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Spent Fuel Storage Requirements— The Need For Away-From-Reactor Storage

MASTER

AN UPDATE OF DOE/ET-0075

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U.S. Department of Energy
Assistant Secretary for Nuclear Energy
Division of Spent Fuel Storage and Transfer

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I. INTRODUCTION

The analyses of on-site storage capabilities of domestic utilities and estimates of timing and magnitude of away-from-reactor (AFR) storage requirements were presented in the report DOE/ET-0075 entitled "Spent Fuel Storage Requirements - The Need For Away-From-Reactor Storage" published in February 1979 by the U.S. Department of Energy. Since utility plans and requirements continue to change with time, a need exists to update the AFR requirements estimates as appropriate.

This short report updates the results presented in DOE/ET-0075 to reflect recent data on reactor operations and spent fuel storage. In addition to the updates of cases representing the range of AFR requirements in DOE/ET-0075, new cases of interest reflecting utility and regulatory trends are presented.

II. SUMMARY

A wide range of AFR requirements result from varying the parameters impacting spent fuel storage. Figure 1 shows the estimated upper bound, lower bound, and the planning base for AFR storage and/or disposal requirements. The amounts of spent fuel stored in the AFR's in each of these cases is only a small portion of the fuel discharged from the reactors as shown in Figure 2.

The data from the utilities and the current regulatory and institutional climate lead to the following conclusions:

A. Utilities are moving toward maximum reracking.

B. Transshipment should serve as a backup to meet short term and emergency needs and should not be a planning base for all reactors.

C. Though the upper range of storage estimates has been reduced, a firm requirement for AFR services still exists.

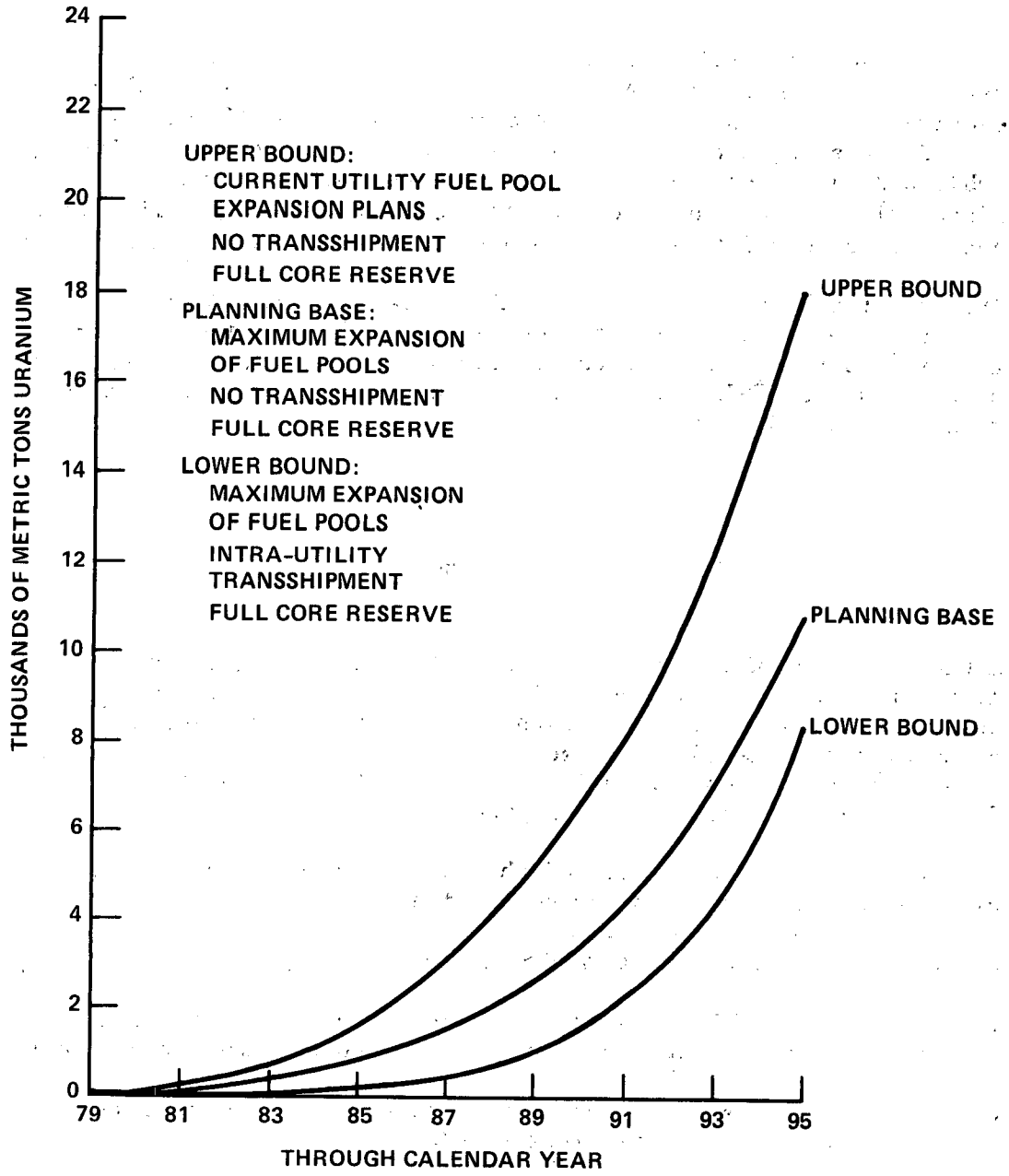
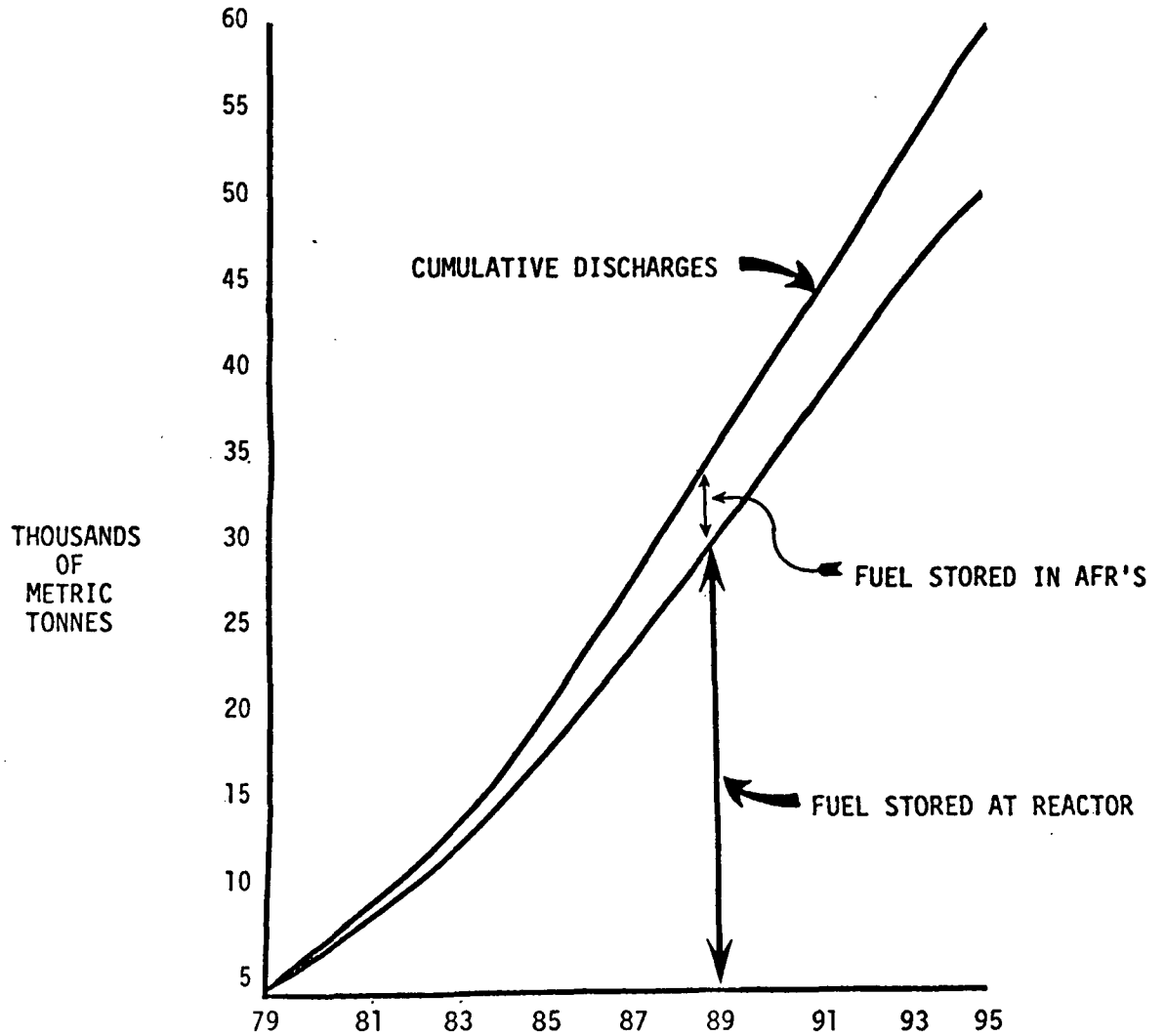


FIGURE 1. RANGE OF AFR REQUIREMENTS FOR PLANNING PURPOSES

FIGURE 2

COMPARISON OF AFR REQUIREMENTS AND FUEL STORED AT REACTORS



ASSUMPTIONS:

DISCHARGES - FROM CURRENTLY OPERATING OR PLANNED REACTORS

AFR REQUIREMENTS - BASED ON MAXIMUM BASIN EXPANSION PLANS AND NO TRANSSHIPMENT

SPENT FUEL STORAGE
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III. DISCUSSION OF THE RANGE OF AFR REQUIREMENTS ESTIMATED FOR PLANNING PURPOSES

A. Cases of Interest

AFR storage requirements are influenced by a number of factors such as plans for on-site storage capacity augmentation, transshipment of spent fuel between reactor basins, philosophy for maintaining reserve in the storage pools, etc. Upon using a combination of these, a number of cases of interest can be identified. These cases represent reasonable projections of AFR requirements and are of interest because of the sensitivity of projected AFR requirements to the variation in the parameters.

Figure 3 shows the six cases of interest with the corresponding AFR requirements. The explanation of assumptions regarding transshipment of fuel between reactor pool and pool expansions is detailed in the glossary at the end of the report. All these cases assume that a full core reserve (as defined in the glossary) is maintained at the storage pools, reactors operate at 70 percent capacity factor, and the average fuel burnup is conservatively assumed to be 23,000 MWD/MTU for BWR's and 31,000 MWD/MTU for PWR's.

Of the six cases of interest shown in Figure 3, three cases are of particular significance to the DOE spent fuel storage program since they represent reasonable upper and lower bounds for DOE planning around a selected base case (Case V).

- Case III represents a reasonable upper bound for planning purposes. It is based on the utilities expanding their basins according to their current plans. Essentially all utilities either have completed a reracking or have plans to do so. In some cases the small overall increase in storage capacity by further reracking may not be economically justified. This case reflects the possible scenario where no further reracking beyond current plans occurs. It also does not assume transshipment between reactors unless specified by the utilities. In view of strong intervenor opposition to transshipment, this assumption appears valid for an upper bound estimate.

- Case V has been chosen as the new DOE basis for planning purposes. It assumes that the utilities expand their reactor basins to the maximum capability they have estimated. As in Case III above, transshipment is not assumed unless specified. Recent information from the utilities confirms that this case best represents the situation that is likely to occur. Most utilities are moving toward maximum expansion of their existing reactor basins. However, many have indicated that transshipment should not be included in the base case planning. It represents a possible emergency stop-gap measure.

- o Case VI presents a lower bound estimate of storage requirements for planning purposes. It contains the same maximum expansion plans as the base case, but also assumes one transshipment of fuel between reactors in the same utility when possible.

Table 1 presents the cumulative annual projection of reactor discharges from the presently committed reactors and the AFR requirements for the three planning cases discussed above. One finds that over 85 percent of the spent fuel is still projected to be stored in on-site reactor basins in DOE's base case.

Table 1 also shows the AFR requirements if foreign fuel is included. As described in DOE/ET-0075, current projections utilize three conceptual levels of foreign fuel delivered to the United States (Options 1, 2 and 3). In this case only Option 2, limited to a total of 1000 MTU, is utilized. Using Case V, the total AFR requirements for foreign and domestic spent fuel are shown.

As before, foreign fuel is projected to have a very small impact on the AFR storage requirements.

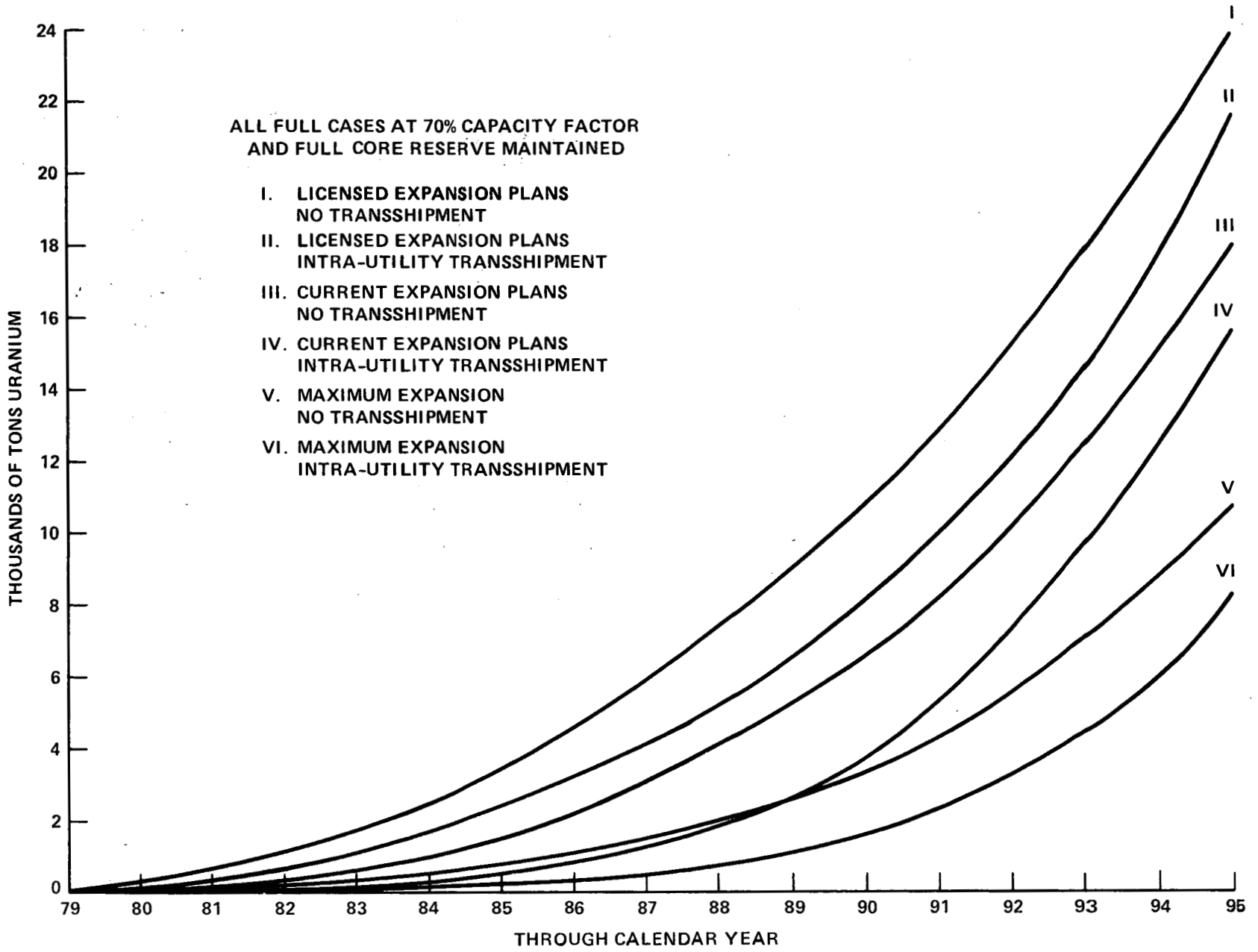

FIGURE 3. COMPARISON OF CUMULATIVE AFR STORAGE NEEDS CASES OF INTEREST.

TABLE 1

CUMULATIVE AFR STORAGE REQUIREMENTS

(MTU)

Year	Cumulative U.S. Reactor Discharges	Domestic AFR Requirements			Foreign Requirements	Planning Base Total (U.S. & Foreign)
		Upper Bound	Planning Base	Lower Bound		
1981	9,102	210	186	22	50	236
1982	10,900	334	280	97	100	380
1983	13,103	617	377	171	220	597
1984	15,740	962	529	233	340	869
1985	18,727	1,457	755	309	435	1,190
1986	22,312	2,238	1,047	385	575	1,622
1987	26,202	3,119	1,491	465	690	2,181
1988	30,425	4,091	1,985	556	885	2,870
1989	34,836	5,147	2,532	899	1,000	3,532
1990	39,368	6,485	3,277	1,586	1,000	4,277
1991	44,105	8,080	4,271	2,367	1,000	5,271
1992	48,965	10,061	5,534	3,219	1,000	6,534
1993	53,894	12,472	7,013	4,375	1,000	8,013

ASSUMPTIONS:

- o FULL CORE RESERVE MAINTAINED FOR ALL CASES
- o UPPER BOUND-CURRENT EXPANSION PLANS-NO TRANSSHIPMENT
- o PLANNING CASE-MAXIMUM POOL EXPANSION-NO TRANSSHIPMENT
- o LOWER BOUND-MAXIMUM POOL EXPANSION-WITH TRANSSHIPMENT
- o FOREIGN DEMAND-OPTION 2 OF DOE/ET-0040-D-DRAFT EIS ON STORAGE OF FOREIGN FUEL
- o CUMULATIVE DISCHARGES BASED ON CURRENTLY OPERATING AND PLANNED REACTORS AND INCLUDES FUEL ALREADY SENT TO STORAGE AND PROCESSING FACILITIES. THE AFR REQUIREMENTS EXCLUDE THIS FUEL.

IV. GLOSSARY OF TERMS AND DEFINITIONS

Current Utility Expansion Plans:

The reactor on-site spent fuel storage pools are expanded in accordance with the latest utility plans, regardless of the current licensing status of the plans.

Full Core Discharge Capability:

A reserve is maintained in the on-site spent fuel storage to prevent extended reactor outages in the event a core must be discharged. For the cases where spent fuel storage is shared by two or more reactors, reserve for only one core is maintained. To be realistic, the full core reserve is temporarily allowed to be violated if it is to be regained within two years by fuel pool expansion. This permits some reactors to operate for periods up to two years without full core reserve. However, a reserve for normal reactor discharge is always maintained.

Intra-utility Transshipment:

Fuel assemblies discharged from any reactor are permitted to be transshipped to one intermediate site before shipment to Federal facilities; that site is chosen as the spent fuel storage for the same kind of fuel (BWR or PWR) within the operating utility's system having the maximum available capacity. Thus, when it becomes necessary for any pool to ship fuel, the oldest fuel in the pool is chosen. If the fuel originated from the reactor at the site, it is shipped to another pool within the utility (chosen as before). If the oldest fuel originated at another reactor, it is shipped to the Federal facilities. Of course, if and when there is no space available for transshipment of fuel, then all fuel is shipped to the Federal facilities.

Licensed Expansion Plans:

Current fuel storage capacity on-site is allowed to be expanded within the limitations of the storage capacity that has been licensed by the Nuclear Regulatory Commission (NRC). Thus, in this pool expansion option, it is assumed that the utility plans, not currently licensed by NRC, do not materialize.

Maximum Expansion Plans:

In this pool expansion option, reactor spent fuel storage pools are expanded to the maximum estimate in the selected year (1985) or at startup, whichever is later; prior to that, pool expansion is assumed to be according to current utility expansion plans.

Whenever possible, a utility provided maximum storage capability is utilized as the maximum estimate. In the instances the utilities could not provide a maximum, an S. M. Stoller Corporation-generated maximum is used, after having been reviewed with the appropriate utility.

No Transshipment:

Fuel discharged from a reactor, unless already shipped off-site or committed to an existing AFR storage, is assumed to be stored only in the reactor's own spent fuel storage before being shipped away to Federal facilities.

Normal Discharge Capability:

A reserve is maintained in the on-site spent fuel storage to accept the estimated normal discharge batch due in the following calendar year. For PWR reactors, every tenth year of operation a full core reserve capability is maintained since these reactors must discharge the full core for the mandatory In-Service Inspection (ISI) every decade. If the storage pool is being expanded and will have a full core reserve on expansion, the mandatory ISI is permitted to be postponed for a maximum of one year.

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