UNITED STATES
NUCLEAR REGULATORY COMMISSION
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ENVIRONMENTAL ASSESSMENT

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATING TO THE MODIFICATION OF THE

SPENT FUEL STORAGE RACKS

FACILITY OPERATING LICENSES NOS. DPR-44 AND DPR-56

PHILADELPHIA ELECTRIC COMPANY
PUBLIC SERVICE ELECTRIC AND GAS COMPANY
DELMARVA POWER AND LIGHT COMPANY
ATLANTIC CITY ELECTRIC COMPANY

PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3

DOCKET NOS. 50-277 AND 50-278

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1.0 INTRODUCTION

The present storage capacity of the spent fuel pools at Peach Bottom Atomic Power Station, Units 2 and 3, is 2,608 fuel assemblies for each spent fuel pool for each unit. These limited storage capacities were in general in keeping with the expectation generally held in the industry that spent fuel would be kept onsite for a few years and then shipped offsite for reprocessing and recycling.

Commercial reprocessing of spent fuel has not developed as had been originally anticipated. In 1975 the Nuclear Regulatory Commission directed the staff to prepare a Generic Environmental Impact Statement (GEIS, the Statement) on spent fuel storage. The Commission directed the staff to analyze alternatives for the handling and storage of spent light water power reactor fuel with particular emphasis on developing long range policy. The Statement was to consider alternative methods of spent fuel storage as well as the possible restriction or termination of the generation of spent fuel through nuclear power plant shutdown.

A Final Generic Environmental Impact Statement on Handling and Storage of Spent Light Water Reactor Fuel (NUREG 0575), Volumes 1-3 (the FGEIS) was issued by the NRC in August 1979. In the FGEIS, consistent with long range policy, the storage of spent fuel is considered to be interim storage, to be used until the issue of permanent disposal is resolved and implemented.

One spent fuel storage alternative considered in detail in the FGEIS is the expansion of onsite storage by modification of the existing spent fuel pools. Since the issuance of the FGEIS, numerous applications have been received and approved. The finding in each case has been that the environmental impact of such increased storage capacity is negligible. However, since there are variations in storage designs and limitations caused by the spent fuel already stored in pools, the FGEIS recommended that licensing reviews be done on a case-by-case basis to resolve plant specific concerns.

In addition to the alternative of increasing the storage capacity of the existing spent fuel pools, the FGEIS discusses in detail other spent fuel storage alternatives. The finding of the FGEIS is that the environmental impact costs of interim storage are essentially negligible, regardless of where such spent fuel is stored. A comparison of the impact-costs of various alternatives reflects the advantage of continued generation of nuclear power versus its replacement by coal fired power generation. In the bounding case considered in the FGEIS, that of shutting down the reactor when the existing spent fuel storage capacity is filled, the cost of replacing nuclear stations before the end of their normal lifetime makes this alternative uneconomical.

This Environmental Assessment (EA) addresses only the specific environmental concerns related to the proposed expansion of the Peach Bottom Atomic Power Station, Units 2 and 3, spent fuel storage capacity. This EA consists of three major parts, plus a summary and conclusion. The three parts are: (1) descriptive material, (2) an appraisal of the environmental impact of the proposed action, and (3) an appraisal of the environmental impact of postulated accident. Additional discussion of the alternatives to increasing the storage capacity of existing spent fuel pool is contained in the FGEIS.

1.1 Description of the Proposed Action

By application dated June 13, 1985 and supplemented by letters dated August 1, 1985, October 9, 1985 and December 26, 1985, Philadelphia Electric Company (the licensee or PECo) requested approval to permit increases in the storage capacity of the Peach Bottom Atomic Power Station, Units 2 and 3, spent fuel pools (SFPs) from 2,608 to 3,819 storage cells. The increases are to be accomplished by use of new rack structures and removal of the SFPs cooling piping and diffusers.

The environmental impacts associated with the operations of Peach Bottom Atomic Power Station, Units 2 and 3, were considered in the Final Environmental Statement (FES) issued in April 1973(1). The purpose of this EA is to evaluate any additional environmental impacts which are attributable to the proposed increases in the SFPs storage capacity at both Peach Bottom units.

1.2 Need for Increased Storage Capacity

Each unit at Peach Bottom Atomic Power Station is a boiling water reactor (BWR). The licensee's projected SFP capacity requirements indicate that both units will lose their full-core discharge reserve storage capacity (764 assemblies) in the 1987-88 time frame; and, in the 1991-1992 time frame, they will no longer have the capacity to store any additional fuel discharges from the operating units. Therefore, to ensure that sufficient capacity continues to exist for Peach Bottom to store discharged fuel assemblies, PECo plans to replace the existing storage racks with new spent fuel storage racks whose design will allow for more dense storage of spent fuel, thus enabling the existing pools to store more fuel in the same place as occupied by the current racks.

1.3 Fuel Reprocessing History

Currently, spent fuel is not being reprocessed on a commercial basis in the United States. The Nuclear Fuel Services (NFS) plant at West Valley, New York, was shut down in 1972 for alterations and expansions; in September, 1976, NFS informed the Commission that it was withdrawing from the nuclear fuel reprocessing business. The Allied General Nuclear Services (AGNS) proposed plant in Barnwell, South Carolina, is not licensed to operate.

The General Electric Company's (GE) Morris Operation (MO) in Morris, Illinois is in a decommissioned condition. Although no plants are licensed for reprocessing fuel, the storage pool at Morris, Illinois and the storage pool at West Valley, New York are licensed to store spent fuel. The storage pool at West Valley is not full, but NFS is presently not accepting any additional spent fuel for storage, even from those power generating facilities that have contractual arrangements with NFS. On May 4, 1982, the license held by GE for spent fuel storage activities at its Morris operation was renewed for another 20 years, however, GE is also not accepting any additional spent fuel for storage at this facility.

2.0 FACILITY

The principal features of the spent fuel storage and handling at Peach Bottom, Units 2 and 3, as they relate to the proposed modifications are described here to aid understanding of the evaluations provided in subsequent sections of this EA.

2.1 Spent Fuel Pool (SFP)

Initially spent fuel assemblies are intensely radioactive due to their fresh fission product content when removed from the core; also, they have a high thermal output. The SFP is designed for storage of these assemblies to allow for radioactive and thermal decay prior to shipping them offsite. Space permitting, assemblies may be stored for longer periods, allowing continued fission product decay and thermal cooling. The SFPs structures structures are reinforced concrete lined with an eight gage thick stainless steel liner.

2.2 Spent Fuel Pool Cooling and Cleanup System

Each Peach Bottom unit has an independent spent fuel pool and spent fuel pool cooling and cleanup system. The spent fuel pool cooling and cleanup system is designed to remove the decay heat generated by the stored spent fuel assemblies and to maintain the water quality and clarity of the pool water. The Peach Bottom spent fuel cooling system is composed of three fuel pool cooling pumps, three heat exchangers, a filter-demineralizer,and two skimmer surge tanks. The filter-demineralizers, which collect radioactive corrosion products, are so arranged that one is designated for each reactor unit, and the third is a common spare for use by either unit when either of the other two units is taken out of service for precoating.

The pumps circulate the pool water in a closed loop, taking suction from the skimmer surge tanks through the heat exchangers, circulating the water through the filter-demineralizers, and discharging through diffusers at the bottom of the pool fuel. The cooled water traverses the pool picking up heat and debris before starting a new cycle by discharging over the skimmer weirs into the skimmer surge tanks. Makeup water for the system can be transferred from the condensate storage tank to the skimmer surge tanks. Pool water clarity and purity are maintained by a combination of filtration and ion exchange. Alarms, differential pressure indicators, and flow indicators monitor the condition of the filter-demineralizers.

2.3 Radioactive Waste Treatment System

Each unit contains waste treatment systems designed to collect and process the gaseous, liquid and solid waste that might contain radioactive material. The waste treatment systems are evaluated in the Final Environmental Statement (FES) for Unit Nos. 2 and 3, dated April 1973. The proposed modifications will not result in any significant additional radwaste that will need to be processed. Therefore, there will be no changes in the waste treatment systems described in Section 3.0 of the FES because of the proposed modifications.

3.0 NON-RADIOLOGICAL ENVIRONMENTAL IMPACTS OF PROPOSED ACTION

The non-radiological environmental impacts associated with the operations of Peach Bottom Atomic Power Station, Unit Nos. 2 and 3, as designed were considered in the FES. The proposed modifications of the SFPs will not cause any new non-radiological environmental impacts which were not previously considered based on the following:

1) The proposed modifications will alter only the spent fuel storage racks. They will not alter the external physical geometry of the SFP structures. In addition, construction of the new racks will be done offsite and transported

to the facility. No unusual terrestrial effects are anticipated or considered likely.

2) Additional storage will not result in a measurable increase in non-radiological chemical waste discharges to the receiving water. The licensee does not propose any changes in chemical usage or change to the NPDES permit.

3) Additional SFP heat output will not cause measurable thermal effects to the receiving water. The increase in the heat load due to this modification is less than five (5) percent for a 18-month reload and less than ten (10) percent for full-core discharge as compared with the present SFP design heat load. These calculated decay heat discharges to the plant water and to the Susquehanna River due to the proposed modifications do not significantly exceed the design values used by the NRC in its 1978 evaluation of the non-radiological environmental impact due to spent fuel increased storage at Peach Bottom.(2)

We conclude, based on the above evaluations, that the SFP modifications will not result in non-radiological environmental effects significantly greater or different from those already reviewed and analyzed in the FES for Peach Bottom, Units 2 and 3.

4.0 RADIOLOGICAL ENVIRONMENTAL IMPACTS OF PROPOSED ACTION

4.1 Introduction

The potential radiological environmental impacts associated with the expansion of the spent fuel storage capacity were evaluated and determined to be environmentally insignificant as addressed below.

During the storage of the spent fuel under water, both volatile and nonvolatile radioactive nuclides may be released to the water from the surface of the assemblies or from defects in the fuel cladding. Most of the material released from the surface of the assemblies consists of activated corrosion products such as Co-58, Co-60, Fe-59 and Mn-54 which are not volatile. The radionuclides that might be released to the water through defects in the cladding, such as Cs-134, Cs-137, Sr-89 and Sr-90 are also predominantly nonvolatile. The primary impact of such nonvolatile radioactive nuclides is their contribution to radiation levels to which workers in or near the SFPs would be exposed. The volatile fission product nuclides of most concern that might be released through defects in the fuel cladding are the noble gases (xenon and krypton), tritium and the iodine isotopes.

Experience indicates, however, that there is little radionuclides leakage from spent fuel stored in pools after the fuel has cooled for several months. The predominance of radionuclides in the SFP water appears to be radionuclides that were present in the reactor coolant system prior to refueling (which becomes mixed with water in the SFP during refueling operations) or crud dislodged from the surface of the spent fuel during transfer from the reactor core to the SFP.

During and after refueling, the SFP purification system reduces the radioactivity concentrations considerably. A few weeks after refueling, the spent fuel is cooled in the SFP and the fuel clad temperature becomes relatively cool, approximately 180°F. This substantial temperature reduction should reduce the rate of release of fission products from the fuel pellets and decrease the gas pressure in the gap between pellets and clad, thereby tending to retain the fission products within the gap. In addition, most of the gaseous fission products have short half-lifes and decay to insignificant levels within a few months. Based on the operational reports submitted by licensees and discussions with the operators, there has not been any significant leakage of fission products from spent light water reactor fuel stored in the MO (formerly Midwest Recovery Plant) at Morris, Illinois, or at the Nuclear Fuel Services (NFS) storage pool at West Valley, New York. Some spent fuel assemblies which have significant leakage while in operating reactors have been stored in these two pools. After storage in the onsite SFP, these fuel assemblies were later shipped to either MO or NFS for extended storage. Although the fuel exhibited significant leakage at reactor operating conditions, there was no significant leakage from these fuel assemblies in the offsite storage facility.

4.2 Radioactive Material Released to the Atmosphere

With respect to releases of gaseous materials to the atmosphere, the only radioactive gas of significance which could be attributable to storing additional fuel assemblies for a longer period of time would be the noble gas radionuclide Krypton (Kr85). Experience has demonstrated that after spent fuel has decayed 4 to 6 months, there is no longer a significant release of fission products, including Kr-85, from stored fuel containing cladding defects.

The proposed Peach Bottom Unit Nos. 2 and 3 SFP modifications will increase the overall capability for each unit from 2608 to 3819 cells per unit. An average of 276 fuel assemblies are expected to be stored following each refueling. Since space must be reserved to accommodate a complete reactor core discharge (764 fuel assemblies), the useful pool capacity after the proposed modification will be 3055 fuel assemblies per unit. For the Peach Bottom site, at least one full core storage capability will be maintained for both units until 1993.

We assumed that all of the Kr-85 that is going to leak from defected fuel will do so in the interval between refuelings. The assumption is conservative and maximizes the amount of Kr-85 to be released. Our calculations summarized in Table 1 show that the maximum expected release of Kr-85 from one refueling cycle (276 assemblies) is approximately 144.3 curies. Spent fuel discharges from both units are expected to yield an annual release of 199 curies/year of Kr-85. This is not significant when compared to the estimated 300,000 curies/year of noble gas releases for the combined units from all other sources (1). Accordingly, the enlarged capacity of the pool has no significant effect on the greatest release rate of Kr-85 to the atmosphere. Thus, we conclude that the proposed modifications will have an insignificant effect on offsite exposures.

Iodine-131 release from spent fuel assemblies to the SFP water will not be significantly increased because of the expansion of the SFP storage capacity because the Iodine-131 inventory in the fuel will decay to negligible levels between refuelings for each unit.

A relatively small amount of tritium is contributed during reactor operation by fission of reactor fuel and subsequent diffusion of tritium through the fuel and Zircaloy cladding. Almost all of the tritium release from the fuel occurs while the fuel is hot, that is, during operations and, to a limited extent, shortly after shutdown. Thus, expanding SFP capacity will not increase the tritium activity in the SFP.

Storing additional spent fuel assemblies is not expected to increase the bulk water temperature during normal refuelings above 150°F used in the design analysis. Therefore, it is not expected that there will be any significant change in the annual release of tritium or iodine as a result of the proposed modifications from that previously evaluated in the FES.

Assuming the loss of all SFP cooling, boiling could occur after 83 hours for the maximum "abnormal" heat load condition (full core discharge with all remaining storage spaces full with fuel from successive cyclic discharges). This is a substantial period for actions to be taken such as initiating pool makeup water for the SFP. The licensee has analyzed the effects of SFP boiling on the outside environment. The licensee utilized a model similar to that previously employed for a comparable analysis on the Limerick Generating Station to determine the offsite radiological consequences of SFP boiling. The results indicate that the potential offsite dose would be a very small fraction of 10 CFR Part 100 limits and was a negligible offsite contributor. We find this analysis and its conclusion to be acceptable.

4.3. Solid Radioactive Waste

The concentration of radionuclides in the SFP water is controlled by the filters and the demineralizers, and by the decay of short-lived isotopes. The activity is highest during refueling operations when reactor coolant water is introduced into the SFP, and decreases as the SFP water is processed through the filters and demineralizers. The increase of radioactivity, if any, due to the proposed modifications, should be minor because of the capability of the cleanup system to continuously remove radioactivity in the SFP water to acceptable levels. The licensee states that the amount of solid waste presently being generated by the spent fuel pool cleanup system is approximately 100 cubic feet per unit every year. The licensee does not expect that these SFP modifications will result in any significant increase in this amount of solid waste generated from the spent fuel pool cleanup system. While we agree with the licensee, we note that should there be an increase in spent fuel pool resin waste generation, the total waste, however, would still be within those values estimated in the FES.

The present spent fuel pool racks will be removed from the pool. The disposal method has not been determined by the licensee. However, should the present racks be shipped to an ultimate burial site, the additional quantity of solid waste is not expected to be environmentally burdensome because the volume is small compared to the annual waste generation rate.

4.4 Radioactivity Released to Receiving Waters

Since the SFP cooling and cleaning systems operate as a closed system, only water originating from cleanup of the SFP floors and resin sluice water need be considered as potential sources of radioactivity. It is expected that neither the quantity nor activity of the floor cleanup water will change as a result of the proposed SFP modifications. The SFP demineralizer resin removes soluble radioactive material from the SFP water. These resins are periodically sluiced with water to the SFP resin storage tank. The amount of radioactivity on the SFP demineralizer resin may increase slightly due to the additional spent fuel in the SFP, but the soluble radioactive material would be retained on the resins. If any radioactive material is transferred from the spent resin to the sluice water it will be removed by processing through the liquid radwaste system. Therefore, because the liquid radwaste processing system captures radioactive material, it is not expected that any additional radioactivity will be released to the environment resulting from the proposed SFP modifications.

4.5 Occupational Radiation Exposures

The staff has reviewed the licensee's plan for the modification of the Peach Bottom SFP racks with respect to occupational radiation exposure involving the removal and disposal of the current racks, and the installation of the proposed higher density racks. The licensee estimates that the exposure for this operation will be approximately 36 man-rems. This estimate is based upon the licensee's breakdown of occupational exposure for each phase of the modification. The licensee considered the number of individuals performing a specific job, their occupancy time while performing this job, and the average dose rate in the area where the job is being performed. This exposure is a small fraction (less than one percent) of the total annual person-rem from occupational exposure.

We have estimated the increment in onsite occupational dose during normal operations after the proposed SFP modifications have been completed with the proposed increase in stored fuel assemblies. Our estimate is based on information supplied by the licensee for occupation times and for dose rates in the SFP area from radionuclides concentrations in the SFP water. The spent fuel assemblies themselves contribute a negligible amount to dose rates in the pool area because of the depth of water shielding the fuel. Based on the present and projected operations in the SFP area, the staff estimates that the proposed modifications should add less than one percent to the total annual occupational radiation exposure at the plant. This small projected increase in radiation should not affect the licensee's ability to maintain individual occupational dose to ALARA levels and within the limits of 10 CFR Part 20. Thus, the staff concludes that the storing of additional fuel in the SFP will not result in any significant increase in dose received by workers.

5.0 ENVIRONMENTAL IMPACTS OF POSTULATED ACCIDENTS

5.1 Rack Module Assembly Drop Accident

The overhead cranes in the auxiliary building at Peach Bottom will be used for removing the existing rack modules and lowering the new modules into the pool. The licensee has stated in Section 4.7.4.2, Procedure, of its August 1, 1985 submittal that all load handling operations for the new high density fuel storage racks in the SFP area will be conducted in accordance with the criteria of Section 5.1.1 of NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants". In this same Section, the licensee has committed that at no time will a rack module be carried directly over another module installed in the SFP, and containing spent fuel. Therefore, the assessment of the radiological consequences of a replacement rack drop accident is not required.

5.2 Fuel Handling Accident

The staff has reviewed the licensee's proposed SFP storage capacity increase as it relates to changes in the radiological consequences of a postulated fuel handling accident as compared to those reported in the FES (1). A bounding calculation performed by the staff shows that the radiological consequences of a cask drop/tip accident are well within the NRC Standard Review Plan (SRP) dose guidelines (SRP 15.7.5). The staff, therefore, concludes that the proposed SFP modifications are acceptable.

5.3 Conclusion

Based upon the above evaluation, the staff concludes that the likelihood of a rack module assembly drop accident is sufficiently small because rack module assemblies will not be carried directly over other fuel-containing modules installed in the SFP and, therefore, the staff concludes that this accident need not be considered. Also, a fuel handling accident involving a dropped assembly or cask would not be expected to result in radionuclide releases leading to offsite radiological consequences exceeding those of the fuel handling accident evaluated in the staff's FES of April 1973; that is, the doses would be well within 10 CFR Part 100 values. We conclude, therefore, that the proposed modifications are acceptable and will not result in radiological environmental effects that differ significantly from those previously evaluated.

6.0 ALTERNATIVE USE OF RESOURCES

This action involves no use of resources not previously considered in the FES(1) for Peach Bottom Units 2 and 3. In addition, because we have not identified any significant environmental impacts which would result from this action, we have not considered alternatives to the proposed action or assessed the impacts of alternative beyond that considered in the FGEIS.

7.0 OTHER PERSONS CONSULTED

The NRC staff evaluated the licensee's proposal and consulted the FGEIS but did not consult other agencies or persons in preparing this environmental assessment.

8.0 SUMMARY

The Final Generic Environmental Impact Statement (FGEIS) on Handling and Storage of Spent Light Water Power Reactor Fuel concluded that the environmental impact of interim storage of spent fuel was negligible and the cost of various alternatives reflect the advantage of continued generation of nuclear power with the accompanying spent fuel storage. Because of the differences in SFP designs the FGEIS recommended licensing SFP expansion on a case-by-case basis. For Peach Bottom Atomic Power Station, Units 2 and 3, expansion of the storage capacity of the SFPs does not significantly change the radiological impact evaluated in the April 1973 FES (1). As discussed in Sections 2.0 and 4.0, the proposed reracking and added fuel are well within the capability of the SFP cleanup system and this system will keep the concentrations of radioactivity in the SFP water well within acceptably low levels. Operation of the proposed SFP with additional spent fuel in the SFPs is not expected to increase the occupation radiation exposure by more than one percent of the total annual occupational exposure at Peach Bottom. We conclude that there are no significant radiological or nonradiological impacts associated with the proposed license amendments and that the amendments will not have a significant effect on the quality of the human environment.

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9.0 REFERENCES

1. Final Environmental Statement (FES) related to Peach Bottom Atomic Power Station, Units 2 and 3, April 1973

2. Letter from J.F. Stolz (NRC) to E.G.Bauer (Philadelphia Electric Company) dated November 30, 1978.

TABLE I

SFP MODIFICATION
ESTIMATE RELEASE RATE OF KR-85

DATA

Peach Bottom, Units 2 and 3

Core = 764 fuel assemblies

Single Refueling = 276 core assemblies per unit per 18 months

Cladding = Zircalay-4

Burnup = approx. 40,000 MWd/MTu

Weight of UO_2 in Core = 164.3 MT of UO_2 or 144.7 MTu

Escape Rate Coeff. of Kr-85 = 6.5×10^{-8}/sec

Fission Yield of Kr-85 = 0.0034

Failed Fuel Fraction (NUREG-0017) = .0012

Half-life (Kr-85) = 10.7 years

$$\text{Amt Kr-85 in fuel} < \frac{\text{Production rate}}{>\text{decay} + >\text{leakage}}$$

atoms/f   f/MWsec

$$\text{Production Rate} = \frac{0.0034 \times 3.12 \times 10^{16} \times 3293 \text{ MWt}}{144/8 \text{ MTu}}$$

$$= 2.4 \times 10^{15} \frac{\text{atoms}}{\text{MTu sec}}$$

$= \underline{2.4 \times 10^{15}}$ atoms/MTu sec

(>decay = 2.05×10^{-9}/sec, >leak = 6.5×10^{-8}/sec)

Amt KR-85 in fuel $\underline{<3.60 \times 10^{22}}$ atoms/MTu
$\underline{<2380}$ Curies/MTu

The following model assumes that all Kr-85 that can leak out from the failed fuel assemblies will be released before the spent fuel is removed from the pool.

Simple case: All Kr-85 escape between refueling =

$$2880 \text{ curie/MTu} \times \frac{244.7 \text{ MTu}}{764 \text{ ass.}} \times \frac{276 \text{ ass.}}{\text{refuel}} \times .0012 = 149.3 \text{ curies/refueling}$$

For the two units, the average spent fuel input yields

$$144.3 \text{ curies/refuel} \times \frac{2 \text{ refuelings}}{18 \text{ months}} \times \frac{12 \text{ months}}{\text{year}} \quad 199.0 \text{ curies/year}$$