Chapter 21

THE PROJECTED INFLUENCE OF EXTENDED UNIT SERVICE

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If the operational life of a nuclear power plant can be extended, decommissioning will be delayed. In effect, this is an alternative to decommissioning. Is this a sensible or desirable option? In this chapter, M.E. Lapides evaluates the cost, environmental consequences, and funding impacts of delaying for 20 to 30 years. One of his conclusions is that the impacts of decommissioning on any of these three categories will be insignificant to the decommissioning decision. A contrasting view was offered in Chapter 20.

INTRODUCTION

U.S. nuclear units are usually licensed to operate for 40 calendar years from the date of their original operating license issuance (Atomic Energy Act of 1954). Virtually all evaluations of decommissioning costs to date have assumed this 40-year operating term for financial evaluations or to define the radiation levels that might exist at the time of decommissioning. When an estimate of isotopic inventory was required, the assumption of a 75 percent to 80 percent capacity factor was applied to yield a base of 30 to 32 effective full power years of operation (Smith et al. 1978).

License renewal for extended service is permitted by Congressional statute. The U.S. Nuclear Regulatory Commission (NRC) is expected to develop license renewal requirements in the 1991-93 time frame (U.S. NRC Report 1988). U.S. utilities are examining the attractiveness of extended light water reactor (LWR) service with the view of adding perhaps 20 to 30 years to currently projected terms (EPRI 1989a). Decommissioning might then occur after 60 to 70 years of service. It is reasonable to consider the effect of such extended service on decommissioning planning and cost projections. The questions of potential concern may be summarized as follows:

- Will capital improvements, such as unit or plant configuration changes associated with extended service, change the cost of decommissioning?
- Will the environmental impacts of the increased inventory of long-lived radioisotopes modify decommissioning practice?
- Are any additional assurances necessary to insure adequacy of decommissioning funding?

Each of these subjects is discussed in the following paragraphs.

Plant Configuration Effects

Decommissioning cost estimates are based either on generic studies of LWRs (Smith et al. 1978; Oak et al. 1980) or private studies that individual utilities undertake to address their specific needs for regulatory compliance. Ongoing plant maintenance needs are considered in these studies. Plants undergo modifications on a continuous basis; most are minor refurbishments, a few result in major plant configuration changes. Two recent studies (EPRI 1987a; EPRI 1987b) suggest that LWR extended service will result in plant configuration changes no more substantive or frequent than have already occurred. It is possible, of course, that LWR units will be reconfigured to a form either more or less favorable to decommissioning. Technology improvements in replacement components is a favorable hypothetical example; the need to adversely change the ultimate decommissioning configuration in order to perform a major pressure vessel modification is an unfavorable hypothetical circumstance. Economic studies imply, however, that replacements mandating configuration changes adverse to decommissioning would also negate a utility decision to extend service (EPRI 1989b). Accordingly, it is reasonable to predicate that extended service introduces no variation in configuration beyond those already examined in utility-specific models. Thus, there is no basis to believe that the models that utilities now use for cost estimates need to be modified for plant modifications attendant on extended service.

Environmental Impacts

The long-lived radioactive isotopic inventory of an LWR increases with service term. The impact of this increase on decommissioning economics results from changes in the radiation levels to which laborers may be exposed, and from the increased inventory of activated products requiring disposal. Although no formal studies of these effects have been located, such effect can satisfactorily be estimated from the generic studies cited previously (Smith et al. 1978; Oak et al. 1980). Almost 60 percent of the reference inventory for a 40-service year (30 equivalent full power year) PWR unit is attributable to cobalt and iron isotopes that are short half-life materials and reach effective saturation levels after eight to 16 years. This inventory segment will not change in level with further service. The remaining 40 percent of the reference inventory is longer half-life materials that will increase in quantity approximately by the ratio (30+N)/30; (N is the equivalent full power years added by extended service). Numerically, the ratio becomes 1.5-2 for service life extensions of 20 to 40 years at 75 percent capacity factors. Combining the fixed and time-dependent fractions results in a radioactive inventory increase by factors of 1.2 to 1.4. Most of this increase is from additional accumulation of long half-life, beta-emitting isotopes in the reactor internals. Inventory calculations for a BWR unit differ quantitatively from those for PWRs but reveal essentially the same relative patterns of behavior (Oak et al. 1980). Because beta particles do not penetrate significant thicknesses of most common materials, they do not usually dictate the procedures and costs of minimizing radiation exposure to workers. (Collocated isotopes emitting more penetrating gamma rays, particularly Cobalt-60, are the more common determining issue.) A possible exception occurs when direct skin contact with an irradiated surface is involved, as is the case of calculating times after shutdown when unrestricted work and termination of possession-only licenses are feasible. Both of these times are already dictated by the decay patterns of those isotopes whose quantity would be doubled by extended service. Based on the preceding observations, it can be concluded that the present decommissioning model values can be assumed to apply to extended service applications as well. The increase in radioactive inventory from extended service does not substantially change the worker-protection costs in either the immediate or deferred dismantlement scenarios; the entombment option is already predicated on removal of the reactor internals prior to the surveillance period. Extended service obviously results in an increase in generation of spent fuel in direct proportion to the extended term equivalent full power years. The annualized impact of this increase on national waste disposal requirements is minimal. (Spent fuel inventory models assume that an LWR will replace about one-third of its fuel every 12 to 24 months, followed by full fuel inventory discharge at 40 years. In extended operation, the unit will continue to discharge only one-third of its inventory until end of service at 60 to 70 years. The result is a temporal decrease in predicted federal disposal requirements for an interval of about five years beginning about year 2010.) This suggests that decommissioning costs should not be impacted by delays in fuel disposal uniquely associated with extended service.

Assurance of Funding Adequacy

Each utility owner of an LWR is required to have financial arrangements for decommissioning at the end of a 40-year license term. These arrangements must provide for anticipated general inflation. The previous analyses suggest that there is no currently identified reason to expect that the cost of decommissioning will increase solely as a result of extending the service term of the unit. The actual situation is a reduction in the potential concerns about decommissioning funding adequacy. The following illustration (Figure 21.1), taken from a study by the Electric Power Research Institute (1988), makes this point.

The reference is an investment that was planned to provide adequate funding for a specified decommissioning scenario beginning at the end of 40-year service. The investment bears interest at an annual rate that is three percent in excess of inflation. Since the expectation is that the real cost of decommissioning is constant, the effect of extended service is to provide a margin of safety beyond the estimate for decommissioning costs. If the margin is considered unnecessary, the annualized contribution can be decreased. Otherwise, the fund value increases by added earnings after collection ceases. The second option is the only one now available to the owner. This implies that the current effect of license renewal is to provide a safety margin applicable to current decommissioning cost estimates.

CONCLUSIONS

Estimating the impacts of extended unit service on LWR decommissioning costs requires further extrapolation in time of the same techniques that are embedded in all current cost models. This paper has examined three critical elements of such extrapolation: plant configuration effects, environmental impacts of increased radioactive inventory, and assurance of funding adequacy. Based on this examination, it can be concluded that the decommissioning planning developed for 40-calendar-year service need not be significantly altered by extended service considerations.

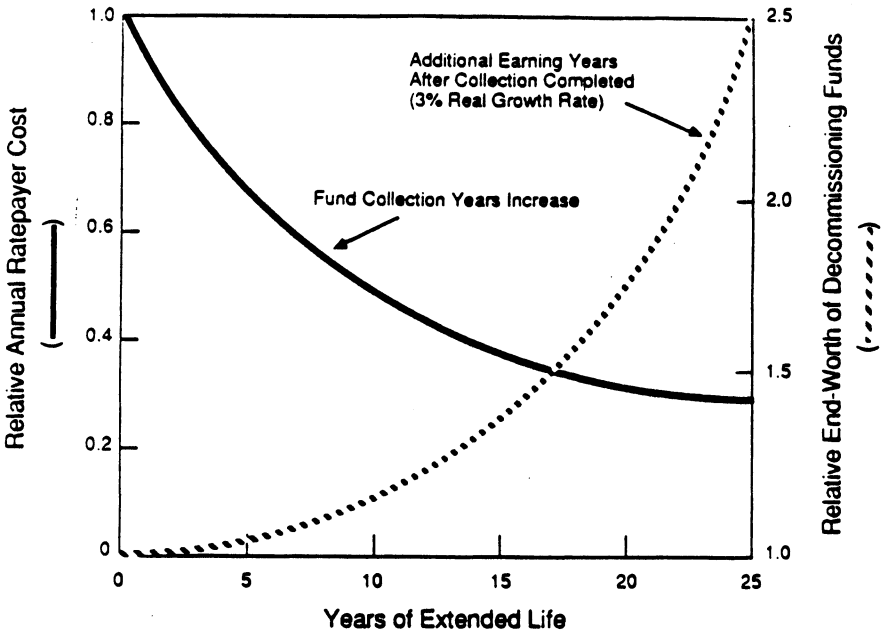

Figure 21.1. Assurance of Funding Adequacy

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