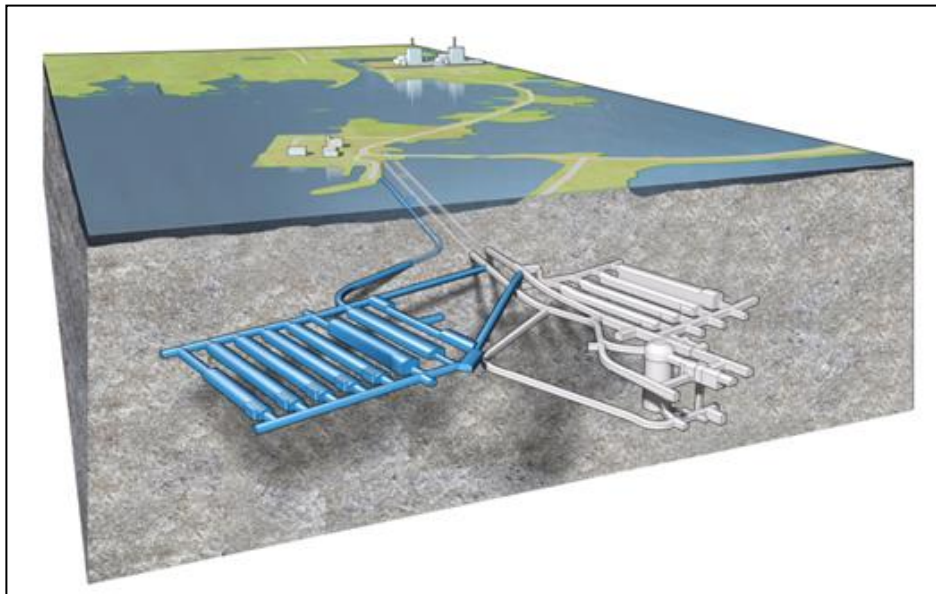


Figure 4: The Swedish final repository SFR for low and intermediate level operational waste in white, with the planned extension for decommissioning waste in blue, (source: SKB) [1]

There will be a need to physically separate the site between the two units in decommissioning and the one unit in operation. How to do this and also how to share the site infrastructure will need to be considered. The infrastructure will have to be rebuilt and added to in order to serve the two working areas.

Maintaining the key personnel for the unit in operation and at the same time trying to change the mentality of the personnel that will be working with the decommissioning to focus on dismantling will be a challenging task.

Conclusions

There are many pre-decommissioning strategic decisions that need to be investigated with the perspective of how it will affect the whole decommissioning program. Some paths may seem to be advantageous in the short run, but when taking the entire decommissioning scope into consideration can in fact be more costly. It is absolutely necessary that some person(s) have the “eagle eye perspective”, the entirety of the decommissioning project in mind. This is in order not to sub optimize things in the beginning of the project which later shows to be disadvantageous for the later phases.

A combination of waste treatment on-site and off-site is probably a good alternative, but to which degree and for what waste streams, needs to be established.

There are plans to combine unit 1 and 2 into one decommissioning project, and to license the two units for one shared dismantling operation. This will allow for smoother planning since you can handle the two units as one object, without the need to physically separate them before going into the decommissioning.

Some of the prioritized decisions that OKG needs to answer as soon as possible are:

- How to organize the decommissioning project and to appoint persons that have the overall responsibility for the whole program
- What critical skills are needed and how to keep or obtain the persons that have those skills
- The waste management strategy
- The procurement strategy

Work is already underway to produce inputs to these decisions.

Future Works

The work with defining strategies, finding solutions and optimization of solutions is an ongoing process that will continue throughout the decommissioning project.

Most of the options and decisions that are described in this paper have not been fully investigated or decided upon by OKG. There are dedicated personnel working continuously with this at the site in order to have good information on which to base the major strategic decisions upon.

A good idea could be to document all the major decisions taken and compare to how the results were after the decommissioning project and what could have been done better, in a lessons learnt report. This would be a valuable document for Oskarshamn 3, the remaining operational unit at the site which according to current planning will run for another 30 years.

References

- [1] H. Larsson, Å. Anunti, M. Edelborg, “Decommissioning Study of Oskarshamn NPP”, SKB R-13-04, June 2013