NUREG-1003

Final Environmental Statement

related to steam generator repair at H. B. Robinson Steam Electric Plant, Unit No. 2

Docket No. 50-261

Carolina Power and Light Company

U.S. Nuclear Regulatory Commission

Office of Nuclear Reactor Regulation

November 1983

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This final environmental statement was prepared by the U.S. Nuclear Regulatory Commission staff. This statement contains an environmental evaluation of the proposed steam generator repair program for H. B. Robinson Steam Electric Plant Unit No. 2 and alternatives thereto.

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Comments on the draft statement were received by the Director, Division of Licensing, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington, DC 20555, and were taken into account in the preparation of this final environmental statement.

ABSTRACT

The staff has considered the environmental impacts and economic costs of the proposed steam generator repair at the H. B. Robinson Steam Electric Plant Unit No. 2 along with reasonable alternatives to the proposed action. The staff has concluded that the proposed repair will not significantly affect the quality of the human environment and that there are no preferable alternatives to the proposed action. Furthermore, any impacts from the repair program are outweighed by its benefits.

SUMMARY

In letters dated July 1, 1982 and September 16, 1982 and supplemented by Carolina Power & Light Company letters dated March 31, 1983 through November 11, 1983 (see References), Carolina Power & Light Company (CP&L) proposed to repair the steam generators in H. B. Robinson Steam Electric Plant Unit 2 (HRB-2, or the plant) (Section 2). The Nuclear Regulatory Commission staff (the staff) determined that the proposed program would require amending the CP&L operating licenses for the plant, and on November 24, 1982 a Notice of the Proposed Issuance of Amendment to the license was published in the Federal Register (47 FR 53157). Petitions for leave to intervene were filed and one was granted in connection with this proposed action.

On March 24, 1983 a special prehearing conference was held at Florence, South Carolina. On April 12, 1983, the Atomic Safety and Licensing Board issued a Memorandum and Order which ordered, among other things, that the petitioner, Hartsville (Group), be admitted as a party intervenor in the proceeding. On June 10, 1983, the Director, Office of Nuclear Reactor Regulation, directed that an Environmental Impact Statement (EIS) be prepared.

The primary impact in this environmental review is the occupational radiation exposure that the HBR-2 repair program will entail (Section 4.1.1.1).

The staff comparatively evaluated the environmental impacts of the proposed repair program (replacing the lower assemblies of the steam generator) and the following alternatives to the repair and disposal programs.

(1) Entirely replacing the steam generator (Section 5.1)

(2) Retubing the steam generators in place (Section 5.2)

(3) Sleeving the steam generators (Section 5.3)

(4) Shutting down H. B. Robinson Steam Electric Plant Unit 2 (no change) (Section 5.4)

(5) Immediate intact offsite shipment without decontamination (Section 5.6)

(6) Immediate intact offsite shipment with decontamination (Section 5.6)

(7) Long-term intact onsite storage (Section 5.6)

(8) Immediate cut-up and offsite shipment with decontamination (Section 5.6)

(9) Immediate cut-up and offsite shipment without decontamination (Section 5.6)

The staff has concluded that the proposed program will not significantly affect the quality of the human environment. Furthermore, the staff found none of the alternatives to be obviously superior to the proposed program. The staff has also concluded that any impacts from the proposed repair program are outweighed by its benefits (Section 6).

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ABBREVIATIONS

ALARA	as low as is reasonably achievable
AVT	all-volatile treatment
BEIR	Biological Effects of Ionizing Radiation (Advisory Committee of the National Academy of Sciences)
BWR	boiling water reactor
CFR	Code of Federal Regulations
CP&L	Carolina Power and Light Company
DER	design electrical rating
EFPM	effective full-power months
EPRI	Electric Power Research Institute
FES	final environmental statement
FPL	Florida Power and Light Company
FR	Federal Register
HBR-2	H. B. Robinson Steam Electric Plant Unit No. 2
ICRP	International Commission on Radiological Protection
NCRP	National Council on Radiation Protection and Measurement
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
PNL	Pacific Northwest Laboratories
PWR	pressurized water reactor
SG	steam generator
SGLA	steam generator lower assembly
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation

1 PURPOSE OF THIS ENVIRONMENTAL STATEMENT

By letter dated July 1, 1982, Carolina Power & Light Company (CP&L, or the licensee) submitted a letter of intent to repair the three steam generators (SGs) at the H. B. Robinson Steam Electric Plant Unit No. 2 (HBR-2). The letter briefly described CP&L's intended program and informed the NRC that a Preliminary Steam Generator Repair Report would be submitted on September 1, 1982. CP&L made a determination that "this repair will be an allowable activity under 10 CFR 50.59, not requiring NRC issue of a Safety Evaluation Report." CP&L made this determination based on the fact that NRC review and evaluation of previous SG replacements had shown the absence of unreviewed safety issues. The Preliminary Repair Report was submitted by CP&L letter dated September 16, 1982. By letter dated November 18, 1982, the NRC staff informed CP&L that the staff first had to review and approve these repairs, and that the CP&L letter of July 1, 1982 as supplemented by the letter dated September 16, 1982 was considered as an application for a license amendment. The staff's letter also notified CP&L that proposed issuance of amendments associated with this action were being published in the Federal Register. Publication in the Federal Register took place November 24, 1982 (47 FR 53157).

On January 6, 1983, CP&L submitted its report entitled "Final Steam Generator Repair Report." This report has been supplemented by Revision 1, dated March 31, 1983, and additional supplemental material to Revision 1 (see letters from CP&L dated March 31, 1983 through November 1, 1983 in the References section). The report describes a proposed program to repair the three steam generators at HBR-2 by replacing the lower assembly, including the tube bundles, of each generator.

On June 10, 1983, the Director, Office of Nuclear Reactor Regulation, directed that an Environmental Impact Statement (EIS) be prepared for the amendment application regarding the repair of the HBR-2 steam generators.

2 BACKGROUND

The steam generator repair program proposed by CP&L is essentially identical to the steam generator repairs completed by the Florida Power and Light Company for Turkey Point Units 3 and 4, and essentially similar to the repairs conducted at Surry Power Station Units 1 and 2. Each of the plants contain two Westinghouse three-loop pressurized water reactors (PWRs). Each plant began operation using a sodium phosphate secondary water chemistry treatment: H. B. Robinson Unit 2 in June 1971 and Turkey Point in late 1974. The Turkey Point repair program was approved June 24, 1981 and repairs commenced on June 19, 1981 for Unit 3 and were completed April 7, 1982. Unit 4 repairs commenced October 16, 1982 and were completed May 16, 1983.

2.1 History of Steam Generator Operation

H. B. Robinson Steam Electric Plant Unit No. 2 (HBR-2) began commercial operation on March 7, 1971. Like almost all units with U-tube design steam generators, it began operation using a sodium phosphate secondary water chemistry treatment. This treatment was designed primarily to remove precipitated or suspended solids by blowdown and was successful as a scale inhibitor.

Eddy current testing began in 1972, when steam generator tube leaks occurred. Upon determining the cause to be caustic corrosion, feedwater chemistry specifications (the sodium to phosphate ratios) at HBR-2 were adjusted to ensure that acceptable caustic conditions would be maintained in the steam generator.

HBR-2 and San Onofre Unit 1 had not experienced phosphate wastage at the rate experienced at other plants using phosphate chemistry during the period when the other PWRs converted to all-volatile-treatment (AVT) chemistry control in the secondary system. Therefore, in 1975, HBR-2 chose not to switch from a sodium phosphate treatment to an AVT chemistry for the steam generator secondary coolant, since the steam generator condition would not be significantly improved and might possibly be degraded. Instead, actions were taken such as "sludge lancing" during outages to remove sludge buildup occurring on the steam generator tubesheet and tube support plates. In addition, condenser air inleakage was more stringently monitored and controlled. Eddy current inspection of tubes during outages was continued to determine tube condition and to monitor the status of tube degradation.

Based on Electric Power Research Institute (EPRI) recommendations, HBR-2 continued to monitor condenser inleakage strictly and to make other modifications to the system to assist in alleviating the inleakage problem. Among these modifications the feedpoint for hydrazine, an oxygen scavenger, and injection into the feedwater system were changed.

In 1980, HBR-2 began experiencing problems with stress corrosion cracking in tubes near the tubesheets. As a result of a high level of stress corrosion cracking activity above the tubesheet area observed during the August 1981

eddy current inspection, licensing conditions were imposed for the balance of cycle 8 operations. The conditions included periodic steam generator primary to secondary hydrostatic tests and more stringent limits on allowable primary to secondary leakage (a definition of terms and general explanation of the corrosion phenomena discussed here may be found in NUREG-0886, "Steam Generator Tube Experience," February 1982).

HBR-2 shut down as a result of a 0.3-gpm leak on July 30, 1981. Inspection of the leaking tube revealed that a through-wall stress corrrosion crack above the top of the tubesheet elevation was the source of the leak. In addition, evidence of general intergranular attack was observed below the top of the tubesheet in the crevice region. The crack above the tubesheet had an axial orientation and was approximatley 0.8 in. long. The low leakage rate has been attributed to the restraining effect of the hard sludge on the tube, a phenomenon similar to one that was observed previously at San Onofre Unit 1. In August 1981, based on advice from Westinghouse and from data obtained by EPRI that correlated temperature to the corrosion phenomenon, HBR-2 began operating at a 50% power level to reduce the hot-leg temperature. In November 1981, HBR-2 began operating on an NRC-approved reduced T_{ave} program to reduce stress corrosion cracking.

An eddy current inspection performed during the refueling operation for cycle 9 core reload, during March and April 1982, indicated that the reduced temperature operation since November 1981 had been successful in sharply reducing the stress corrosion cracking activity above the tubesheet. However, the inspection also indicated an acceleration of phosphate wastage corrosion during the reduced power operating cycle (cycle 8). Therefore, an additional operating limit of 6 effective full-power months (EFPMs) was imposed on the plant. After 6 EFPM operation, the unit was to be shut down for a steam generator inspection to ensure that further progression of wastage did not become excessive. Since the reduced temperature operation was successful in reducing stress corrosion cracking, the licensing condition for primary to secondary steam generator hydrostatic testing imposed in 1980 was removed.

The operation of HBR-2 continues to be subject to operating restrictions such as reduced power level, stringent limits for primary to secondary leakage, and additional inspection and reporting requirements in the event that the unit is shut down because of leakage in excess of the limits in the Technical Specification.

The licensee took additional actions to assist in controlling tube deterioration. These actions included removing of copper from the feedwater system and condenser, improving inspections to identify and correct existing and potential leakage paths into the condenser, and relocating the condensate makeup line to the hotwell to provide better oxygen removal. The May 1983 eddy current inspection was performed on 100% of the unplugged tubes. As a result of this inspection, 16 tubes were plugged in the A steam generator, 139 in B, and 208 in C. In 1982 a total of 196 tubes were plugged; in 1981, 401 tubes; in 1980, 314 tubes; in 1979, 38 tubes; and prior to 1979, 324 tubes.

2.2 Reasons for Steam Generator Repair

The steam generators at CP&L's H. B. Robinson Unit 2 have experienced significant corrosion-related phenomena that require periodic inspection and plugging

of steam generator tubes to ensure their continued safe operation as discussed in Section 2.1 above. At the present time, HBR-2 is being operated at reduced power to retard the rate of SG tube degradation. Projections of industry experience and CP&L experience at HBR-2 indicate the possibility of increasingly frequent inspection intervals and a permanent reduction of unit power. As of May 1983, tube plugging for various reasons has resulted in removing about 16.7% of the steam generator tubes from continuing service at the HBR-2 plant.

Because of the continuing tube degradation problems, the certainty of additional tube plugging that will result in continuing power reduction, and the economic considerations for operating with substantially reduced heat transfer capacities on Unit 2, CP&L submitted a proposal for the replacement of the degraded portions of the steam generators. This replacement would increase availability and reliability of the plant and permit the plant to return to full power operation.

2.3 Staff Environmental Review

Information useful to the environmental review was also obtained from the updated NRC staff safety evaluation report (NUREG/CR-1595) on the repair project, particularly the sections evaluating (1) the effects of steam generator design changes, (2) the radiological and ALARA (as low as reasonably achievable) considerations, and (3) the radiological consequences of postulated accidents.

2.4 Major Environmental Impact

The major environmental impact is the occupational radiation exposure associated with the proposed repair of the degraded steam generators of the H. B. Robinson Steam Electric Plant Unit No. 2.

3 DESCRIPTION AND SCOPE OF THE PROPOSED REPAIR

A drawing showing the principal parts of a typical steam generator is presented in Figure 3.1. Figure 3.2 shows the regions where the main cuts are proposed to remove the degraded steam generator. The figure also shows the radiation levels in the work area. A brief description of the CP&L proposed repair procedure follows.

3.1 Changes

A number of changes have been made in the materials, the design, and the operating procedure for the replacement steam generators to ensure that the corrosion and denting problems will not recur. Among the more important of these changes are

(1) Using all-volatile-treatment chemistry control in the secondary system from the beginning of operation

(2) Changing the flow distribution baffle design to produce greater lateral flow across the surface of the tubesheet to minimize the number of tubes exposed to sludge

(3) Improving lateral blowdown design by the use of 2-in. internal blowdown pipes for continuous blowdown which provides for constant removal of impurities from the secondary water systems and steam generators

(4) Minimizing the potential for buildup impurities forming in the crevice region by means of full depth expansion of tubes in the tubesheet (The original steam generators were only partially expanded in this region.)

(5) Selecting corrosion-resistant material for the support plates using SA-240 type 405 ferritic stainless steel to reduce corrosion in the crevices between the tube and tube support plate, thus minimizing tube denting

(6) Thermally treating the Inconel 600 heat exchanger tubes for better corrosion resistance

(7) Using a broached hole pattern with a quatrefoil design in the support plates rather than separately drilled flow holes to minimize the accumulation of corrosion products where the tubes pass through the plates

Other plant support system modifications either have been accomplished or will be accomplished to increase the operating reliability and flexibility and to improve the secondary side resistances to corrosion and consequently minimize the potential for future repairs as a result of corrosion product buildup. Some of the more important changes are:

(1) Remove copper-based alloys condenser tube and replace with Type 439 stainless steel.

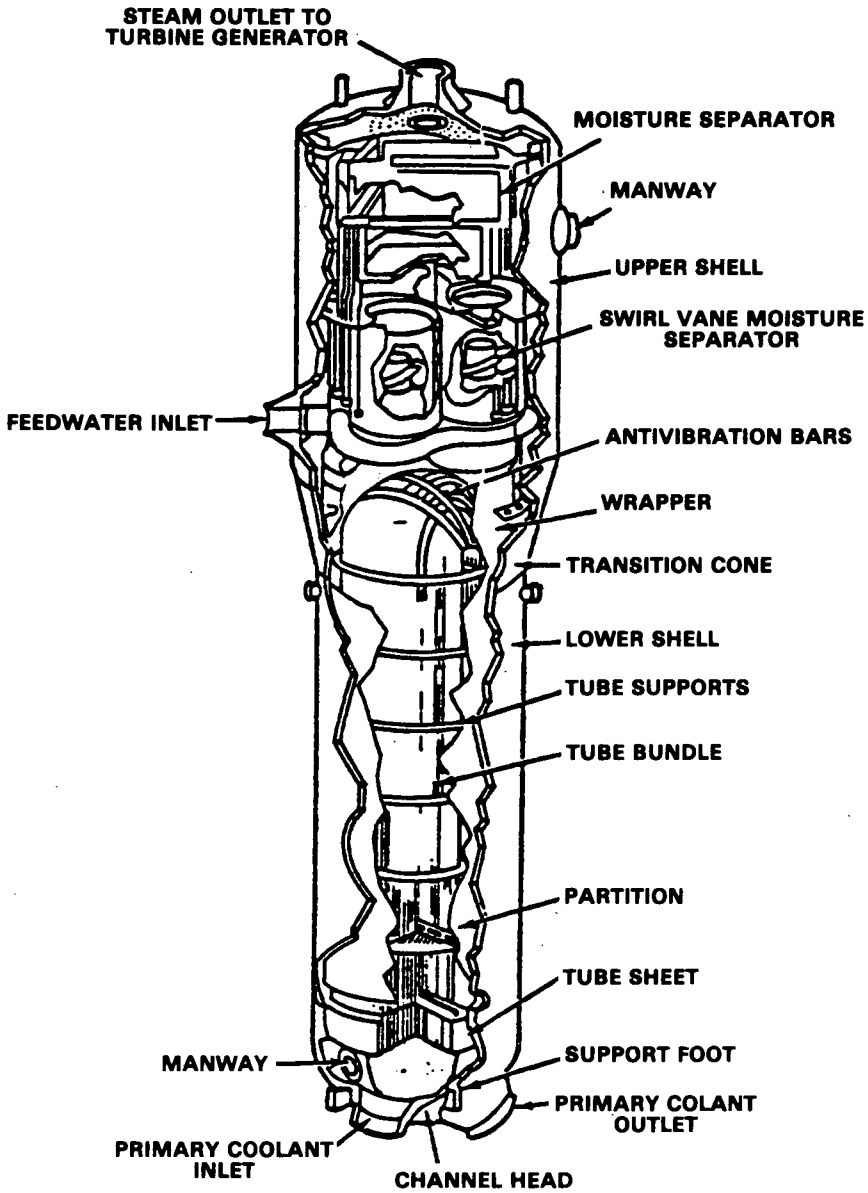

Figure 3.1 Typical steam generator

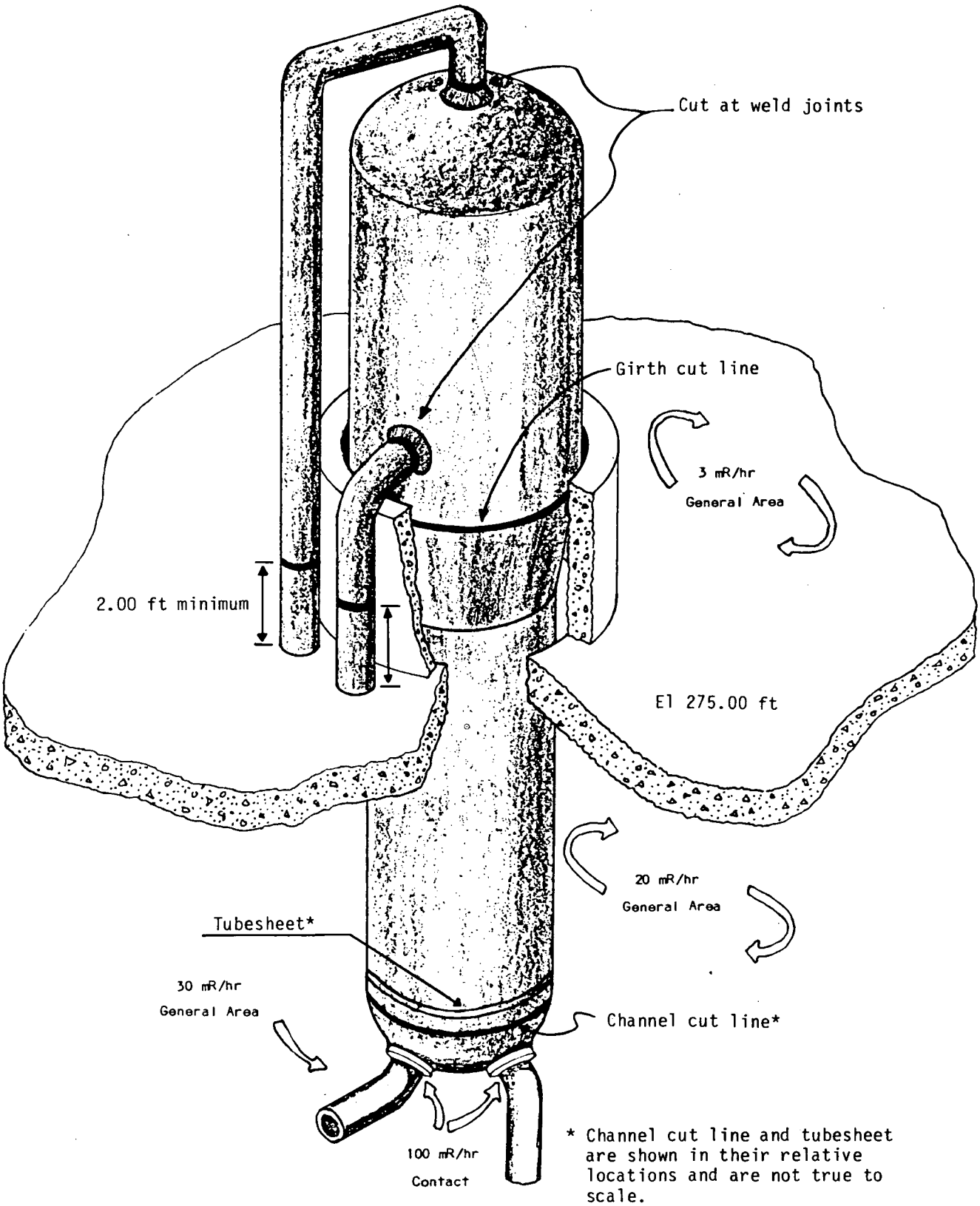

Figure 3.2 Dose rates around steam generator and proposed cuts

(2) Replace feedwater headers with stainless steel tubes.

(3) Replace moisture separator reheater tube bundles with stainless steel.

3.2 Steam Generator Repair

CP&L is planning to repair all three steam generators at HBR-2. The repair will consist of replacing the lower assembly of each steam generator including the shell and the tube bundle and refurbishing the upper assembly. The old lower assembly will be removed from the containment building through the existing equipment hatch and transported to a special storage facility that will be constructed on the HBR-2 site. The new steam generators will be received by rail, and will be stored in a temporary laydown area west of the protected area.

Before initiating the repair work, the unit will be shut down and all systems will be placed in condition for long-term layup. The reactor vessel head will be removed for defueling. All of the normal procedures for fuel cooling and fuel removal will be followed. The fuel will be removed from the reactor and placed in the spent fuel storage facility, and then the reactor vessel head will be replaced. The equipment hatch will be opened and access control will be established. Two to three feet of the biological shield wall will be removed to provide access to the steam generators.

During this preparatory work, the cutting of the system piping will begin. This will include cutting and removal of sections of steam lines, feedwater lines, and miscellaneous smaller lines for the service air and water and the instrumentation systems. The steam generator will then be cut at the transition cone, and the steam dome will be removed and will be refurbished outside containment in a temporary protective enclosure. After the channel cut at the bottom (see Figure 3.2), the lower assembly will be lifted from its support to the working level where it will be welded shut.

Following this, the steam generator lower assembly will be lowered and placed in position on a transport trailer. This trailer will carry the assembly through the equipment hatch. A mobile crane will lift the lower assembly onto a transporter that will carry it to the steam generator storage facility on the site. The other two lower assemblies will be lifted from their location, welded shut, and lowered through the same hatch where the first steam generator was removed.

After all the lower assemblies have been removed and stored, their replacements will be transported from the temporary storage location to the equipment hatch. The same machinery used to remove the lower assemblies will be used to install the new assemblies in their cubicles. The steam generator's lower assembly will be reinstalled and rewelded to the old bottom section. The upper assembly with its refurbished internals will be mounted on the lower assembly. After welding the two assemblies together, the piping will be reconstructed.

3.3 Post-Installation Testing

Once the major repair activities have been completed, cleaning, hydrostatic testing, baseline inservice inspections, and preoperational testing of instruments, components, and systems will follow. The reactor will then be refueled

and startup tests will be performed. The performance of the repaired steam generators will be tested for moisture carryover and verification of thermal and hydraulic characteristics.

4 ENVIRONMENTAL IMPACTS OF THE STEAM GENERATOR REPAIR PROJECT

4.1 Radiological Assessment of Doses Due to Repair

4.1.1 Occupational Exposure

The Carolina Power & Light Company (CP&L, or the licensee) has estimated that the occupational exposure from the proposed steam generator repair at the H. B. Robinson Steam Electric Plant Unit No. 2 (HBR-2) will be about 2120 person-rems (CP&L, January 6, 1983). On the basis of the staff's review of the licensee's report, the staff concludes that the licensee's estimate of 2120 person-rems to the workforce is a reasonable estimate of the expected dose. The estimate for each task is shown in Table 4.1

Table 4.1 Person-rem assessment for the H. B. Robinson Unit 2 steam generator replacement project

Task description	Estimated task time in man-hours	Estimated person-rems
Construction of pedestal cranes, preparation of polar crane, miscellaneous cribbing platforms, and steam generator transfer platform	10,000	25
Initial containment decontamination	2,000	20
Concrete and structural steel removal and replacement	8,000	20
Defueling and fuel storage	1,000	40
Installation and removal of shielding	2,500	145
Installation, maintenance, and removal of scaffolding, temporary lighting, and power	35,000	185
Installation, maintenance, and removal of contamination containments and temporary ventilation systems	4,500	30
Removal of insulation	7,500	85
Removal of mainsteam piping	500	5
Removal of feedwater piping	2,500	5
Removal of miscellaneous piping	6,000	70

Table 4.1 (Continued)

Task description	Estimated task time in man-hours	Estimated person-rems
Cutting and removal of steam generator upper assembly	7,000	80
Cutting of channel head	4,000	95
Weld shield cover on lower assembly at:		
Channel head	900	10
Transition end	600	10
Removal of steam generator lower assembly	500	25
Lateral support ring removal	2,500	25
Channel head decontamination	4,500	105
Refurbishment of upper assembly	8,000	20
Installation of lower assembly pre and weld channel head	40,000	310
Weld divider plates	5,000	80
Installation and welding of upper assembly	6,500	15
Lateral support ring installation	6,000	45
Install main steam piping	2,000	5
Install feedwater piping	5,000	10
Install insulation	20,000	100
Install miscellaneous piping	10,000	75
Non manuals (HP, QA, engineering, supervision, administration, etc.)	60,000	295
Ongoing decon/cleanup and disposal of contaminated material	28,000	150
Miscellaneous testing/inspections	2,500	5
Steam generator storage activities	1,000	30
TOTAL	293,000	2120

4.1.1.1 Environmental Significance of Occupational Exposure

To determine the relative environmental significance of the estimated occupational dose for the repair, the staff has compared that dose with the doses experienced at modern pressurized water reactors (PWRs). In addition, the staff has compared the estimated risk to nuclear power plant workers with published risks for other occupations.

Most of the doses to nuclear plant workers result from external exposure to radiation emitted by radioactive materials outside of the body, rather than from internal exposure to inhaled or ingested radioactive materials. Experience has shown that the total annual dose to nuclear plant workers varies from reactor to reactor and from year to year. Recently licensed 1000-MWe PWRs are designed in accordance with the post-1975 regulatory requirements and guidelines that place increased emphasis on maintaining occupational exposure at nuclear power plants as low as is reasonably achievable (ALARA). These requirements and guidelines are outlined respectively in 10 CFR 20, Standard Review Plan Chapter 12 (NUREG-0800), and Regulatory Guide 8.8, "Information Relevant to Ensuring That Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable."

The NRC staff reviewed the licensee's proposed implementation of these requirements and guidelines for the repair work. The results of that review are reported in the staff's Safety Evaluation Report (NUREG-1004).

Table 4.2 shows the occupational dose history for HBR-2. With the addition of 2120 person-rems for the repair, the average annual dose for the 11 years of dose history at HBR-2 (1971 through 1982) will be approximately 1107 person-rems.

Table 4.2 Annual collective occupational dose at the H. B. Robinson Steam Electric Plant Unit No. 2

Year	Reported collective occupational dose* (person-rems)
1972	215
1973	695
1974	672
1975	1142
1976	715
1977	455
1978	963
1979	1188
1980	1852
1981	733
1982	1426
Average	914

*NUREG-0713

Average collective occupational dose information of 239 PWR reactor years of operation is available for those plants operating between 1974 and 1981. (The year 1974 was chosen as a starting date because the dose data for years before 1974 are primarily from reactors with average rated capacities below 500 MWe.) These data indicate that the average reactor annual collective dose at PWRs has been about 500 person-rems, with some plants experiencing an average plant lifetime annual collective dose to date as high as 1400 person-rems (NUREG-0713). These dose averages are based on widely varying yearly doses at PWRs. For example, for the period mentioned above, annual collective doses for PWRs have ranged from 18 to 5262 person-rems per reactor. However, the average annual dose per nuclear plant worker of about 0.8 rem (NUREG-0713) has not varied significantly during this period. The worker dose limit, established by 10 CFR 20, is 3 rems per quarter, if the average dose over the worker lifetime is being controlled to 5 rems per year, or 1.25 rems per quarter if it is not.

The wide range of annual collective doses experienced at PWRs in the United States results from a number of factors, such as the amount of required maintenance and the amount of reactor operations and inplant surveillance. Because these factors can vary widely and unpredictably, it is impossible to determine in advance a specific year-to-year annual occupational radiation dose for a particular plant over its operating lifetime. There may on occasion be a need for relatively high (with respect to the average annual collective dose) collective occupational doses, even at plants with radiation protection programs designed to ensure that occupational doses will be kept ALARA.

4.1.1.2 Risks Attributable to Occupational Exposure

The average annual dose of about 0.8 rem per nuclear-plant worker at operating BWRs (boiling water reactors) and PWRs (pressurized water reactors) has been well within the limits of 10 CFR Part 20. However, for impact evaluation, the NRC staff has estimated the risk to nuclear-power-plant workers and compared it in Table 4.3 to published risks for other occupations. On the basis of comparisons, the staff concludes that the risk to nuclear-plant workers from plant operation is comparable to the risks associated with other occupations.

In estimating the health effects resulting from occupational radiation exposures as a result of this steam generator repair program, the NRC staff used somatic (cancer) and genetic risk estimators that are based on widely accepted scientific information. Specifically, the staff's estimates are based on information compiled by the National Academy of Sciences Advisory Committee on the Biological Effects of Ionizing Radiation (BEIR I, 1972; NUREG-0713). The estimates of the risks to workers and the general public are based on conservative assumptions (that is, the estimates are probably higher than the actual number). The following risk estimators were used to estimate health effects: 135 potential deaths from cancer per million person-rems and 258 potential cases of all forms of genetic disorders per million person-rems. The cancer-mortality risk estimates are based on the "absolute risk" model described in the BEIR I, 1972 report. Higher estimates can be developed by use of the "relative risk" model along with the assumption that risk prevails for the duration of life. Use of the "relative risk" model would produce risk values up to about four times greater than those used in this report. The staff regards the use of the "relative risk" model values as a reasonable upper limit of the range of uncertainty. The lower limit of the range would be zero because there may be biological mechanisms that can

Table 4.3. Incidence of job-related mortalities

Occupational group	Mortality rates (premature deaths per 10^5 person-years)
Underground metal miners*	~1300
Uranium workers*	420
Smelter workers*	190
Mining**	61
Agriculture, forestry, and fisheries**	35
Contract construction**	33
Transportation and public utilities**	24
Nuclear-plant workers†	23
Manufacturing**	7
Wholesale and retail trade**	6
Finance, insurance, and real estate**	3
Services**	3
Total private sector**	10

*U.S. Department of Health, Education and Welfare, 1972.

**U.S. Bureau of Labor Statistics, 1978.

†The nuclear-plant worker's risk is equal to the sum of the radiation-related risk and the nonradiation-related risk. The estimated occupational risk associated with the industrywide average radiation dose of 0.8 rem is about 11 potential premature deaths per 10^5 person-years due to cancer, based on the risk estimators described in the following text. The average nonradiation-related risk for seven U.S. electrical utilities over the period 1970-1979 is about 12 actual premature deaths per 10^5 person-years as shown in Figure 5 of the paper by R. Wilson and E. S. Koehl, 1980. (Note that the estimate of 11 radiation-related premature cancer deaths describes a potential risk rather than an observed statistic.)

repair damage caused by radiation at low dose and/or dose rates. The number of potential nonfatal cancers would be approximately 1.5 to 2 times the number of potential fatal cancers, according to the 1980 report of the National Academy of Sciences Advisory Committee on the Biological Effects of Ionizing Radiation (BEIR III).

Values for genetic risk estimators range from 60 to 1500 potential cases of all forms of genetic disorders per million person-rems (BEIR I, 1972). The value of 258 potential cases of all forms of genetic disorders is equal to the sum of the geometric means of the risk of specific genetic defects and the risk of defects with complex etiology.

The preceding values for risk estimators are consistent with the recommendations of a number of recognized radiation-protection organizations, such as the International Commission on Radiological Protection (ICRP, 1977), the National Council on Radiation Protection and Measurements (NCRP, 1975), the National Academy of Sciences (BEIR III, 1980), and the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR, 1977).

The risk of potential fatal cancers in the exposed workforce population at HBR-2 and the risk of potential genetic disorders in all future generations of this workforce population, are estimated as follows: multiplying the plant-worker-population dose (about 2120 person-rems) by the risk estimators, the staff estimates that about 0.3 cancer death may occur in the total exposed population and about 0.6 genetic disorder may occur in all future generations of the same exposed population. The value of 0.3 cancer death means that the probability of one cancer death over the lifetime of the entire work force as a result of the repair is about one chance in 3. The value of 0.6 genetic disorder means that the probability of 1 genetic disorder in all future generations of the entire work force as a result of the repair project is about 6 chances in 10.

The significance of these risk estimates can be determined by comparing them with the natural incidence of cancer deaths and genetic abnormalities. Multiplying the estimated exposed worker population of about 1500 persons by the current incidence of actual cancer fatalities (~20%), about 300 cancer deaths are expected (American Cancer Society, 1978). The risk of potential genetic disorders attributable to exposure of the workforce is a risk borne by the progeny of the entire population, and is thus properly considered as part of the risk to the general public. Since BEIR III (1980) indicates that the mean persistence of the two major types of genetic disorders is about 5 generations and 10 generations, in the following analysis the risk of potential genetic disorders from the repair is conservatively compared with the risk of actual genetic ill health in the first 5 generations, rather than the first 10 generations. Multiplying the estimated population within 50 miles of the plant of about 800,000 persons in the year 1986 (CP&L, 1971) by the current incidence of actual genetic ill health in each generation (~11%), about 750,000 genetic abnormalities are expected in the first 5 generations of the population within 50 miles of the plant (BEIR III, 1980).

4.1.1.3 Summary

The NRC staff has reached the following conclusions regarding occupational radiation dose. The licensee's estimate of about 2120 person-rems for the repair at HBR-2 is reasonable. This dose falls within the normal range of annual occupational doses that have been observed in recent years at operating reactors. Although the dose resulting from the steam generator repair will increase the annual occupational dose average of 914 person-rems to approximately 1107 person-rems, this is still well below the 1400 person-rems per reactor annual average which is an upper bound dose average of PWRs experiencing high levels of special maintenance work. The licensee has taken appropriate steps to ensure that occupational doses will be maintained within the limits of 10 CFR Part 20 and the ALARA concept. The additional health risks from these doses over normal risks are quite small, less than 1% of normal risk to the project work force as a whole. The risk to an average individual in the work force will be lower than the risk incurred from participation in many commonplace activities. The individual risks associated with exposures involved in the repair will be controlled and limited so as not to exceed the limits set forth in 10 CFR 20 for occupational exposure. For the foregoing reasons, the staff concludes that the environmental impact from occupational exposure will not significantly affect the quality of the human environment.

4.1.2 Public Exposure

This section contains conservative estimates of the impacts on the public from the proposed steam generator repair project. The major sources of direct radiation and environmental pathways were considered in preparing this section, as shown in Figure 4.1. The section includes doses from radioactive effluents released during the steam generator repair, doses from the storage or disposal of solid radioactive wastes, and the impacts due to solid waste storage.

4.1.2.1 Doses From Effluents

Public radiation exposure from the HBR-2 steam generator repair can be evaluated by comparing the estimated quantities of radioactive effluents from the steam generator repair with annual average releases from normal operations.

The licensee has estimated the amount of radioactivity that will be released in liquid and gaseous effluents as a result of the repair. Those estimates are presented in Table 4.4. The staff has reviewed the licensee's estimates (CP&L, January 6, 1983) and concluded that they are reasonable. The expected releases from the repair are less than both the final environmental statement (FES) estimates (NUREG-75/024) and the plant's actual annual releases for normal operations.

On the basis of this comparison, the staff concludes that the offsite environmental impact that may occur during the period of this procedure will be smaller than that which occurs during normal operation.

The staff has estimated the doses to individual members of the public as well as the population as a whole in the area surrounding HBR-2 based on the radioactive effluents which the licensee estimated for the repair (summarized in Table 4.4) and on the calculational methods presented in Regulatory Guides 1.109 and 1.113. The staff estimated the total body dose for an adult at the worst site boundary location, 0.27 mile south of the plant resulting from the release of airborne radioactive effluents during the steam generator repair effort. An airborne release source term of 140 Ci, consisting primarily of Xe-133 and Kr-85 (Table 4.4) and an annual average (ground level continuous release) atmospheric dispersion factor of 4×10^{-5} sec/m^3 were used in these estimates. The total body dose from external gamma radiation for an adult exposed to a semi-infinite cloud of noble gases at this location was estimated to be less than 4.0×10^{-1} mrem. Using a maximum liquid release source term attributable to the repair of 1.3×10^{-1} Ci, consisting primarily of Cs-137 (Table 4.4), the staff calculated the maximum individual total body bose for an adult to be much less than 0.01 mrem for the operation. This dose is equivalent to a very small fraction of the limits of 40 CFR 190. The annual limits of 40 CFR 190 are 25 mrem to the total body or any organ except the thyroid and 75 mrem to the thyroid.

The doses to the population of 2.5 million within 50 miles was estimated to be less than 5.7×10^{-3} person-rem to the total body from liquid effluents.

By comparison, every year the same population of about 100,000 persons will receive a cumulative total body dose of more than 10,000 person-rems from natural background radiation of about 0.1 rem per year per person. Thus, the population total body dose from the repair is less than one millionth of the annual dose from natural background. On this basis, the staff concludes that

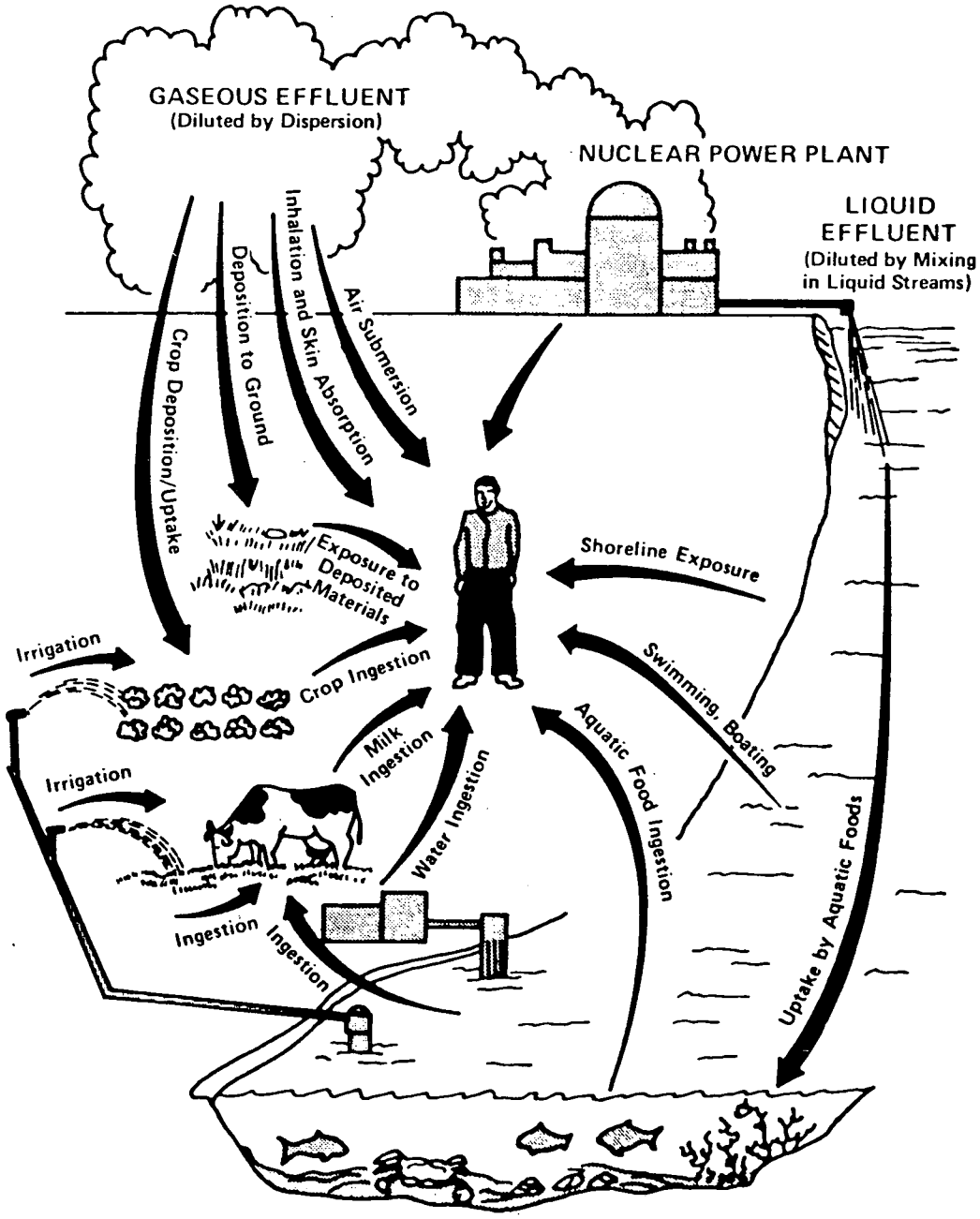

Figure 4.1 Exposure pathways to man

Table 4.4 Radioactive effluents source terms for H. B. Robinson Steam Electric Plant Unit No. 2

Type of radioactive effluent	Surry* actual measurement (Ci/unit)	Turkey Point** estimate (Ci/unit)	Point Beach† estimate (Ci/unit)	H. B. Robinson†† estimate (Ci/unit)	H. B. Robinson source term (Ci/unit)
Gaseous					
Noble gases	100	Negligible	Negligible	140	140
Iodines	7×10^{-7}	1×10^{-2}	7×10^{-6}	4×10^{-5}	4×10^{-5}
Particulates	1.3×10^{-3}	4×10^{-2}	1.5×10^{-4}	9×10^{-5}	9×10^{-4}
Tritium	4.3	Negligible	Negligible	7×10^{-1}	7×10^{-1}
Liquid					
Mixed fission & activation products (excluding tritium)	0.5	0.55	0.23	1.3×10^{-3}	1.3×10^{-1}
Tritium	8.5	185	125	14	14

*NUREG-0692
**NUREG-0743
†Wisconsin Electric Power Company, 1981
††CP&L, January 6, 1983.

the doses to individuals in unrestricted areas and to the population within 50 miles because of liquid effluents from the repair will not be environmentally significant.

In summary, the estimated radioactive releases resulting from the repair are less than those from normal plant operation. The doses from these releases are small compared with the limits of 40 CFR 190 and the annual doses from natural background radiation. Therefore, the radiological impact of the repair will not significantly affect the quality of the human environment.

4.1.2.2 Impacts From Solid Wastes (Not Including Steam Generator Assemblies)

The environmental impact of solid radioactive wastes from the HBR-2 steam generator repair can be estimated by comparing the quantity of radionuclides present in the solid waste resulting from the steam generator repair with the annual average releases from normal operations. CP&L (January 6, 1983) has estimated that the steam generator repair efforts will generate about 1700 m^3 of solid waste containing approximately 160 Ci of radioactive materials. This value is consistent with the generic report (NUREG/CR-1595) which estimates that 760 m^3 of low activity waste per steam generator would be produced. In the years 1973 through 1982, HBR-2 generated an annual average of about 640 m^3 of solidified radwaste containing approximately 520 Ci (CP&L, 1973 through 1982). Therefore, the radioactive content of the solid waste from the repair will be small compared with the annual amount from normal operations. Since the estimated quantity of radioactive content present in the solid waste generated by the repair is small in comparison with the amount contained in solid waste from normal operation, the effect of this additional solid waste is not environmentally significant.

4.1.2.3 Impacts From Solid Wastes (Steam Generator Assemblies)

Because the removed steam generator assemblies will be stored in a shielded building on the H. B. Robinson site, there will be no solid waste shipments containing radioactive materials on steam generator components. Ultimate disposal of these steam generator units will be part of the plant decommissioning. At that time, approximately 30 additional years of decay will have reduced the radioactive content significantly.

4.1.2.4 Doses From Onsite Storage of Steam Generator Assemblies

CP&L estimates that each steam generator will contain approximately 300 Ci of fixed gamma emitters at the time the steam generators are removed from the containment. The steam generator assemblies will be stored on site in a shielded building. This building will contain sufficient shielding to limit the dose rate to less than 1 mrem per hour at the outside of the building. This building is approximately 1500 ft from the nearest site boundary. The staff estimated the additional dose rate at the site boundary to be less than 0.00001 mrem per hour from onsite storage of the steam generators. An individual living an entire year at this location would receive less than 0.1 mrem from this source. This dose rate would decrease rapidly during the first 2 years of storage because short-lived radionuclides would decay; thereafter, the dose would decrease by a factor of 2 every 5 years as the remaining Co-60 decayed. Since these dose estimates represent less than a 0.1% increase in natural background dose and because it is not credible for an individual to

camp at the site boundary for great lengths of time, the staff concludes that radiation doses to the public from onsite stored steam generators will be very small and will not be environmentally significant.

4.1.2.5 Effect of Repair on Future Normal Operation

The repair effort will return the plant to the design conditions on which the staff evaluation in the FES (NUREG-75/024) was based. Therefore, the staff concludes that the quantity of radioactive materials released from normal operations after the repair should not be significantly greater than those presented in the FES. Thus, the potential doses to the public and the impact on biota other than man from those materials will be no greater than the doses and impacts presented in the FES.

4.1.2.6 Conclusion

On basis of its review of the proposed steam generator repair, the staff concludes that

(1) The estimated total occupational exposure of 2120 person-rems for the repair is within the expected range of doses incurred at light water power reactors in a year.

(2) The risks to the workers involved in the repair are comparable to the risks associated with other occupations.

(3) The licensee has taken appropriate steps to ensure that occupational dose will be maintained as low as is reasonably achievable and within the limits of 10 CFR 20.

(4) The estimated doses to the general public are:

   (a) much less than those incurred during normal operation of HBR-2, and

   (b) negligible in comparison to the dose members of the public receive each year from exposure to natural background radiation.

4.2 Economic Costs of Steam Generator Repair

Carolina Power and Light Co. has estimated (CP&L, January 6, 1983) that the replacement of the three H. B. Robinson steam generator lower assemblies (SGLAs) in the manner proposed in Section 3 will require a total capital expenditure of approximately $102 million (1983 dollars). This cost includes labor, equipment, and other charges such as overhead, contingency funds, and allowance for funds used during construction. The staff believes the cost is reasonable in light of the experience with similar repairs at the Surry and Turkey Point nuclear plants.

The replacement effort is anticipated to require the shutdown of HBR-2 for a period of about 43 weeks, beginning in July 1984. Normally scheduled annual maintenance, which typically requires 7 weeks, will be performed in parallel with the replacement effort. Therefore, the portion of the total outage time, which can be attributed soley to the replacement effort, amounts to about 36 weeks. Staff views the licensee's estimate of outage time as reasonable in

light of the experience gained with other SGLA modifications (Surry and Turkey Point) and compared with a recent projection for the Point Beach Nuclear Plant, Unit No. 1 SGLA replacement effort.

Staff estimates that differential replacement power costs for this additional 36-week outage period are expected to total about $49 million (1983 dollars). This dollar amount reflects the differential fuel cost derived by subtracting the average $5 per MWh cost of energy produced by the HBR-2 from the average $25* per MWh cost of energy from projected sources of replacement power (primarily from the coal-fueled plants in the licensee's system). A major assumption in calculating this cost is that the unit could operate at its current maximum capability--70% of its design electrical rating (DER)--throughout the outage period. This assumption is somewhat optimistic. At the current rate of corrosion, tube degradation will continue causing further reductions in maximum dependable capacity from the unit. Although these reductions are not anticipated to be substantial for the additional 36-week period, the replacement cost differential calculated above and based on the projected amount of energy to be replaced can be considered conservative (high) in view of these reductions.

In summary, the total cost of the replacement effort is projected to be $151 million (1983 dollars)--the sum of the capital investment and the replacement power costs.

4.2.1 Nonradiological Environmental Costs

Socioeconomic impacts will be small and generally beneficial. No effects on historic or archeological resources are anticipated.

4.2.2 Construction Cost Impacts

Socioeconomic impacts associated with changes in the natural and physical environment will be negligible. Socioeconomic impacts associated with up to 1000 personnel required over approximately 43 weeks will be generally small and beneficial to the region. A large portion of the work force will be hired from within daily commuting distance.

No known historic or archeological resources exist on the portion of the site affected by the project.

4.3 Nonradiological Environmental Assessment

4.3.1 Construction Impacts

Nonradiologically related construction activities have been evaluated for their potential to impact both aquatic and terrestrial species occurring at the H. B. Robinson site (see Figure 4.2). The following presents a discussion of these activities and an assessment of their potential impact on organisms inhabiting the site.

*This cost is based on the cost of coal fuel to the licensee of about $1.93 per million Btu in December 1982 (U.S. Department of Energy, 1982).

The repair involves removal of the lower steam generator assemblies and replacing them with new assemblies which will be shop fabricated and delivered to the site ready for installation. Before dissassembly and removal of the existing assemblies, the steam generators will be decontaminated. The new steam generator sections will be brought in by rail, and will be stored in a temporary laydown area west of the protected area. Related facilities to be built include a permanent maintenance building. Additionally, there will be minor foundation work in the immediate vicinity of the containment building.

All construction activities associated with the steam generator repair will take place in areas within the site boundary previously used as laydown storage areas during original plant construction. Some of these former construction areas will have to be recleared. The method for ultimate disposal of the old steam generator assemblies has not been selected. They will be stored on site in a concrete vault for the life of the plant.

Such temporary nuisances as erosion, dust, and noise often associated with construction will be confined to a much smaller area and will be of much shorter duration than experienced with initial construction. Although the outage for repair should be less than 270 days, the licensee will pave or spray the roadways to abate dust. The licensee has projected that noise at the site boundary from the steam generator replacement activities will not exceed noise experienced during the most recent outage.

The usage rate of water for HBR-2 during the replacement outage will be less than during normal operation. Sanitary waste treatment facilities for the site are being expanded for reasons unrelated to the steam generator replacement. Portable units will supplement this expanded waste treatment system during the construction period.

Processing of decontamination will be dictated by radiological considerations. Generally, waste streams resulting from decontamination are expected to be "processed as appropriate and drummed for off-site disposal" and no discharge to surface or groundwater will occur. The contamination to be removed from the steam generators before disassembly is primarily the metallic activation products in a thin film of oxides on internal surfaces. The oxides are generally regarded as magnetite. The decontamination method chosen by the licensee was the method used at Turkey Point which is an alumina grit decontamination system utilizing a high pressure water-grit spray that impinges upon the surface of the channel head and abrades away the radioactive oxide film. This system incorporates a radioactive waste-handling subsystem with appropriate shielding for processing the slurry waste water. Waste water may be either recycled or disposed of as radwaste following processing. Because the metal oxides picked up in decontamination have some radioactivity, no discharge will be made. Although NRC regulations would permit discharge if activity were very low, such discharge should be subject to State review and approval. The licensee has indicated that the steam generator replacement will not require any change to the National Pollutant Discharge Elimination System (NPDES) discharge permit.

Because all activities will take place on previously cleared areas and because all discharges will be consistent with the terms of the current NPDES discharge permit, it is concluded that construction activities associated with the steam

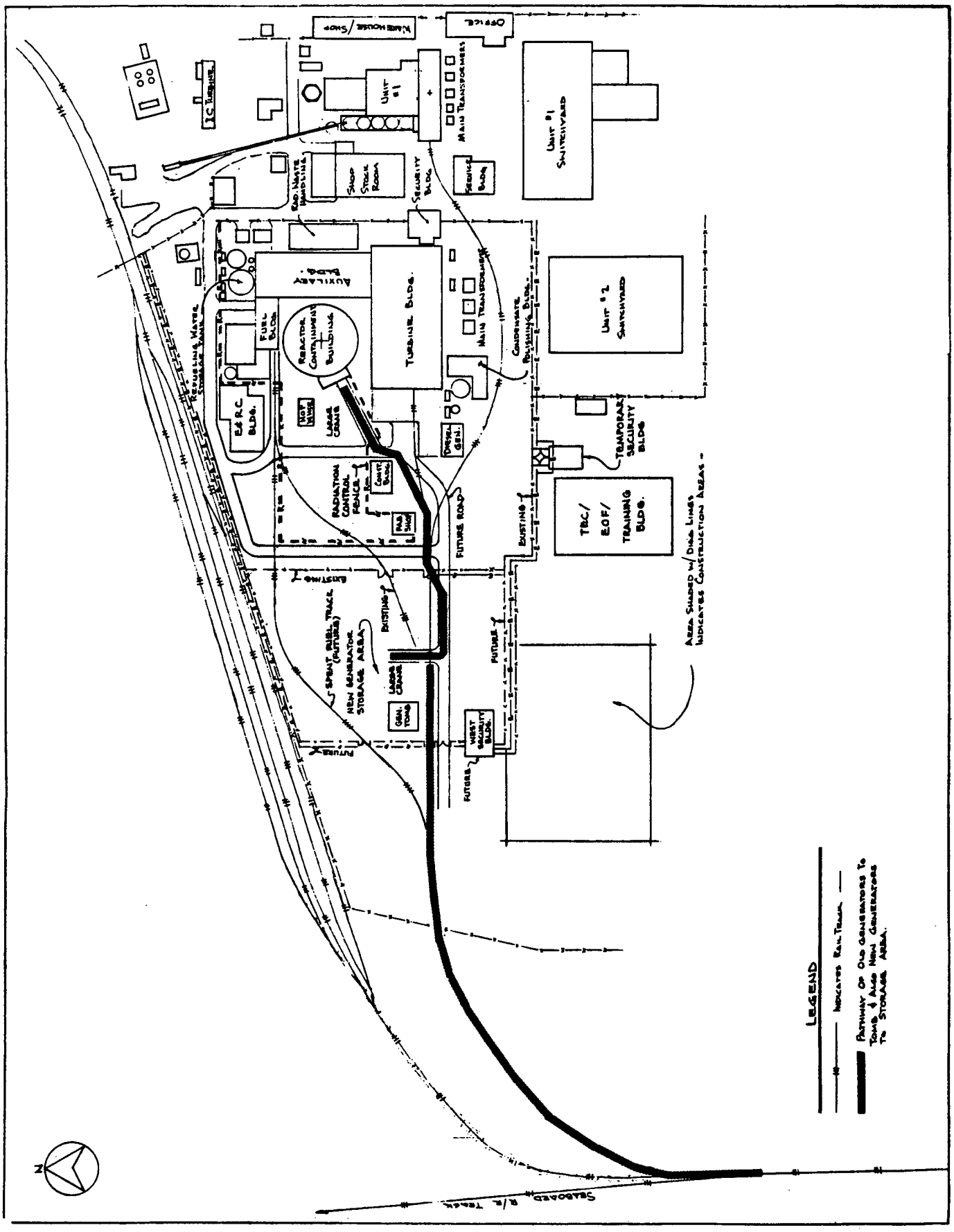

Figure 4.2 H. B. Robinson plant site

generator repair program will not have a significant adverse impact on natural resources of the site and vicinity.

4.3.2 Operational Impacts

When the station is returned to service, the licensee expects secondary system water consumption during normal operation to be considerably less than during previous operation. During previous operations, frequent unit shutdowns for steam generator inspections required significant consumption of water for the purpose of leak testing prior to tube plugging, hydrostatic testing after tube plugging, and maintenance of steam generators in wet-layup. Following repair, the steam generator tubes will remain intact, thereby minimizing the need for periodic inspections and the water consumption requirements associated with the inspections. The steam generator makeup and blowdown systems are being modified to permit higher makeup and blowdown rates during startup and other periods when steam generator chemistry requirements so dictate.

A full-flow condensate polishing demineralizer system is being installed to further control the chemical quality of secondary water. Treatment systems to process regenerants and waste effluents for reuse or disposal will also be added. The licensee is also adopting all volatile treatment in lieu of phosphate treatment to control corrosion. This will result in the discharge of small amounts of organic materials instead of the small amount of phosphates in the steam generator blowdown. The licensee expects steam generator blowdown flow rate normally will be about at the same rate (25 gpm per generator) as before replacement. As indicated above, during certain periods necessitated by chemical quality considerations, flow will be somewhat higher. As before the repairs, steam generator blowdown is monitored for radiation and, if acceptable, is discharged to the cooling lake without further treatment. No NPDES discharge permit modification is necessary for these design changes, according to the licensee.

Since the changes in operation of the secondary cooling system are small with regard to discharge and since such changes are within the bounds of the current NPDES discharge permit, the environmental effects of operation after restart will not be significantly greater or different from those previously reviewed and analyzed in the FES.

4.3.3 Endangered Species

Since all activities associated with steam generator replacement will take place on site in areas previously disturbed for initial plant construction and since there is no significant change in station waste discharges, endangered species will not be directly affected by the replacement program. A colony of red cockaded woodpeckers has been identified on the licensee's property well outside of the security fence. This colony appears to be co-existing with the industrial usage of the property. The stresses to the woodpeckers from the steam generator replacement program are believed to be within the envelope of other stresses of power generation activities at the site and, therefore, no impact is expected.

4.4 Environmental Impact of Postulated Accidents

The design and plant operating parameters that are relevant to accident analyses will not change as a result of a steam generator repair effort. Therefore, the assessment of the environmental impact of postulated accidents presented in the FES of April 1975 (NUREG-75/024) will be unchanged and remains valid.

The safety evaluation also considers accidents that are unique to the repair effort. The accidents considered were accidents that occurred during cutting operations and lifting accidents inside and outside of containment, both from the point of view of damage to the steam generator itself and to nearby components and structures. All the accidents were evaluated with large factors of conservatism. The one with the largest calculated dose was found to be release of activity following the drop of the steam generator outside of the containment building.

About 31 Ci of radioactive materials could be dislodged if the welded end plate over the primary side of the steam generator failed during the drop. The staff estimated that a release of half of the "loose" activity might occur. The limiting potential receptor from the point of view of both breathing rate and dose conversion factors is the teenager's lung. Average meteorological conditions were postulated, and the potential receptor was assumed to be at the exclusion area boundary. The radiological consequence evaluated for these conditions is a dose of about 0.1 mrem. Several areas of conservatism are present in this evaluation: (1) the drop accident itself is unlikely, (2) it is unlikely that the welded end plate could completely fail, and (3) the amount of activity that was considered to be dislodged and released to the environment was conservatively estimated.

Some amount of activity, primarily Co-60, would probably be carried to the site boundary and deposited as "contamination" in case of an actual accident. It is not possible to evaluate quantitatively the amount of activity that actually might be transported to the boundary, mainly because the effects of the factors of conservatism listed above cannot be evaluated. It is the staff's judgment, however, that the amount would be acceptably small.

Compliance with staff guidelines related to postulated accidents involving steam generators is discussed in the Safety Evaluation Report (NUREG-1004). For the purposes of assessing the environmental impact of accidents, the staff has compared the environmental impact of an accident with 10 CFR 20, which is applicable to normal operation, and concluded that the consequences of accidents are comparable to those allowed during normal operation. The combination of the potential environmental impact with the probability of occurrence of accidents results in a risk to the public that is acceptably small.

5 ALTERNATIVES TO THE PROPOSED ACTION

The basic options for future action regarding the H. B. Robinson steam generator tube degradation problems are (1) replacing the steam generators' deteriorating lower assemblies as proposed, (2) entirely replacing the three steam generators, (3) retubing the steam generators in place, (4) sleeving the steam generator tubes, or (5) shutting down the unit and replacing its energy by using CP&L existing generating units and/or by intersystem purchases. CP&L has opted to immediately replace the lower assemblies of the unit's three steam generators (alternative 1), and to make changes in design, materials, and operating procedures calculated to eliminate the future occurrence of tube degradation problems.

The following sections consider the benefits and costs associated with the above alternatives using alternative 1 as the base case. Sections 4.1 and 4.2 describe the radiological and economic impacts associated with alternative 1.

5.1 Alternative 2: Entirely Replacing the Steam Generators

Entirely replacing the steam generators is not a reasonable alternative to the proposed method of repairs because of space and handling limitations within the containment structure. There is insufficient laydown area within the containment building to accommodate an entire steam generator, and it is questionable whether the existing polar cranes can be upgraded to lift the 355-ton weight of a steam generator. Even if upgrading were possible, there is insufficient "head room" to provide the clearance required to lift the steam generators. Therefore if the steam generators were to be replaced, the structural integrity of the containment building would have to be breeched by cutting an access hole in the dome of the building large enough to accommodate the steam generator. In addition, special exterior cranes would have to be constructed to lift the units from the containment.

Because of the inordinate amount of structural modification required for removal and the internal limitations for positioning the steam generators, the staff feels that entire replacement of the steam generators is not a viable alternative.

5.2 Alternative 3: Retubing the Steam Generators in Place

Another alternative to the proposed plan is to retube the generators while they remain in the containment building, as described by the Westinghouse Nuclear Energy System Group in "Steam Generator Retubing and Refurbishment" (WCAP-9398). At present, no major commercial reactor has undergone such a modification; however, this or a similar technique may be used in the future. Current projections (NUREG/CR-1595) indicate that occupational dose associated with this repair technique is expected to be approximately 2300 person-rems per steam generator. The licensee's proposed modification program is expected to result in approximately 706 person-rems per steam generator or about one-third the exposure of the retubing method. In addition, retubing the steam generators in place would increase the difficulty of implementing the full spectrum of the proposed design

improvements incorporated in the new SGLAs, which in turn would probably result in a more exposure-intensive operation. The staff views the proposed alternative as the most favorable.

5.3 Alternative 4: Sleeving the Steam Generators

The tube sleeving concept and design are based on observations that tube degradation from caustic attack occurs primarily in the tubesheet crevice region. The sleeves are designed to span the degraded regions for those tubes that have already suffered damage and for those that are more likely to suffer damage. Experience has shown that the tubes in the central regions of the steam generators are most likely to suffer damage. Thus, the sleeving alternative envisions sleeving only about half of the steam generator tubes.

In evaluating the sleeving alternative, the licensee made certain assumptions which are summarized as follows:

(1) The sleeving alternative would only postpone the need for the proposed SGLA replacement for about 2 to 6 years, at which time the currently proposed replacement program or a similar program will be required.

(2) Tube inspection would be required approximately every 3 months of operation.

(3) NRC would authorize operation at 95% of full rated power.

(4) The sleeves would be installed during a 12-week scheduled outage in 1984.

The capital costs of the sleeving alternative is estimated at about $172 million (1983 dollars) or about $21 million more than the proposed replacement plan. This cost includes the approximately $67 million (CP&L, July 14 and 25, 1983) of capital already "sunk" in the proposed plan.

The sleeving and "sunk" costs above do not include repair costs subsequent to the sleeving operation. Also excluded is the additional cost of replacement power which will be incurred as a result of the additional time required during each scheduled maintenance outage for tube inspection and plugging during the remaining lives of the steam generators. Staff estimates differential replacement power costs to total approximately $1.3 million (1983 dollars) per week.

After the 2 to 6 years of extended operation afforded by the sleeving alternative, the plant availability may be adversely impacted by further degradation of the steam generators (assuming the SGLAs are not replaced). However, the effects are not anticipated to be as severe as the impact produced under alternative 5, which follows. The 2-to-6-year lead time would give the licensee some time to either install additional facilities or negotiate for sufficient purchased power.

In addition to the greater monetary costs of the sleeving alternative, person-rem exposures under the sleeving option are anticipated to be higher. In the proposed plan a total of approximately 2420 person-rems are expected; whereas, the sleeving alternative will produce approximately 3970 person-rems, or a 60% greater exposure during the 1984 through 1990 period. After 1990, exposures would be comparable for the two alternatives. Considering the greater monetary

sleeving alternative, the staff's view is that the proposed alternative 1 is preferable.

5.4 Alternative 5: Shutting Down H. B. Robinson Unit No. 2 and Relying on Licensee's Existing Generation

Unlike the previously considered alternatives, alternative 5 involves no immediate capital cost expenditure with the exception of the $67 million sunk costs already incurred under the proposed plan. A cost analysis was performed by CP&L which compared system costs under alternative 1 (the proposed plan) and alternative 5. Under alternative 5 HBR-2 would be shut down on December 31, 1984.

The licensee has estimated that based on the history of tube plugging and at the current level of tube plugging, approximately 300 plugs per year, the units will have to be retired in December 1984 because (1) of reduced heat transfer area within the steam generators, and (2) with increased tube plugging, the operating time between inspections would be too short to justify continued operation.

The comparison of this alternative with the proposed plan includes all applicable costs, both capital and other costs (including production, decommissioning, and nuclear insurance costs) for the 15-year study period 1984 through 1998. For purposes of the comparison it was optimistically assumed (see Section 4.2) that HBR-2 could continue to operate at basically the same level as is currently being experienced, which is at approximately a 70% operating capacity factor* and a steam generator inspection outage every 3 months through 1984. The unit would then be retired on December 31, 1984. This scenario was compared with the proposed plan which reflects a return to full-power operation and an 85% operating capacity factor* after replacement of the SGLAs. Over the remaining life of the plant, this operating capacity factor translates to a 60 to 65% annual capacity factor.

The result of the licensee's cost comparison indicates that premature retirement of HBR-2 will result in a net cost of $348 million (1983 dollars) to the CP&L system during the period 1984 through 1998.

The staff estimates that the economic penalty of the December 1984 shutdown of HBR-2 will total over $62 million per year (1983 dollars). Thus the estimate of $151 million for the steam generator repair will be recovered in less than 3 years. Over the 15-year period 1984 through 1998, staff estimates that accumulated annual savings (or cost avoided) resulting from the proposed replacement plan will total over $600 million (1983 dollars). Therefore the staff views the CP&L estimate of $348 million as understating the economic advantage of the proposed replacement program.

Although the immediate shutdown would result in a reduction in potential exposure of about 11,000 person-rems during the study period (maintenance and refueling), this reduction must be balanced against the $348 million cost penalty associated with shutdown.

*Operating capacity factor is an average capacity factor which excludes periods of scheduled outage.

The retirement of HBR-2 under alternative 5 would leave the CP&L system with insufficient generating capacity. Construction of generating units planned or anticipated for the future would have to be accelerated to make up the deficiency created by the retirement of HBR-2. Inclusion of the cost of replacement generating capacity would further increase the margin of savings in HBR-2 retirement, resulting in increased savings from continued operation of HBR-2 after replacement of the SGLAs in 1984.

The licensee states that the increase in fossil fuel usage over the 1984 through 1998 study period would be approximately 16 million tons of coal, 3 million cubic feet of natural gas, 7 million gallons of oil, and 33 million gallons of propane. The staff concludes that based on the cost differential, the environmental consequences of increased fossil fuel consumption and the uncertainty of power available for purchase, the proposed alternative is preferred.

5.5 Summary of Alternatives

Table 5.1 summarizes the economic and radiological costs of the various alternatives discussed. These costs are supplemented by qualitative assessments which attempt to characterize the major advantage and/or drawbacks of each alternative. Comparing the economic and exposure costs of these alternatives and giving due regard to the qualitative evaluation, the staff concludes that the replacement plan selected by CP&L (alternative 1) is the best of the available alternatives.

5.6 Decontamination and Disposal of the Steam Generators

The proposed plan for replacement and disposal of the lower assemblies of H. B. Robinson steam generators is discussed in Section 3. The following sections discuss (1) methods under consideration to reduce exposure levels in and around the areas in which the proposed modification will take place, and (2) the radiological and economic costs of alternative methods of disposal of the removed assemblies.

5.6.1 Decontamination

The licensee states (CP&L, January 6, 1983) that two levels of decontamination will be employed in the replacement project. During the initial stages of the project, a general area decontamination will be performed. A second primary surface decontamination will be performed on high exposure rate components such as the steam generator channel head.

With the general decontamination of the containment building, most of the exposed surfaces in task-related areas will be cleaned. The removal of much of the radioactive surface contamination will decrease the potential for the spread of contamination to clean areas, and lessen the chances for personnel and equipment contamination incidents.

With primary surface decontamination, specific decontamination will be performed on high exposure rate components such as the steam generator channel head. In the channel head cut approach, some decontamination of the channel head region of the steam generators would be advantageous in maintaining exposures to a minimum. The interior surface of the channel head will probably be decontaminated by some remote means before the final cut separates the lower shell

Table 5.1 Comparison of alternatives

Alternative	Economic penalty in millions (1983 $)	Exposure (person-rem)	Comment
1 Proposed replacement plan	Base	2420*	Minimum inspection or repairs required in the future.
2 Replace steam generators	NA	NA	Integrity of containment compromised.
3 Retube steam generators	NA	6900**	No commercial application of this technique has been made to date.
4 Sleeve	21	3970*	Considerable inspection, repairs, and replacement power required. Eventually, SGLA must be replaced.
5 Continue operation in the present mode	348	NA	Based on current rate of degradation, unit would be shut down giving no long-term benefit.

*Includes exposures resulting from eddy current tests during the 1984 through 1990 period.
** NUREG/CR-1595.
NOTE: NA = not available.

assembly from the channel head. Appropriate blocking devices will be placed in the reactor coolant pipe before the decontamination takes place. The person-rems expended in the decontamination effort will be balanced against the potential person-rem savings incurred during the removal operations.

Two different decontamination methods have been evaluated for primary surface decontamination. They are:

(1) Fill and Soak - This would involve filling the primary side of the steam generator with a suitable decontaminating solution and allowing sufficient soak time for the solution to work. This soak would be followed by a rinse of the primary side. The liquid waste would be processed as appropriate and run into drums for offsite disposal.

(2) Mechanical - A wet abrasive grit would be sprayed at a high velocity against the area to be decontaminated. This method removes the surface layer of the metal that contains the radioactive contamination. The abrasive, surface contamination, and corrosion products are filtered out of the

wet slurry and drummed for offsite disposal. The liquid steam would be processed as appropriate and drummed for offsite disposal. This method was used at San Onofre Unit 1 and Turkey Point Unit 3.

Radiation dose to workers from decontamination efforts can vary depending upon the process. The staff views both methods for primary surface decontamination to be equally effective, with exposure levels in the range 5 to 60 person-rems to be expected from either method. CP&L has chosen the mechanical method for primary surface decontamination. The procedure will be performed by the Westinghouse Electric Corporation. NUREG/CR-2963 and NUREG/CR-1595 give more detailed information on decontamination methods.

5.6.2 Alternative Disposal Methods

CP&L identified five disposal alternatives for the steam generator lower assemblies once they are removed from containment. These alternatives are presented in Table 5.2 along with licensee's estimates of economic and person-rem costs.

Table 5.2 Disposal alternatives: Economic and radiological costs

Alternative	Applicant's cost estimate	
	1983 dollars	Person-rems
1 Immediate intact offsite shipment without decontamination	2,870,000	30-50
2 Immediate intact offsite shipment with decontamination	3,361,000	40-70
3 Long-term intact onsite storage	2,858,000	10-20
4 Immediate cut-up and offsite shipment with decontamination	5,396,000	175-350
5 Immediate cut-up and offsite shipment without decontamination	5,637,000	550-1650

NUREG/CR-1595 discusses the radiological costs of several alternative methods for disposing of removed steam generators. This discussion is summarized in Table 5.3. The licensee's estimates of person-rem exposure under each alternative compare favorably with the Table 5.3 estimates.

Based on a comparison of the economic and person-rem costs of these five alternatives (Table 5.2), alternative 1, immediate intact offsite shipment without decontamination, and alternative 3, long-term intact onsite storage, seem best. The licensee plans to proceed with onsite storage of the steam generators. This would still allow CP&L to proceed with alternative 1 should future conditions enhance its desirability.

Table 5.3 Steam generator disposal alternatives of NUREG/CR-1595

Alternative	Approximate person-rems/SG	Approximate airborne release, Ci/SG
Long-term* storage (including surveillance) with intact shipment	10	Negligible**
Long-term* storage with cut-up and shipment	16	0.005
Shorter storage with cut-up		
at 5 yr	230	0.026
at 15 yr	60	0.015
Immediate intact shipment	2.4†	Negligible**
Immediate cut-up and shipment by rail/truck - no decontamination	580	0.042
Immediate cut-up and shipment by rail/truck - with chemical decontamination	270	0.010

*30 to 40 years.

**Since the steam generator will be sealed before it is removed from containment, no release of radioactive material is expected during the repair operation.

†Estimates for short-term storage followed by intact shipment would be only slightly larger than this, perhaps 5 person-rems.

6 CONCLUSIONS

The staff has reviewed the proposed steam generator repair action and has reached the following conclusions:

(1) The proposed replacement of the lower assemblies of the steam generators is the best available option, from both the radiological and economic standpoint, for eliminating the tube degradation problem.

(2) The dose reduction measures to be used by the licensee have been reviewed by the staff, with the conclusion reached that the doses would be ALARA. The health effects resulting from such exposure have also been considered and it is concluded that these are not significant.

(3) The new steam generator design incorporates features that will eliminate the potential for the various forms of tube degradation observed to date.

(4) The restoration would return the generators to the condition evaluated in the FES (NUREG-75/024).

(5) Offsite doses resulting from the steam generator repair will be less than those from recent plant operations, comparable with doses presented in the FES (NUREG-75/024), and small compared with the annual doses from natural background radiation. Therefore, the offsite doses will not be significant.

Balancing the costs of the proposed action, both environmental and economic, against the benefits of the continued safe production of power for the public, the staff concludes that the benefits of the proposed project outweigh the costs. The overall cost benefit would not be improved by any of the alternatives.

On the basis of the foregoing analysis, the staff concludes that the proposed steam generator repair will not adversely impact the quality of the human environment.

7 REFERENCES

American Cancer Society, "Cancer Facts and Figures 1979," 1978.

Carolina Power & Light Company, 1973 through 1982, "Effluent and Waste Disposal Semi-Annual Reports."

---, November 1971, "H. B. Robinson Unit No. 2, Environmental Report."

---, July 1, 1982, letter from E. E. Utley, CP&L, to S. A. Varga, NRC, Subject: Repair of the Three Steam Generators at HBR-2.

---, September 16, 1982, letter from E. E. Utley, CP&L, to S. A. Varga, NRC, Subject: Preliminary Steam Generator Repair Report.

---, January 6, 1983, letter from L. W. Eury, CP&L, to S. A. Varga, NRC, Subject: Request for License Amendment, "Final" Steam Generator Repair Report.

---, March 31, 1983, letter from L. W. Eury, CP&L, to S. A. Varga, NRC, Subject: Revision 1 to Final Steam Generator Repair Report.

---, May 23, 1983, letter from L. W. Eury, CP&L, to S. A. Varga, NRC, Subject: Revision 1 to Final Steam Generator Repair Report, Revised Figures.

---, June 3, 1983, letter from S. R. Zimmerman, CP&L, to S. A. Varga, NRC, Subject: Request for Additional Information, "Final" Steam Generator Repair Report.

---, July 11, 1983, letter from S. R. Zimmerman, CP&L, to S. A. Varga, NRC, Subject: Request for Additional Information, "Final" Steam Generator Repair Report.

---, July 14, 1983, letter from S. R. Zimmerman, CP&L, to S. A. Varga, NRC, Subject: Response to Request for Additional Information for Environmental Impact Statement.

---, July 15, 1983, letter from S. R. Zimmerman, CP&L, to S. A. Varga, NRC, Subject: Request for Additional Information, Final Steam Generator Repair Report, Revision 1.

---, July 25, 1983, letter from S. R. Zimmerman, CP&L, to S. A. Varga, NRC, Subject: Supplemental Information to Request for Additional Information for Environmental Impact Statement.

---, August 3, 1983, letter from S. R. Zimmerman, CP&L, to S. A. Varga, NRC, Subject: Response to Request for Additional Information, Steam Generator Replacement, Effect on Terrestrial Biota.

---, August 11, 1983, letter from S. R. Zimmerman, CP&L, to S. A. Varga, NRC, Subject: Revision to Additional Information for Environmental Impact Statement.

---, October 31, 1983, letter from A. B. Cutter, CP&L, to S. A. Varga, NRC, Subject: Draft Environmental Statement Comments.

---, November 1, 1983, letter from S. R. Zimmerman, CP&L, to S. A. Varga, NRC, Subject: Request for Additional Information, "Final" Steam Generator Repair Report.

Federal Register, 47 FR 53157, November 24, 1982.

---, 48 FR 41363, September 16, 1983.

International Commission on Radiation Protection, "Recommendation of the ICRP," ICRP Publication 26, January 1977.

National Academy of Sciences/National Research Council, "The Effects on Populations of Exposure to Low Levels of Ionizing Radiation," report of the Advisory Committee on the Biological Effects of Ionizing Radiations (BEIR I), November 1972; (BEIR III), 1980.

National Council on Radiation Protection and Measurements, "Review of the Current State of Radiation Protection Philosophy," Report No. 43, January 1975.

United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), "Sources and Effects of Ionizing Radiation," 1977.

U.S. Bureau of Labor Statistics, "Occupational Injuries and Illness in the United States by Industry, 1975," Bulletin No. 1981, 1978.

U.S. Department of Energy, "Cost and Quality of Fuel," December 1982.

U.S. Department of Health, Education, and Welfare, "The President's Report on Occupational Safety and Health," May 1972.

U.S. Nuclear Regulatory Commission, November 18, 1982, letter from S. A. Varga, NRC, to E. E. Utley, CP&L, informing applicant that NRC prior review and approval of repairs was necessary.

---, NUREG-75/024, "Final Environmental Statement Related to the Operation of H. B. Robinson Steam Electric Plant, Unit 2," April 1975.

---, NUREG-0692, "Final Environmental Statement Related to Steam Generator Repair at Surry Power Station, Unit No. 1," July 1980.

---, NUREG-0713, Vol. 3, "Occupational Radiation Exposure at Commercial Nuclear Power Reactors - 1981," November 1982.

---, NUREG-0743, "Final Environmental Statement Related to Steam Generator Repair at Turkey Point Plant, Units 3 and 4," March 1981.

---, NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," LWR Edition, July 1981.

---, NUREG-0886, "Steam Generator Tube Experience," February 1982.

---, NUREG-1004, "Safety Evaluation Report Related to Steam Generator Repair at H. B. Robinson Steam Electric Plant Unit 2," November 1983.

---, NUREG/CR-1595, "Radiological Assessment of Steam Generator Removal and Replacement," December 1980.

---, NUREG/CR-2963, "Planning Guidance for Nuclear Power Plant Decontamination," June 1983.

---, Regulatory Guide 1.109, Revision 1, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," October 1977.

---, Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I."

---, Regulatory Guide 8.8, Revision 3, "Information Relevant to Ensuring That Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable," June 1978.

Westinghouse Electric Corporation, "Steam Generator Retubing and Refurbishment," WCAP-9398, January 1979.

Wilson, R., and E. S. Koehl, "Occupational Risks of Ontario Hydro's Atomic Radiation Workers in Perspective," presented at Nuclear Radiation Risks, A Utility - Medical Dialog, sponsored by the International Institute of Safety and Health, Washington, D.C., September 22-23, 1980.

Wisconsin Electric Power Co., "Point Beach Nuclear Plant, Unit No. 1, Steam Generator Repair Report," August 1981.

8 FEDERAL, STATE, AND LOCAL AGENCIES TO WHOM ENVIRONMENTAL STATEMENTS WERE SENT

The Draft and Final Environmental Statements were sent to the following:

Advisory Council on Historic Preservation
Carolina Power and Light Company
Darlington County
Department of Agriculture
Department of the Army, Corps of Engineers
Department of Commerce
Department of Energy
Department of Health and Human Services
Department of Housing and Urban Development
Department of the Interior
Department of Transportation
Environmental Protection Agency
Federal Emergency Management Administration
Federal Energy Regulatory Commission
State of South Carolina

9 STAFF RESPONSES TO PUBLIC COMMENTS ON THE DRAFT ENVIRONMENTAL STATEMENT

9.1 Background

The NRC invited comments on the Draft Environmental Statement from interested persons by a Notice published in the Federal Register on September 16, 1983 (48 FR 41363).

Comments in response to the Notice referred to above were received from the following:

Commentor	Abbreviation
U.S. Department of Agriculture	AG
Department of the Army	ARMY
U.S. Department of Transportation	TR
U.S. Environmental Protection Agency	EPA
Department of Health and Human Services	HHS
Carolina Power & Light Company	CP&L
U.S Department of Interior	INT

The comments received on the Draft Environmental Statement are reproduced in Appendix A. The comments from ARMY, AG, EPA, TR, and INT and one comment from HHS (comment 3) did not require a staff response. The comments from HHS and CP&L did require a response. The staff responses to those comments follow. In Appendix A, the commentors' comments have been arranged in chronological order. Additionally, each separate comment is preceded by a number directly to the left of the comment. Comments addressed below will be listed by author and number; thus, comment HHS-2 would be second comment submitted by the Department of Health and Human Services.

9.2 Department of Health and Human Services

The Department of Health and Human Services provided three comments that require staff response, HHS-1, HHS-2, and HHS-4. These comments are addressed below.

9.2.1 Comment HHS-1

This comment addressed five separate issues. For clarity, these issues and the staff responses will be listed separately.

a. Comment

It would be helpful in assessing the health aspects of the occupational exposure if the licensee's estimate of 2120 person-rem for the repair could show the dose to the 1500 workers by occupational category.

Response

The NRC staff agrees that it would be helpful. However, generally speaking, individuals working during a complex operation such as steam generator replacement are typically involved in a number of tasks. The dosages associated with the various tasks an individual may have participated in would be measured by appropriate dosimetry: the total individual dose is recorded. The licensee has estimated and summarized dosages by specific task in Table 3.4-2 of the Final Steam Generator Repair Report. That table has been reproduced as Table 4.1 in this FES.

b. Comment

Further, we believe the DES should point out that an increase of about 2120 person-rems projected for the year 1983 is a significant annual increase when compared with the annual collective occupational doses shown in Table 4.1 [herein redesignated Table 4.2], but is considered acceptable based on the average annual collective doses for the plant as discussed in Section 4.1.1.1.

Response

The NRC staff agrees that the total dose resulting from the steam generator repair is significantly higher, of itself, than the annual doses experienced during the life of the plant to date. Its impact on the total dose generated by the repair is about 50 person-rems per year.

c. Comment

As noted in this section, it is essential that the licensee make a commitment to maintain the occupational doses within the 10 CFR 20 limit and as low as reasonably achievable (ALARA).

Response

The NRC staff review of the proposed steam generator repair is addressed in the SER (NUREG-1004). The staff has considered the licensee's activities related to keeping doses as low as is reasonably achievable (ALARA), in accordance with Regulatory Guide 8.8, "Information Relevant to Ensuring That Occupational Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable." This is addressed in Section 4.1.1.1 of the DES and FES.

The licensee provided interactions related to dose-reducing considerations. The staff also considered the prior Health Physics Appraisal, as well as related health physics inspections. The staff concluded that the licensee's radiation protection/ALARA program and commitments are generally acceptable and consistent with Regulatory Guide 8.8.

d. Comment

The discussion in paragraph 4 of Section 4.1.1 on the average annual dose for 11 years of dose history at HBR-2 (1972 through 1983) should be clarified. As of this date, the steam generator

repair is unlikely to commence before 1984. Thus, it should state for the purpose of showing the impact on the average annual dose, the 2120 person-rems was added to the 1982 annual collective occupational dose. With this addition, the average annual dose for the 11-year history would be 1107 person-rems.

Response

We do not agree. Total doses recorded in DES Table 4.1 [renumbered Table 4.2 in this FES] are actual doses received during each year of operation. Whatever doses are recorded during the steam generator repair will be recorded under the year in which the doses occur.

e. Comment

Section 4.1.1.1, paragraph 4, incorrectly shows the annual dose as 1075 person-rems. However, it is correctly shown as 1107 person-rems in Section 4.1.1.3, Summary.

Response

Section 4.1.1.1 has been corrected.

9.2.2 Comment HHS-2

However, it would be helpful if a paragraph could be added to Section 4.1.2.1 (Doses from Effluents) that points out that the doses from the repair occur during the approximately 6 months refueling outage. Thus, the dose to individuals and populations will be the sum of the doses from normal operations and from steam generator repair. For instance, if the repair begins in January 1984, there would be 6 months of generator repair and 6 months of normal operations that would need to be summated to obtain the annual dose to compare with the radiation protection standards cited in this section.

Response

The repair schedule has been changed to mid-1984. The doses recorded will be those doses incurred for each task; see comments to HHS-1b and c, above.

9.2.3 Comment HHS-4

There is no indication in the DES on emergency preparedness. We believe a section should be added on emergency response planning to mitigate the consequences of an accident which could impact on the offsite population. It should identify existing emergency plans and procedures that have been established to notify State and local authorities on accidents that are unique to steam generator repair.

Response

The licensee has an inspected and approved emergency plan and procedures. The plan was implemented in accordance with 10 CFR 50 Appendix E and

10 CFR 50.47 using the guidance of NUREG-0654. The plan includes incident and accident classification schemes which would include any work completed on site. The plan includes procedures to notify State and local authorities dependent upon which category of emergency classification has been defined relative to an accident. Therefore, no special procedures are required because the steam generator repairs are unique. The procedures are too voluminous (hundreds of pages) for existing time constraints to allow reproduction in whole or in part in this Final Environmental Statement.

The NRC staff has evaluated the consequences of accidents unique to the repair effort and found that the consequences of these accidents are comparable to those allowed during normal operation (see FES Section 4.4).

9.3 Carolina Power & Light Company

Carolina Power & Light Company provided four comments that require staff response, CP&L-2, 9, 10, and 14. Comments CP&L 1, 3 through 8, and 11 through 13 are editorial in nature, identify typographical errors, and more correctly reflect certain background information. These changes have been made as requested in the comments. In addition, CP&L provided an attachment which consisted of reproduced DES pages depicting typographical errors. These pages have not been reproduced but the corrections have been made.

9.3.1 Comment CP&L-2

Page 2-3, Section 2.2, Paragraph 2

Revise the first sentence to read ". . . will result in continuing power reduction, and . . ."

Page 4-10, Section 4.2, Paragraph 3

Revise the fifth sentence to read ". . . tube degradation will continue causing further reductions in power output from the unit." and the sixth sentence to read "Although these power reductions are not anticipated . . . in view of these reductions."

Response

The subject areas have been revised to eliminate the term "derating." This term connotes a permanent reduction in dependable capacity while the reduction under discussion is temporary and will be eliminated with the completion of the proposed repair program.

9.3.2 Comment CP&L-9

Page 4-10, Section 4.2, Paragraph 2

The first sentence should be revised to read ". . . beginning in July 1984." to reflect the change in the repair program schedule.

Response

The text has been modified to reflect the change in the schedule of the repair program. Staff does not anticipate that this change will alter the overall conclusion drawn in its review.

9.3.3 Comment CP&L-10

Page 4-11, Section 4.3.1, Paragraphs 2 and 6, and Page 5-5, Section 5.6.1, Paragraph 4

Delete information concerning the use of solvents in the decontamination of the steam generators. Carolina Power & Light Company has chosen a grit blast method to be performed by the Westinghouse Electric Corporation. No solvents will be used. See CP&L letter dated July 15, 1983 (Serial: LAP-83-320) for further information.

Response

Sections 4.3.1 and 5.6.1 have been modified to reflect applicant's selection of the mechnical decontamination method for primary surface decontamination.

9.3.4 Comment CP&L-14

Page 5-1, Section 5.2, Paragraph 1

Revise the fourth sentence to read ". . . result in approximately 706 person-rems per steam generator . . ."

Response

The "806 person-rem" estimate has been changed to exclude the exposures projected to account for future eddy current tests (approximately 100 person-rem per steam generator). The staff's intention here is to compare expected occupational dose associated with the repair/replacement alternatives only.

Page 5-2, Section 5.3, Paragraph 5 and Page 5-5, Table 5.1

Revise to show an exposure of 2120 person-rem (as shown on Page 4-4, Section 4.1.1.3 and Page 4-9, Section 4.1.2.6(1)).

Carolina Power & Light Company has estimated the total occupational exposure for the repair program to be 2120 person-rem. See CP&L letter dated July 14, 1983 (Serial: LAP-83-317) for further information.

Response

The text reflects dose estimates for both alternatives during the 1984 through 1990 period. This period is selected because, as the text states, the reusing alternative would merely postpone the need to replace the

steam generator lower assemblies. Any exposure comparison would necessarily have to encompass this period. The text has been changed to reflect that dose estimates are for the period 1984 through 1990. The 2420 person-rem includes 100 person-rem per steam generator for future eddy current test for direct comparison to sleeving operation which also includes person-rem for eddy current testing. Therefore, the comparison values are not in error.

APPENDIX A

PUBLIC COMMENTS ON THE DRAFT ENVIRONMENTAL STATEMENT

Comments are arranged in chronological order. Individual comments are numbered in sequence to the left of the comment.

United States Department of Agriculture

Economic Research Service

Washington, D.C. 20250

September 12, 1983

Mr. Steven A. Varga
Chief, Operating Reactors Branch #1
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Varga:

Thank you for forwarding the Draft Environmental Statement concerning the Carolina Power and Light Company's intent to repair three steam generators at the H. B. Robinson Steam Electric Plant Unit No. 2.

We have reviewed Docket No. 50-261 and have no comments.

Sincerely,

VELMAR W. DAVIS
Acting Director
Natural Resource Economics Division

DEPARTMENT OF THE ARMY
CHARLESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 919
CHARLESTON, S.C. 29402

REPLY TO
ATTENTION OF

September 22, 1983

Environmental Resources Branch

Mr. Steven A. Varga, Chief
Operating Reactors Branch #1
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Varga:

Reference your letter dated September 8, 1983 transmitting a Draft Environmental Impact Statement on proposed repairs at the H. B. Robinson Steam Electric Plant, Unit No. 2.

We have reviewed the draft statement within the scope of our designated areas of responsibility and expertise and have no comments.

Sincerely,

Arthur P. Crouse, Jr.
Chief, Engineering Division

Copy furnished:
Commander
US Army Corps of Engineers
ATTN: DAEN-CWP-V
Washington, DC 20314

U.S. Department
of Transportation

**Federal Highway
Administration**

South Carolina Division Office

1835 Assembly Street
Suite 758
Columbia, South Carolina 29201

October 24, 1983

IN REPLY REFER TO:
HA-SC

Division of Licensing
Office of Nuclear Reacter Regulation
U.S. Nuclear Regulation Commission
Washington, D.C. 20555

Gentlemen:

Subject: Docket No. 50-261

We appreciate the opportunity to review the Draft Environmental Statement related to the repair of steam generators at the H. B. Robinson Steam Electric Plant, Unit No. 2.

This is to advise that we have reviewed the Draft Statement and have no comment.

Sincerely yours,

B. G. Cloyd
Division Administrator

S. C. Gresham

By S. C. Gresham
District Engineer

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IV
345 COURTLAND STREET
ATLANTA, GEORGIA 30365

OCT 19 1983

4PM-EA/GM

Mr. Glode Requa, Project Manager
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Requa:

We have reviewed the Draft Environmental Impact Statement on the H. B. Robinson Steam Electric Plant, Unit No. 2, in Florence, South Carolina. On the basis of the information provided, it appears that Alternative 1 is preferable to the others from most interests. As a result of our evaluation, a rating of LO-1 was assigned. That is, we do not anticipate any significant adverse environmental consequences from this action and no additional information is requested.

Sincerely yours,

Sheppard N. Moore

Sheppard N. Moore, Chief
Environmental Review Section
Environmental Assessment Branch

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Food and Drug Administration
Rockville MD 20857

OCT 27 1983

Mr. Steven A. Varga, Chief
Operating Reactor Branch, #1
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Varga:

The National Center for Devices and Radiological Health staff has reviewed the Draft Environment Statement (DES) related to the steam generator repair at H. B. Robinson Steam Electric Plant, Unit No 2, NUREG-1003, September 1983. Our staff has evaluated the public health and safety impacts associated with steam generator repair and have the following comments to offer:

1. We agree with the NRC analysis that the major environmental impact is occupational exposure associated with the steam generator repair. It would be helpful in assessing the
a health aspects of the occupational exposure if the licensee's estimate of 2120 person-rem for the repair could show the dose to the 1500 workers by occupational category. Further,
b we believe the DES should point out that an increase of about 2120 person-rems projected for the year 1983 is a significant annual increase when compared with the annual collective occupational doses shown in Table 4.1, but is considered acceptable based on the average annual collective doses for the plant as discussed in Section 4.1.1.1. As noted in this section, it is
c essential that the licensee make a commitment to maintain the occupational doses within the 10 CFR 20 limit and as low as reasonably achievable (ALARA). The discussion in paragraph 4
d of Section 4.1.1. on the average annual dose for 11 years of dose history at HBR-2 (1972 through 1983) should be clarified. As of this date, the steam generator repair is unlikely to commence before 1984. Thus, it should state for the purpose of showing the impact on the average annual dose, the 2120 person-rems was added to the 1982 annual collective occupational dose. With this addition, the average annual dose for the 11-year history would be 1107 person-rems. Section 4.1.1.1, paragraph 4,
e incorrectly shows the annual dose as 1075 person-rems. However, it is correctly shown as 1107 person-rems in Section 4.1.1.3, Summary.

2. The public radiation exposure as presented in Section 4.1.2, covers all possible emission pathways, as depicted in Figure 4.1, that could impact on the population in the environs of the facility. The dose computational methodology used in the estimation of radiation doses to individuals and populations within 80 km. of the plant have provided the means to make reasonable estimates of the doses resulting from normal operations. The results of these computations based on radioactive releases resulting from steam generator repair indicate that the doses are well within the radiation protection standards of 10 CFR, Part 20. However, it would be helpful if a paragraph could be added to Section 4.1.2.1 (Doses from Effluents) that points out that the doses from the repair occur during the approximately 6 months refueling outage. Thus, the dose to individuals and populations will be the sum of the doses from normal operations and from steam generator repair. For instance, if the repair begins in January 1984, there would be 6 months of generator repair and 6 months of normal operations that would need to be summated to obtain the annual dose to compare with the radiation protection standards cited in this section.

3. The discusssion in Section 4.4. on the environmental impact of postulated accidents indicates that the accidents presented in the FES of April 1975 will be unchanged and remain valid for the repair. The FES considered accidents unique to the repair. We believe that this section provides adequate assessment of the dose and health impact of atmospheric release of radioactive materials.

4. There is no indication in the DES on emergency preparedness. We believe a section should be added on emergency response planning to mitigate the consequences of an accident which could impact on the offsite population. It should identify existing emergency plans and procedures that have been established to notify State and local authorities on accidents that are unique to steam generator repair.

Thank you for the opportunity to review and comment on this Draft Environmental Statement.

Sincerely yours,

John C. Villforth
Director
National Center for Devices
and Radiological Health

CP&L

Carolina Power & Light Company

OCT 31 1983

SERIAL: LAP-83-496

Director of Nuclear Reactor Regulation
Attention: Mr. Steven A. Varga, Chief
Operating Reactors Branch No. 1
Division of Licensing
United States Nuclear Regulatory Commission
Washington, DC 20555

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261
LICENSE NO. DPR-23
DRAFT ENVIRONMENTAL STATEMENT
COMMENTS

Dear Mr. Varga:

Carolina Power & Light Company (CP&L) hereby submits its comments from its review of NUREG-1003 "Draft Environmental Statement related to steam generator repair at H. B. Robinson Steam Electric Plant Unit No. 2," transmitted to us in September 1983. Areas of the Draft Environmental Statement (DES) which require revision are listed below. Pages containing typographical errors have been appropriately marked and attached.

(1) Page 2-1, Section 2.1, Paragraph 3

Revise the third sentence to read ". . . to remove sludge buildup occurring on the steam generator tube sheet and tube support plates and . . ."

(2) Page 2-3, Section 2.2, Paragraph 2

Revise the first sentence to read ". . . will result in continuing power reduction, and . . ."

Page 4-10, Section 4.2, Paragraph 3

Revise the fifth sentence to read ". . . tube degradation will continue causing further reductions in power output from the unit." and the sixth sentence to read "Although these power reductions are not anticipated . . . in view of these reductions."

411 Fayetteville Street • P. O. Box 1551 • Raleigh, N. C. 27602

(3) Page 3-1, Section 3.1(3)

Revise the sentence to read "improving internal blowdown design by the use of two 2 inch internal blowdown pipes for continuous blowdown which provides for a constant removal of impurities from . . ."

(4) Page 3-4, Section 3.2, Paragraph 1

Delete "and partially replacing the steam separation equipment in" from the second sentence. Carolina Power & Light Company will not be replacing the steam separators.

(5) Page 3-4, Section 3.2, Paragraph 1

Revise the last sentence to read: "The new steam generator lower assemblies will be received by rail, and will be stored in a temporary laydown area west of the protected area."

Page 4-11, Section 4.3.1, Paragraph 2

Revise the third sentence to read as above.

(6) Page 3-4, Section 3.2, Paragraph 4

Revise the first sentence to read ". . . in position on a transport trailer." and the second sentence to read "This trailer will carry . . ."

(7) Page 3-4, Section 3.2, Paragraph 5

Revise the first sentence to read "After the lower assemblies . . ." A determination on the sequence for removing the old steam generator lower assemblies (SGLA) from and installing the new SGLAs in containment has not yet been finalized. The sequence of the SGLA movements will not impact the evaluations presented in the DES.

(8) Page 4-9, Section 4.1.2.4, Paragraph 1

Revise the fourth sentence to read "This building is approximately 1500 ft. from the nearest site boundary." The SGLA tomb is approximately 1500 ft. from the nearest site boundary, not 5000 ft. as stated in the DES.

(9) Page 4-10, Section 4.2, Paragraph 2

The first sentence should be revised to read ". . . beginning in July 1984." to reflect the change in the repair program schedule.

(10) Page 4-11, Section 4.3.1, Paragraphs 2 and 6, and Page 5-5, Section 5.6.1, Paragraph 4

Delete information concerning the use of solvents in the decontamination of the steam generators. Carolina Power & Light Company has chosen a grit blast method to be performed by the Westinghouse Electric Corporation. No solvents will be used. See CP&L letter dated July 15, 1983 (Serial: LAP-83-320) for further information.

(11) Page 4-11, Section 4.3.1, Paragraph 3

Revise the first sentence to read ". . . repair will take place on areas within the site boundary previously used as laydown areas during original plant construction."

Page 4-13, Section 4.3.3, Paragraph 1

Delete "within the security fence" from the first sentence.

All construction and associated activities for the SG repair will not be within the security fence (the protected area). Refer to CP&L letter dated August 11, 1983 (Serial: LAP-83-367) and the FSGRR Section 3.1.2 for further details.

(12) Page 4-11, Section 4.3.1, Paragraph 3

Revise the fourth sentence to read "They will be stored on site in a . . ." The SGLAs will be stored on site in the SGLA tomb with their final disposition being decided upon at a later date.

(13) Page 4-13, Section 4.3.2, Paragraph 1

Sentences 2 and 3 of this paragraph are apparently based in part on the information provided in Sections 2.6.2 a) and b) and 6.6.1 of the Final Steam Generator Repair Report. We believe these sentences may be misleading as written and should be replaced by the following:

During previous operations, frequent unit shutdowns for steam generator inspections required significant consumption of water for the purpose of leak testing prior to tube plugging, hydrostatic testing after tube plugging, and maintenance of steam generators in wet-layup. Following repair, the steam generator tubes will remain intact, thereby minimizing the need for periodic inspections and the water consumption requirements associated with the inspections.

(14) Page 5-1, Section 5.2, Paragraph 1

Revise the fourth sentence to read ". . . result in approximately 706 person-rems per steam generator . . ."

Page 5-2, Section 5.3, Paragraph 5 and Page 5-5, Table 5.1.

Revise to show an exposure of 2120 person-rem (as shown on Page 4-4, Section 4.1.1.3 and Page 4-9, Section 4.1.2.6(1)).

Carolina Power & Light Company has estimated the total occupational exposure for the repair program to be 2120 person-rem. See CP&L letter dated July 14, 1983 (Serial: LAP-83-317) for further information.

If you should have any questions concerning this transmittal, please contact a member of the Nuclear Licensing Staff.

Yours very truly,

for A. B. Cutter
Vice President
Nuclear Engineering & Licensing

AWS/ccc (8267NLU)
Attachment

cc: Dr. David L. Hetrick (ASLB)
Myron Karman, Esquire (NRC-ELD)
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Mr. Morton B. Marqulies (Chm.-ASLB)
Mr. B. A. Matthews (Hartsville Group)
Mr. J. P. O'Reilly (NRC-RII)
Mr. G. Requa (NRC)
Mr. John C. Ruoff (Hartsville Group)
Mr. George F. Trowbridge, P.C.
Mr. Steve Weise (NRC-HBR)

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER 83/1126

NOV 3 1983

Steven A. Varga, Chief
Operating Reactors Branch #1
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Varga:

The Department of the Interior has reviewed the draft environmental statement related to steam generator repair at H. B. Robinson Steam Electric Plant, Unit No. 2, Darlington County, South Carolina and has the following comments.

The draft statement adequately reflects the impacts on those resources within the Department's jurisdiction and expertise. In particular, we believe the impacts to wildlife habitat and fishery resources will not be significant provided the mitigation measures described in the draft statement are implemented.

We appreciate the opportunity to comment.

Sincerely,

Bruce Blanchard, Director
Environmental Project Review

NRC FORM 335 (11-81)

U.S. NUCLEAR REGULATORY COMMISSION

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16. ABSTRACT (200 words or less)

The staff has considered the environmental impacts and economic costs of the proposed steam generator repair at the H. B. Robinson Steam Electric Plant Unit No. 2 along with reasonable alternatives to the proposed action. The staff has concluded that the proposed repair will not significantly affect the quality of the human environment and that there are no preferable alternatives to the proposed action. Furthermore, any impacts from the repair program are outweighed by its benefits.

17. KEY WORDS AND DOCUMENT ANALYSIS

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FES RELATED TO STEAM GENERATOR REPAIR AT H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

NOVEMBER 1983