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Benefits of Actinide-Only Burnup Credit for Shutdown PWRs

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I. Introduction

Owners of PWRs that are shutdown prior to resolution of interim storage or permanent disposal issues have to make difficult decisions on what to do with their spent fuel. Plants in this category already include Rancho Seco, Trojan, Yankee Rowe, Connecticut Yankee, Maine Yankee and Zion. Utilities are currently considering early shutdown of several other plants. For the PWR owners who have made decisions on spent fuel handling (Rancho Seco, Trojan, and Yankee Rowe), they have all selected to use a canister approach that will be acceptable for both dry storage and transport. Some interest in disposability of these canisters is often raised. With dual purpose canisters, it is possible to shutdown the spent fuel pool and not worry about a dry transfer system.

II. The Maine Yankee Case

Maine Yankee is currently evaluating multiple options for spent fuel storage. Their spent fuel pool has 1434 assemblies. In order to evaluate the value to a utility of actinide-only burnup credit, analysis of the number of canisters required with and without burnup credit was made. In order to perform the analysis, loading curves were developed for the Holtec Hi-Star 100/MPC-32.[1] The MPC-32 is hoped to be representative of future burnup credit designs from many vendors. The loading curves were generated using the actinide-only burnup credit currently under NRC review.[2] The canister was analyzed for full loading (32 assemblies) and with partial loadings of 30 and 28 assemblies. Figures 1 and 2 show the canister loading curves for 32 and 30 assembly loadings. If no burnup credit is used the maximum capacity was assumed to be 24 assemblies. This reduced capacity is due to the space required for flux traps which are needed to sufficiently reduce the canister reactivity for the fresh fuel assumption.

Without burnup credit the 1434 assemblies would require 60 canisters. If all the fuel could be loaded into the 32 assembly canisters only 45 canisters would be required. Table 1 shows the number of canisters required with the current actinide-only burnup credit. Although the actinide-only burnup credit approach is very conservative, the total number of canisters required is only 47 which is only two short of the minimum possible number of canisters. The utility is expected to buy the canister and the storage overpack. A reasonable cost estimate for the canister plus overpack is $500,000. Actinide-only burnup credit would save 13 canisters and overpacks which is a savings of about $6.5 million. This savings is somewhat reduced since burnup credit requires a verification measurement of burnup. The measurement costs for these assemblies can be estimated as about $1 million (about $800 per assembly in a burnup credit canister). The net savings would be $5.5 million.

DOE would also anticipate less cost for moving the Maine Yankee fuel if burnup credit canisters are

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used. Using an estimate of $100,000 per shipment costs for DOE,[3] implies DOE would save $1.3 million dollars in moving Maine Yankee fuel if burnup credit was utilized. There may also be savings in disposal if the canister is determined to be disposable.

Analysis has also been performed to investigate the impact of seeking more burnup credit beyond the currently submitted actinide-only approach. Also, analysis has been performed for the case where the NRC grants less burnup credit than that currently under review. In all the analyses it was assumed that the uncertainty in the utility reactor record burnup was 5%. This assumed uncertainty must be shown by the utility. Many utilities believe that less uncertainty can be justified. If 4% uncertainty could be justified this would be the same as 1% more burnup credit. As can be seen from Table 1, the number of canisters needed remains at 47. This observation could be used by Maine Yankee to set the target uncertainty justification to 5%. If, however, Maine Yankee could only justify a 6% uncertainty in the declared burnup then 48 canisters will be required.

Table 1 shows that additional burnup credit is of little value to Maine Yankee but loss of any of any of the burnup credit could add millions to their expenses.

III. Conclusions

Although $5.5 million is a significant savings to a utility like Maine Yankee, it is still a small fraction of the total expenses in their decommissioning efforts. Hence, any delay in schedule, if caused by burnup credit, would overwhelm the savings. Unfortunately, Maine Yankee has many uncertainties to deal with since none of the dual purpose systems have received their license from the NRC.

If dual purpose containers are needed for shutdown PWRs, actinide-only burnup credit can provide significant savings to the utility. It also provides cost benefits to DOE in transportation savings and possible disposal savings. It is desirable to use burnup credit for shutdown PWRs but in the end the utilities will have to make the difficult economic cost/benefit analysis.

References:

1) "Safety Analysis Report, Holtec Report HI-951251," NRC Docket No. 71-9261.

2) "Topical Report on Actinide-Only Burnup Credit for PWR Spent Fuel Packages," DOE/RW-0472, Rev. 1, Office of Civilian Radioactive Waste Management, US Department of Energy, May 1997 (Rev. 0 May 1995).

3) W. Lake, "Cost-Savings Potential for Transport and Storage of Spent Nuclear Fuel Available from Burnup Credit," *Trans. Am. Nucl. Soc.*, **76**, 52 (1997).

Table 1: Number of Canisters Needed for Maine Yankee Under Various Assumptions

Number of Assemblies	1434
Canisters without Burnup Credit	60
Minimum Canisters with Burnup Credit	45
Canisters with Current Actinide-Only Burnup Credit	
32 Assembly Canisters	31
30 Assembly Canisters	7
28 Assembly Canisters	0
24 Assembly Canisters	9
TOTAL	**47**
Additional/Less Burnup Credit	
Canisters with 1% MORE Burnup Credit	47
Canisters with 2% MORE Burnup Credit	47
Canisters with 5% MORE Burnup Credit	46
Canisters with 10% MORE Burnup Credit	45
Canisters with 1% LESS Burnup Credit	48
Canisters with 2% LESS Burnup Credit	49
Canisters with 5% LESS Burnup Credit	51

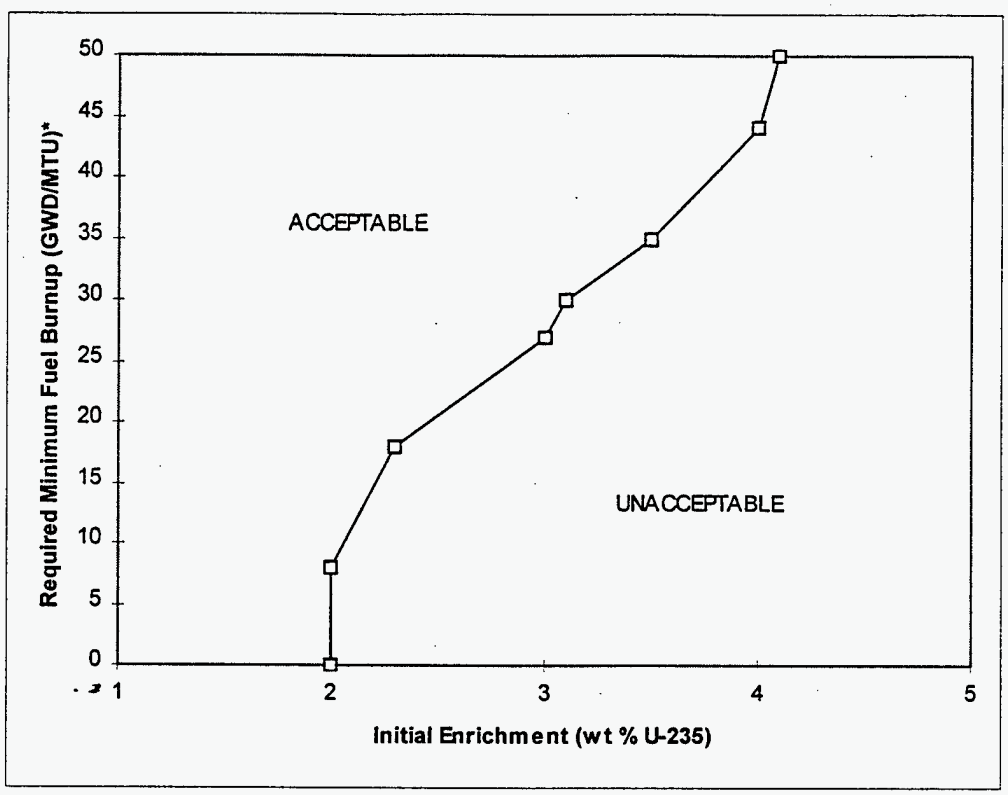

Figure 1: **Loading Curve for the HI-STAR 100/MPC-32 using the currently under review Actinide-Only Burnup Credit Methodology.**

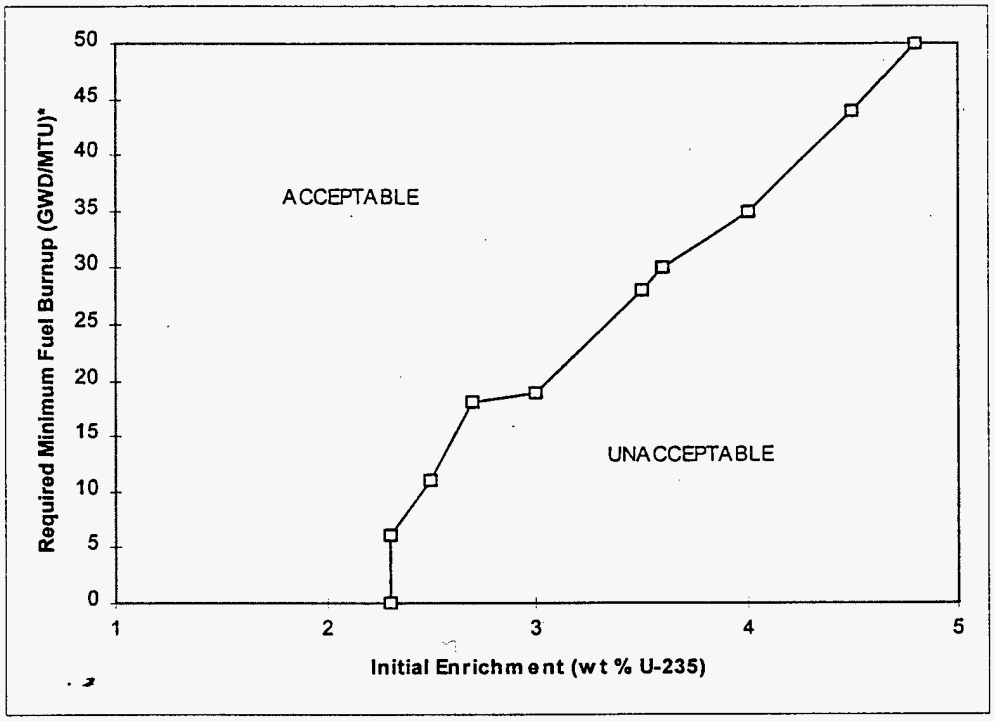

Figure 2: **Loading Curve for the HI-STAR 100/MPC-32 using the currently under review Actinide-Only Burnup Credit Methodology – derated to 30 assemblies.**

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