

# IN-SITU LOW LEVEL WASTE MANAGEMENT

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## ABSTRACT

A concept is presented which combines low level radioactive waste disposal with the decommissioning of a nuclear power plant, and applies this concept to the State of Maine. All radioactive waste generated in Maine would be temporarily stored at the site of the Maine Yankee Atomic Power Plant until the year 2009 when the plant's operating license expires. The plant would then be decommissioned with all buildings dismantled except the reactor containment building. All low level radioactive waste, including decommissioning waste, would be placed inside the Maine Yankee Containment which would serve as the State's permanent repository. The repository would accept waste for another 30 years before being closed. The study showed that the concept is viable in that all Maine low level waste prior to decommissioning can be temporarily stored on site, more than adequate storage space exists in the Containment for waste projected to be produced to the year 2041, and only minor structural modifications need to be made to the Containment floors to allow for storage. Dose analysis indicates lower occupational exposure and adequate long term protection to the public.

## BACKGROUND

Currently all low-level radioactive waste produced in Maine is shipped to an out-of-state repository for burial. After 1993, however, this may no longer be possible under the terms of the 1985 Amendment to the Federal Low Level Radioactive Waste Policy Act. Maine pursued, and is still pursuing, the formation of a compact with other states; however, Maine's position that a compact site cannot be within the state has hindered the search for partners. If it remains by itself, a complex process for the selection of a waste repository within the state will be required.

In 1986 the Department of Energy identified two locations in Maine as potential sites for the second High Level Waste Repository for the country. This action, in conjunction with a series of public meetings held by DOE, generated strong public opposition to nuclear waste in the State of Maine. Capitalizing on this public response against nuclear waste, the Maine Nuclear Referendum Committee had no problem obtaining the required signatures to hold a third (unsuccessful) statewide referendum on the shutdown of Maine Yankee. The primary arguments during the referendum campaign dealt with both high level and low level waste.

Although Maine Yankee Atomic Power Co. (MYAPCO) has no legislative mandate, it clearly has a vested interest in helping solve the waste problem. MYAPCO has studied a possible solution to Maine's low level waste problem that includes using the Maine Yankee Atomic Power Plant as the State's low level waste repository. This concept combines a strategy for LLW disposal with a new approach to plant decommissioning and an engineered barrier alternative to shallow land burial. We have referred to

this concept as "In-Situ Decommissioning and Low Level Waste Management", and MYAPCO commissioned Ebasco Services Inc. to perform a technical feasibility study of it. This paper reports on the results of this study (1) and its potential application. IN-SITU CONCEPT

Low level radioactive waste is generated in Maine by several medical, research and commercial facilities; however, the largest single source is the Maine Yankee Atomic Power Plant. This power plant, located near Wiscasset, Maine, uses a pressurized water reactor to produce 850 MW of electricity. It has been in operation since 1972. The reactor is housed inside a seismic Class I Containment Building of reinforced concrete 1.37 m thick, 52 m high, 41 m in diameter, with a 3 m foundation. The building has a steel liner, is located on bedrock and was specifically designed to retain radioactivity in case of an accident. In the center of the Containment, the 429 metric ton reactor pressure vessel has wall thickness of 0.22 m carbon steel with a stainless steel liner. Among other buildings on the site, shown in Fig 1, is a building designated as the Onsite Storage Facility (OSF), designed to temporarily store 5 years of operational waste from the plant. The Maine Yankee plant will have to be decommissioned at the end of its useful life. Many factors would influence when this would occur, but this study assumes the plant will be decommissioned at the end of its present operating license in the year 2008.

The In-Situ concept envisions four distinct periods of operation:

1. Operating Period (1993-2008). All low level waste generated in the state of Maine, along with operational waste from Maine Yankee, would be temporarily stored in the OSF building at the Maine Yankee Site.

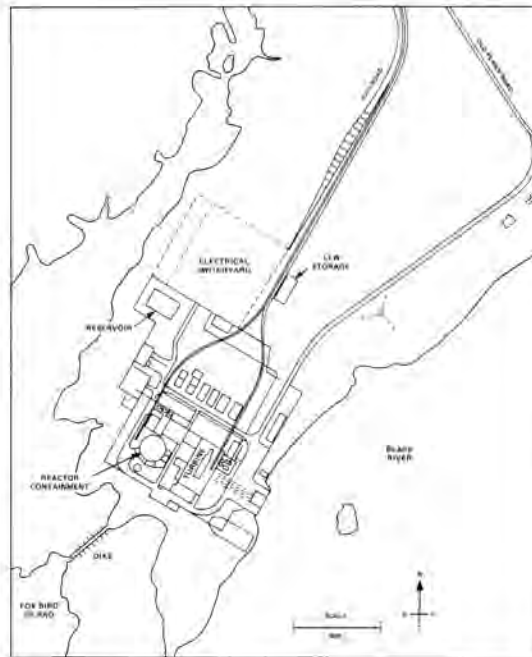


Fig. 1. Maine Yankee Atomic Power Plant Site Plan.

2. Decommissioning Period (2009-2011). All nuclear fuel along with certain reactor vessel internals whose activity exceeded 10CFR61 Class C would be removed from the site. All buildings at Maine Yankee outside the Containment would be decontaminated and dismantled. All radioactive decommissioning waste along with waste previously stored at the site would be placed inside the Containment. All penetrations to the Containment would be sealed except those needed for repository operations.

3. Active Repository Period (2012-2041). The repository, consisting of the former Maine Yankee Containment Building, would be operated by the State Low Level Waste Authority, and would continue to receive waste from all State of Maine generators. This period could vary, but was assumed to be 30 years in this study.

4. Post-Closure Period (2042-2146). In accordance with 10CFR61, environmental monitoring would continue for 5 years. Remaining penetrations would be sealed, and a 100 year period of institutional control would begin.

#### TECHNICAL FEASIBILITY

Based upon the previous waste shipment records of Maine Yankee as well as the 81 other current licensees in Maine, and taking into account future trends and plans for volume reduction, an estimate of the total radioactive waste to be disposed of is shown in Table I. Of the total 10,558 m<sup>3</sup>

of waste, approximately 60% of this volume results from decommissioning of the plant. At the beginning of repository operation, the waste contains 1.6 million curies, 99% of which represents residual radioactivity from the primary coolant system of the reactor.

During operation of the power plant, a projected maximum of approximately 3,000 m<sup>3</sup> of waste must be temporarily stored at the site. The present OSF building designed to store waste is 50 meters long by 21 wide by 12 high, and is presently empty. Although the storage period of 15 years is triple the original design basis of 5 years for the OSF, only moderate expansion is needed to meet the requirement. As shown in Fig. 1, adequate room at the site exists, and lead time for a new or expanded building is only one year.

After plant decommissioning, the final encapsulation boundary would be the Containment Building shown in Fig. 2. There is more than adequate space inside the Containment for the total 10,558 m<sup>3</sup> of waste produced to the year 2041 in the State of Maine. Numerous storage schemes are possible and the study worked out one scheme in some detail. All waste is packed in 55 gallon drums or 90 and 120 cubic foot steel liners, which is the present practice at Maine Yankee. All Class C and most Class B waste is sealed inside the Reactor Pressure Vessel for additional confinement. The remainder of the Class B waste along with 1350 m<sup>3</sup> of Class C waste is sealed in the refueling pool cavity. The large remaining volume of Class A waste and contaminated equipment is stored at floor levels corresponding to

## State of Maine Radioactive Waste.

<u>SOURCE</u>	<u>PACKED VOLUME (m<sup>3</sup>)</u>
Institutional Waste (1993-2008)	
Class A (a)	634
Maine Yankee Operational Waste (1993-2008)	
Class A	2232
Class B	23
Class C	9
Decommissioning Waste (b)	
Contaminated equipment/debris	5855
Class A	376
Class B	122
Institutional Waste (2009-2041)	
Class A	1307
Total (1993-2041)	10,558

- a) Classification from 10CFR61 based on relative radionuclide concentrations with Class A the lowest activity and Class C the highest.
- b) Does not include radioactive equipment already located within the containment.

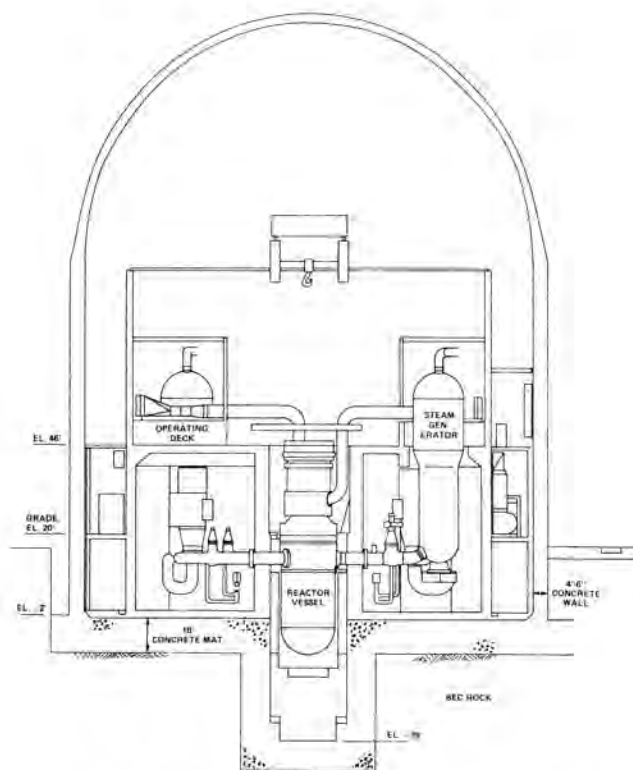


Fig. 2. Cross Section of Containment and Encapsulation Boundary.

elevations -2 ft, 20 ft. and 46 ft. The 55 gallon drums are stacked 5 high and the steel liners are stacked 2 high. Structural modifications include removal of interfering equipment to allow placement of the waste, addition of floor supports where design floor loadings are exceeded, and sealing of all penetrations. The weight added by the waste will have no effect on the structural integrity of the building.

The encapsulation boundary for the LLW repository consists of Containment outer wall, dome and base mat. The long term stability of this boundary was examined in more detail in a previous study (2) and concluded that it would withstand severe environmental conditions without any maintenance for more than 100 years. The Maine Yankee case has less severe conditions than the generic case studied, and it is concluded that the encapsulation boundary would also maintain its confinement integrity for more than 100 years.

A radiological assessment was performed for all occupational and public exposure pathways for each phase of the waste disposal and decommissioning scenarios. Methodologies were in accordance with NUREG/CR-4370 (3) and AIF/NESP-034 (2). Transportation and storage operations result in very minor exposure. Decommissioning occupational exposure, while significant, is lower for the In-situ method than the currently favored immediate dismantlement option. Finally, the repository can provide adequate, long-term protection for the stored waste, meeting all regulatory requirements protecting the public from exposure.

### APPLICATION

The In-situ concept appears to be technically feasible for the Maine Yankee site, but to be a viable alternative it must be acceptable to State and Federal regulators, various state organizations and the citizens of Maine. MYAPCO has started by making some of the decision makers cognizant of the concept.

MYAPCO has held several meetings with the NRC management and staff to discuss this concept. The NRC reactions were mixed, but most stated that the concept did not violate any current NRC regulations, but that it did appear to possibly conflict with NRC policy. The NRC is reluctant to extend temporary waste storage times beyond five years, and they are also reluctant to encourage plant decommissioning approaches that leave residual radioactivity at the site. The apparent purpose of this policy is to discourage the proliferation of waste sites. We believe the utilizing of the site as the state LLW repository does not represent proliferation, and in fact would result in one less nuclear site in Maine.

Although the concept does not violate current regulations, there would be several permitting steps such as permission to extend temporary storage beyond 5 years, permission to operate a facility for storage of waste generated by others (EIS likely), approval of the decommissioning plan and the termination of the plant license. The evaluation and permitting of the final repository would be regulated by 10CFR61 with the reactor containment evaluated as an above ground vault.

As a result of the Low Level Radioactive Policy Act of 1980, the State of Maine has formed an Advisory Commission on radioactive waste to provide advice to the state government with respect to the actions necessary to comply with that law. More recently a Low Level Waste Authority has been formed with the mandate to site, design and build a low level waste facility. MYAPCO has met with both of these groups as well as the Governor's office and other state officials to inform them of the In-situ option. If interest is apparent in this concept, more detailed cost, engineering and radiological studies would be conducted.

This concept has potential application to other states or compacts, especially those with only one reactor site (even if that site has multiple reactors). It should be especially attractive to those compacts that require engineered barrier concepts or forbid shallow land burial. These studies (1,2) may be used as a baseline, but site specific studies must be conducted; and the states must also gain local acceptance and overcome NRC reluctance.

### CONCLUSION

This study concludes that the In-situ Decommissioning and Low Level Waste Management concept appears to be technically feasible, and has several attractive features which make it worth considering further:

- (1) It presents a viable solution to the problem of what to do with Maine low-level waste generated after January 1, 1993 when the State of Maine must assume responsibility for disposal of low-level waste produced within the state.
- (2) It avoids having to create another licensed nuclear facility in Maine, in addition to the Maine Yankee site.
- (3) It makes maximum utilization of existing facilities, security, technical personnel and monitoring already located at the Maine Yankee site.
- (4) Radiation exposures to workers from waste handling, transportation and storage would be lower than if a repository were located at a different site.
- (5) It would minimize the amount of radioactive waste shipments that would go over public roads.

(6) The "In-situ" decommissioning concept of leaving the Containment Building standing will result in a lower occupational exposure during decommissioning than the currently favored immediate dismantlement option.

(7) The long-term protection afforded to the public by the Containment Building should be equal to, if not better than, the shallow land burial method.

(8) Although cost was never quantified in the study, it is reasonable to expect that onsite storage at Maine Yankee would be less expensive than constructing a facility elsewhere and shipping Maine Yankee waste to it.

#### REFERENCES

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