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U. S. Nuclear Regulatory Commission
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Subject: Arkansas Nuclear One - Unit 2
Docket No. 50-368
License No. NPF-6
Supplemental Information Regarding the Environmental Impact of ANO-2 Power Uprate

Gentlemen:

In a letter dated December 19, 2000 (2CAN120001), Entergy Operations, Inc. submitted a license application for Arkansas Nuclear One, Unit 2 (ANO-2) to increase the authorized power level from 2815 to 3026 megawatts thermal. In a conference call on October 1, 2001, with the NRC staff, a general request was made to provide additional details in regard to the radiological and non-radiological environmental impact from the power uprate process.

Attachment 1 to this submittal provides a summary description of the environmental impact from the power uprate of ANO-2. As discussed in the attachment to this letter, Entergy believes that there is minimal change in the impact to the environment in and around the ANO-2 facility as a result of the proposed power uprate.

This submittal contains no regulatory commitments.

I declare under penalty of perjury that the foregoing is true and correct. Executed on December 10, 2001.

Very truly yours,

Glenn R. Ashley

Glenn R. Ashley
Manager, Licensing

GRA/dwb
Attachment

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ANO-2 POWER UPRATE LICENSING AMENDMENT REQUEST
ENVIRONMENTAL ASSESSMENT SUPPLEMENT

1.0 NEED FOR THE PROPOSED ACTION

The ANO-2 steam generators were replaced in 2000 due to primary water stress corrosion cracking (PWSCC). In evaluating the options for the replacement steam generators (RSGs), Entergy determined that the replacement would be economically viable if accompanied by a 6.5% power uprate that would provide revenue for capital recovery. During the procurement and design phase of the RSGs, engineering determined that the RSGs would be capable of supporting a 7.5% thermal uprate, which would increase the licensed core thermal power level to 3026 MWt. The proposed action to increase the licensed core thermal power level to 3026 is based on the operational goal of increasing electrical generating capacity. With the uprate, ANO-2 will continue to be a significant part of the Entergy strategy of maintaining a flexible and robust fleet of electric generation stations.

There are two significant aspects of maintaining a flexible and robust generation fleet. The first is to retain low cost power options and the second is to maintain a fleet with sufficient diversity to allow utilities to respond to changes in the underlying cost of power. The increase in capacity of ANO-2 provides the Entergy System with lower cost power than can be obtained in the current and anticipated energy market. In addition, the increased capacity reduces exposure to potential cost increases in fossil fuel based alternatives. Summer peak temperatures in the south challenge the ability of Entergy and other power producers to meet peak load demands and nuclear power has shown to be a reliable source during these peak periods.

In addition, there is an ongoing need for existing Entergy System generating capacity, including that provided by ANO-2. Reliability purchases have increased substantially over the last few years and load growth is expected to further increase the System's resource requirements. High availability and low energy cost positions nuclear generation at the foundation of Entergy's resource portfolio. Even though potential load loss, cogeneration options, and retail competition may cause variability in the System's future resource requirements, the power uprate for ANO-2 is expected to provide an economically sound choice with minimal impact to the environment.

Therefore, a power uprate of ANO-2 is an important step in improving the economic performance of the System both before and after utility deregulation. The improved performance is accomplished by cost reductions in production and total bus bar cost per kilowatt-hour, which is afforded by the ANO-2 power uprate.

2.0 ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

The effects of an ANO-2 power uprate have been comprehensively evaluated. The evaluation concluded that sufficient safety and design margins exist such that the increase in the rated core thermal power can be accomplished without adverse impact on the health and safety of the public or the environment.

The environmental impacts of ANO-2 have been described in (1) the final environmental impact statement (FES), dated June 1977 (NUREG-0254), (2) the power uprate licensing amendment request (PULR), dated December 19, 2000, and (3) the June 26, 2001 (2CAN060108), response to a staff request for additional information (RAI). On September 22, 2000, Entergy submitted a supplement to its environmental report supporting the license renewal of ANO-1. This has been issued as NUREG-1474, Supplement 3 (Supplement 3). Supplement 3 addresses many balance-of-plant site features that are common to ANO-1 and ANO-2. Supplement 3 was cited in Enclosure 5 of the December 19, 2000, license application in instances where site characteristics common to both ANO-1 and ANO-2 are unchanged by power uprate. This supplement provides additional clarifications to the other three documents.

The original operating license for ANO-2 allowed a maximum reactor power level of 2815 MWt. Based on Entergy's analyses of the non-radiological and radiological impacts, the environmental impacts of the power uprate are essentially unchanged from the environmental impacts previously evaluated in the FES and Supplement 3. The power uprate does not involve extensive changes to plant systems that directly or indirectly interface with the environment. Additionally, no changes are necessary to the National Pollutant Discharge Elimination System permit issued by the Arkansas Dept of Environment Quality (ADEQ), formerly the Arkansas Department of Pollution Control and Ecology.

Table 1

List of Acronyms and Abbreviations Frequently Used in this Supplement	
ADEQ	Arkansas Department of Environmental Quality
ANO-1	Arkansas Nuclear One Unit One
ANO-2	Arkansas Nuclear One Unit Two
AP&L	Arkansas Power & Light
DAW	Dry Active Waste
ER	Arkansas Nuclear One Unit 2 Environmental Report
FES	Final Environmental Statement
FSAR	Final Safety Analysis Report
ITP	Iodine-Tritium-Particulate
NPDES	National Pollutant Discharge Elimination System
PULR	Power Uprate Licensing Amendment Request, December 19, 2000
RSG	Replacement steam generators
Wbt	Wet bulb temperature
Supplement 3	ANO-1 ER supplement for license renewal of ANO-1 (NUREG-1474)

3.0 NON-RADIOLOGICAL IMPACTS

The following contains the non-radiological environmental impacts of the power uprate on land use, water use, waste discharges, terrestrial and aquatic biota, transmission facilities, and social and economic conditions at ANO-2.

3.1 Land Use Impacts

The power uprate does not modify land use at the site. As stated in Supplement 3, there are no impacts on lands with historic or archeological significance. This is also true for the power uprate. ANO has no plans to construct any new facilities or alter the land around existing facilities, including buildings, access roads, parking facilities, laydown areas, onsite transmission and distribution equipment, or power line rights-of-way in conjunction with the power uprate. The power uprate will not significantly affect the storage of materials, including chemicals, fuels, and other materials stored above or under the ground. The power uprate will not alter the aesthetics of the site. Therefore, FES Section 5-2 and Supplement 3 conclusions for impacts on land use, augmented by information in the PULR and the June 26, 2001 RAI response, will remain valid under power uprate conditions.

Noise was not addressed in the ER or FES. However, FES section 5.2 notes that ANO is located on 1164 acres and FES section 2.2.2 states that the "station has altered the land use in Pope County, primarily through the conversion of 430 acres to an industrial site. Only 150 acres actually are being disturbed. The total acreage of the land affected by the construction and operation of ANO is extremely small. Most of the changes in land use have occurred with the construction and operation of Unit 1." Supplement 3 section 2.1 states that "the ANO site is located on a peninsula formed by Lake Dardanelle, and three sides of the site are surrounded by lake water." The two nearest residences are "approximately 3 and 1.2 miles, respectively, from the Unit 2 containment building centerline" (ER 2.2.3.2). The power uprate will not change the character, sources, or energy of noise generated at ANO-2. Modified structures, systems and components (SSCs) necessary to implement the power uprate will be installed within existing plant buildings and no noticeable increase in ambient noise levels within the plant is expected.

3.2 Water Use Impacts

ANO engineering has evaluated ground and surface water use as environmental impacts of water usage at ANO-2. Ground and surface water use impacts are also discussed in the "Radiological Impacts" section below.

3.2.1 Groundwater Use

As stated in the letter to the staff dated June 26, 2001(2CAN060108), ANO-1 and ANO-2 do not use any groundwater. Power uprate will have no non-radiological effects on groundwater.

3.2.2 Surface Water Use

The power uprate is accomplished by increasing the heat output of the reactor, thereby increasing the steam flow to the turbine for which increased feedwater flow is needed. As a result, more heat will be rejected to the circulating water and cooling tower complex. Increased heat load to the cooling tower will cause evaporative losses to increase. Therefore, cooling tower makeup, supplied from Lake Dardanelle, will increase due the increased evaporative losses.

While the power uprate will require increased water use, ANO-2 will not use more water from the lake than permitted. ANO-2 has a contract with the U. S. Corps of Engineers that allows water to be withdrawn from the lake at an average rate of 22 ft^3/sec. An average evaporation rate of 22 ft^3/sec (9900 gpm) and maximum evaporation rate of 27 ft^3/sec (11,900 gpm) was analyzed in FES section 5.3.4. PULR section 10.4.1.2 stated that the maximum cooling tower make-up for evaporation will increase from 12,180 (27.1 ft^3/sec) to 13,020 gpm (29.0 ft^3/sec) under power uprate conditions. However, by allowing the cooling tower cycles of concentration to increase by 0.3 to 3.8 (see section 3.3.3), still a low concentration value, maximum cooling tower evaporation at design conditions will be about 11,600 gpm (25.8 ft^3/sec) and blowdown will be about 4,150 gpm (9.2 ft^3/sec) for a total makeup requirement of 15,750 gpm (35 ft^3/sec). Cooling tower design conditions continue to be 81.0 °F wet bulb temperature (Wbt) and 37.0% relative humidity. These are conservative values. The meteorological worst day on record, July 17, 1934, reflects a worst average 4-hour Wbt and relative humidity of 82.4 °F and 59.20%, respectively. The Wbt during this worst 4-hour period exceeds the tower design temperature by only 1.4 °F and the relative humidity was 22.2% higher than design. Cooling tower performance at a given Wbt improves as relative humidity increases.

The limits on withdrawal from Lake Dardanelle are based on economics. By withdrawing from the lake, less stream flow is available to flow through Corps of Engineers hydroelectric generation plants. ANO has compensated the Corps of Engineers for reduction of the flow of the stream (Lake Dardanelle) and the resultant power generation losses to its hydroelectric projects (See FES section 5.3.4) and will continue to do so for any additional water withdrawal from Lake Dardanelle as a result of power uprate per the terms of the contract.

Surface water hydrology is discussed in ER sections 2.5.1 and 5.1.3 and FES section 2.3.2. ER section 5.1.3 conclusions that ANO-2 "cooling water facilities will have no adverse effects on the local environment, agriculture, housing, roads, airports, and other facilities…measures are being provided to control the formation of slime and algae in the circulating water system, without causing unnecessary harm to aquatic life and biota" remains true for the power uprate. FES section 2.3.2 statements remain unaffected by the power uprate. See the discussion below on drift regarding replacing chlorination with bromination at ANO.

3.3 Discharge Impacts

Environmental impacts such as cooling tower fogging, icing, drift, noise, chemical discharges to surface water, sanitary waste discharges, blowdown, thermal plume spread, temperature of the lake, cold shock to aquatic biota, hazardous waste effluents, and air emissions were evaluated in the FES. The power uprate causes no significant change to the FES evaluations.

3.3.1 Cooling Tower Fogging, Icing, and Drift

The ANO-2 cooling tower is discussed extensively in FES Section 5.4. Entergy (formerly Arkansas Power & Light) prepared the ANO-2 Environmental Report (ER) and submitted its seventh and final amendment attached to a September 8, 1976 letter. As stated in section 10.1 of the ER, several types of cooling systems such as a cooling pond, a spray pond, a mechanical draft cooling tower and dry cooling towers were evaluated before a natural draft cooling tower was selected as the best option.

Fogging, Icing and Drift – The FES does not discuss in detail the fogging and icing in relationship to the cooling tower. FES sections 2.4.2 and 2.4.3 address fogging and icing but not in regard to the cooling tower. As stated in ER section 10.1.6.3.C, based on studies done at the Keystone Station in Pennsylvania, “fogging and icing were not problems in the area surrounding these towers.” This ER section also noted that “the physical conditions at the Arkansas Nuclear One site were comparable to the installation at Pennsylvania, and the winters less severe.” ER Table 10.1-2 section 3, “Air” states that fogging and icing caused by cooling tower evaporation and drift has either a “minimal” or no effect on ground transportation, air transportation and water transportation. These statements remain unchanged for the power uprate.

In section 10.4.1.2 of the PULR, the increase in circulating water makeup rate was stated to be approximately 840 gpm (1.87 ft^3/sec) due to increased evaporation. As stated above, makeup due to evaporation will increase. However, PULR section 10.4.1.4 states that the circulating water flow rate actually decreased slightly after the condenser was refurbished during 2R13. Since drift is a function (i.e., is some fractional amount) of circulating water flow rate, drift has not increased due to power uprate.

FES Section 5.4.1.1 assesses cooling tower drift. The discussion in this section states, “chlorides were selected by the staff as the primary component of total dissolved solids which may cause potential vegetation damage above certain deposition rates.” The chlorination system for biological control was revised to include a bromination process for the circulating water systems on both ANO-1 and ANO-2 in early 1990s. Chlorination was abandoned in 1991 in lieu of the preferred bromination process. This approach was discussed in a follow-up ANO response to Generic Letter 89-13, "Service Water Problems Affecting Safety-Related Equipment" in 1992.

Since drift has not increased and the evaporation increase is relatively small, the conclusions of the ER and FES regarding fogging, icing and drift are not altered due to power uprate.

3.3.2 Chemical and Sanitary Discharges

Surface water and wastewater discharges are regulated by the ADEQ. The National Pollutant Discharge Elimination System (NPDES) permit is periodically reviewed and reissued by the ADEQ. The present NPDES permit for ANO-2 authorizes discharges from nine outfalls, only one of which will be affected by the power uprate. The one affected outfall is the cooling tower blowdown that is addressed below.

The use of chemicals and their subsequent discharge to the environment will not change significantly as a result of the power uprate. The cooling tower concentration cycle will remain within the current range. Therefore, the concentration of pollutants in the effluent stream will remain the same.

Sanitary wastes are described in ER section 3.7.1 and ANO-2 FSAR section 9.2.4.2. Sanitary wastes from ANO-2 are discharged directly to the ANO-2 sewage treatment plant in accordance with a permit issued by the ADEQ. Since there is no increase in the ANO staff as a result of the power uprate, there is no increase in sanitary waste. Therefore, the power uprate requires no changes to the sanitary waste systems or to the parameters regulated by the NPDES permit.

3.3.3 Blowdown

Blowdown is discussed in PULR section 10.4.1.2. As discussed in the ANO-2 FSAR Section 10.4.5, Circulating Water, the cooling tower blowdown system, which discharges through the Unit 1 discharge flume, maintains the concentration of the circulating water below the solubility limit of calcium sulfate thereby preventing condenser tube scale precipitation.

FES section 5.3.2 evaluated the concentrating effect of evaporation of cooling tower water. The FES states that "substances brought into the circulating water system with the makeup will be concentrated by a factor that will range from 3 to 14 due to evaporation of the water in the cooling tower." The power uprate will not increase the number of cooling tower concentration cycles beyond this range. Cycles of concentration will remain at the lower end of the range cited as discussed below. Therefore, current water appropriation limits are maintained and the conclusions in the FES will remain valid under the power uprate conditions.

As stated in the section above, additional cooling tower evaporation will require a small (1.87 ft^3/sec) increase in cooling tower makeup rate. However the blowdown rate will only increase slightly or be kept at the current rate. With blowdown rate at the current rate, cooling tower cycles of concentration will increase by about 0.3 from approximately 3.5 to 3.8. The effect is negligible with either maintaining the current blowdown rate by

increasing cycles of concentration or with increasing blowdown. This is because the blowdown is normally mixed with the ANO-1 circulating water system discharge, which has a flow rate of 383,000 gpm (853 ft^3/sec) with two of the four circulating water pumps in operation. Mixing of the blowdown with the Unit 1 circulating water is discussed in FES summary and conclusion paragraph 3.b and section 5.3.2.

There are no blowdown flow limitations established in ANO NPDES Permit Number AR0001392, issued by ADEQ. Other parameters such as pH, free available chlorine and total zinc will continue to be monitored in accordance with the permit to ensure that state water quality standards are met.

3.3.4 Thermal Plume Spread and Temperature of Lake Dardanelle

These two topics are discussed in PULR section 10.4.1.3. As stated above, the ANO-2 cooling tower makeup rate will increase by 840 gpm (1.87 ft^3/sec) from 12,180 (27.1 ft^3/sec) to 13,020 gpm (29.0 ft^3/sec), but blowdown will remain at essentially the current rate. As stated above, this blowdown is normally mixed into the ANO-1 circulating water system discharge which has a much greater flow rate. Since the blowdown temperature will increase by less than 1°F due to power uprate, the effect of power uprate on thermal plume spread and Lake Dardanelle temperature is negligible.

3.3.5 Cold Shock

Cold shock to an aquatic biota occurs when the warm water discharge from a plant abruptly stops because of an unplanned shutdown, resulting in a rapid temperature drop of the discharge water to the lake and possible adverse impact on aquatic biota. The FES does not discuss cold shock caused by an unplanned trip of ANO-2 and the probability of an unplanned shutdown is independent of a power uprate. As stated above, the ANO-2 blowdown is normally mixed with the much larger ANO-1 circulating water discharge. An unplanned shutdown of ANO-1 can cause cold shock as evaluated in Supplement 3. However, even if the ANO-1 circulating water pumps are not in service, the amount of ANO-2 blowdown flow into Lake Dardanelle at the ANO-1 circulating water discharge, even at power uprate conditions, is too small to cause cold shock. The risk of aquatic biota mortality by cold shock is not applicable to ANO-2 even at power uprate conditions. The discussion in FES section 5.4.2 regarding winter lake water temperature effects on shad (FES pages 5-8 and 5-9) remains unchanged.

3.4 Hazardous Waste Generation and Air Emissions

As stated in PULR section 10.4.1.4, ANO holds an Air Permit issued and monitored by the ADEQ Air Division. This permit identifies emission sources at ANO. These sources include, but are not limited to, emergency diesel generators, plant heating boilers, cooling tower, start-up boiler and bulk storage tanks.

ANO generates hazardous waste from routine plant operations. ANO has a hazardous waste generator's identification number assigned by the ADEQ Solid Waste Division. ANO files Annual Hazardous Waste Reports to the ADEQ.

The power uprate has no impact on the quality or quantity of effluents from these sources, and operation under power uprate conditions will not reduce the margin to the limits established by the applicable permits.

3.5 Terrestrial Biota Impacts

The power uprate will not change the previously evaluated land use at ANO and will not disturb the habitat of any terrestrial plant or animal species. There are no significant increases in previously evaluated environmental impacts from cooling tower operation at power uprate conditions.

According to a 1999 review by the Arkansas Natural Heritage Commission in Supplement 3 section 4.6, there are no known rare or endangered plant species within the area of the site boundary. As stated in Supplement 3, section 4.6, the Arkansas Natural Heritage Commission and the U.S Fish and Wildlife Service have recently (June 2000) stated that no endangered species have been identified at the ANO site or along the transmission rights-of-way. This agrees with the subsection on "Fishes" in FES section 2.5.1. See the first paragraph after FES Table 2.4.

As stated in the June 2001 environmental impact RAI response, the power uprate will not disturb land and land use will remain unchanged. The power uprate will not adversely impact the habitat of any terrestrial plant or animal species. There are no deleterious effects on the diversity of biological systems or the sustainability of species due to the power uprate and it does not involve additional changes to the stability or integrity of ecosystems. Therefore, it is concluded that the description of the impact on terrestrial ecology, including endangered and threatened plant and animal species will remain valid for the power uprate.

3.6 Aquatic Biota Impacts

ANO-1 has a traveling water screen system that protects the suction to both its large circulating water pumps and the much smaller safety-related service water pumps. This same traveling water screen system is used for ANO-2 only for its safety-related service water pumps. The power uprate did not require larger service water pumps and therefore has no increased impact on the traveling water screen system. Losses associated with the impingement and entrainment of organisms via the traveling water screen system were recently reassessed in Supplement 3 Section 4.1.1 and judged to be insignificant. The effect of the power uprate on the impingement and entrainment of organisms is unchanged and therefore remains insignificant. Therefore, the conclusions regarding impingement, entrainment, and endangered and threatened aquatic species as discussed in FES sections 2.5.1 and 5.4.2, and Supplement 3 section 4.1.1 will remain valid for the

power uprate. The power uprate does not affect ANO's compliance with Sections 316(a) or 316(b) of the Federal Water Pollution Control Act.

3.7 Transmission Facility Impacts

Environmental impacts, such as exposure to electromagnetic fields (EMFs) and shock, could result from a major modification to transmission line facilities. However no change is being made to the existing transmission line design or operation as a result of the power uprate. As stated in the letter dated October 30, 2001 (2CAN100113), main transformer capacity is adequate to deliver the additional power to the offsite grid. Grid stability is addressed in PULR section 2.2.1 which cites ANO procedure changes to avoid grid instability with either the Mablevale or Pleasant Hill 500 kV line out of service or during minimum load conditions. These modifications are consistent with Entergy's program of maintaining grid stability. Therefore, no significant environmental impacts from any changes in transmission facility design and equipment are expected, and the conclusions of FES sections 3.3, 4.2 and 5.2 remain valid.

The rise in generator output associated with power uprate will slightly increase the current and the EMFs in the onsite transmission line between the main generator and the plant substation. The line is located entirely within the fenced, ANO-controlled boundary of the plant, and neither members of the public nor wildlife is expected to be affected. Exposure to EMFs from the offsite transmission system is not expected to increase significantly and any such increase is not expected to change any conclusion in FES section 5.4.1.3 that no significant biological effects are attributable to EMFs from high voltage transmission lines.

ANO-2 transmission lines are designed and constructed in accordance with the applicable shock prevention provisions of the National Electric Code and the power uprate will not cause the transmission line design to deviate from these provisions. Therefore, the expected increase in current attributable to the power uprate does not change the conclusion in FES section 5.4.1.3 that adequate protection is provided against hazards from electrical shock.

3.8 Social, Economic, and Physical Impacts

ANO employs more than 1000 people and is a major contributor to the local tax base. The power uprate will not significantly affect the size of the ANO workforce and will have no material effect on the labor force required for future outages. Because the plant modifications needed to implement the power uprate will be minor, any increase in sales taxes and local and national business revenues will be negligible relative to the large amount of taxes paid by ANO. It is expected that improving the economic performance of ANO-2 through cost reductions and lower total bus bar costs per kilowatt hour will enhance the value of ANO-2 as a generating asset and lower the probability of early plant retirement.

Early plant retirement would have a negative long-term impact upon the local economy and the community as a whole by reducing public services, employment, income, business revenues, and property values. Conclusions in FES Section 10 and Supplement 3 regarding social and economic impacts and benefits remain valid under power uprate conditions.

The potential for direct physical impacts of the power uprate, such as vibration and dust from construction activities has been considered. The power uprate will be accomplished primarily by changes in station operation and a few physical modifications to the facility. These limited modifications will be accomplished without physical changes to transmission corridors, access roads, other offsite facilities, or additional project-related transportation of goods or materials. Therefore, no significant additional construction disturbances causing noise, odors, vehicle exhaust, dust, vibration, or shock from blasting are anticipated, and the conclusions in FES sections 4.1 and 5.2 remain valid.

3.9 Summary

In summary, the power uprate will not result in a significant change in non-radiological impacts on land use, water use, waste discharges, terrestrial and aquatic biota, transmission facilities, or social and economic factors, and will have no non-radiological environmental impacts other than those evaluated in the FES. Table 2 provides a tabular summary of the non-radiological results.

Table 2

Summary of Non-Radiological Environmental Impacts of Power Uprate	
Land Use Impacts:	No change in land use or aesthetics; will not impact lands with historic or archeological significance. No significant impact due to noise.
Water Use Impacts: Surface Water	There is only a small increase in water withdrawal rate from the lake from 27.1 ft^3/sec to 29 ft^3/sec maximum; withdrawal rate remains within permitted levels.
Groundwater Use:	No groundwater use.
Discharge Impacts: Cooling Tower Fogging, Icing, Drift	Fogging evaluated as minimal in ER Table 10.1-2. Remains minimal for power uprate. No significant change in icing. Icing evaluated as minimal in ER Table 10.1-2. Remains minimal for power uprate. No significant change in cooling tower drift per PULR 10.4.1.4.

Table 2 (continued) Summary of Nonradiological Environmental Impacts of Power Uprate	
Chemical and Sanitary Discharge:	No expected change to chemical use and subsequent discharge, or sanitary waste systems; cooling towers will operate in the current cycle range. No changes to sanitary waste discharges.
Blowdown:	Increase in blowdown discussed in PULR section 10.4.1.2. Max. 29 ft^3/sec BD normally mixed with 853 ft^3/sec CWS discharge from ANO-1's once-through cooling system. Blowdown remains within permitted limits.
Thermal Plume and Temperature of Lake Dardanelle:	Negligible and unnoticeable increase in thermal plume size. No discharge temperature increase; lake temperature, primarily affected by ANO-1 once-through cooling system, remains in NPDES limit
Hazardous Waste and Air Emissions:	No changes to hazardous waste sources or air emissions.
Terrestrial Biota Impacts:	No change in terrestrial biota impacts; no known threatened or endangered species within the site boundary.
Aquatic Biota Impacts:	No change in aquatic biota impacts; no known threatened or endangered species in the area of surface water intake or discharge.
Transmission Line Facility Impacts:	No change to transmission line design or operation; main transformer capacity to deliver additional power is unchanged; no significant change in exposure to EMFs.
Social and Economic Impacts:	No significant change in the local economy. Few modifications to physical station facility.

4.0 RADIOLOGICAL IMPACTS

The staff evaluated radiological environmental impacts on waste streams, in-plant and offsite doses, accident analyses, and fuel cycle and transportation factors. The following is a general description of the waste treatment streams at ANO-2 and an evaluation of the environmental impacts.

4.1 Surface Water

There is no discussion in the FES regarding radiological impacts on surface water. Power uprate will not cause any radiological effects to surface water in the station environs.

4.2 Groundwater

Even though there is no discussion in the ANO-2 FES regarding radiological impacts on surface water, ER Table 10.1-2 states that the impact on groundwater due to chemical, radionuclides or "other" impacts is "NA", i.e., not applicable. As stated in ER section 2.5.2, Ground Water Hydrology, "contamination of underground water by radioactivity pre-supposes the discharge of radioactive liquids from a leaking or ruptured tank into the general environs of the plant site. As discussed in ER section 7.1, the liquid released by the rupture of any tank in the Boron Management System or Waste Management System will be contained within the Auxiliary Building and safely processed". This statement remains true for the power uprate as do further FES statements regarding the refueling water tank.

4.3 Radioactive Waste Stream Impacts

ANO-2 uses waste treatment systems designed to collect, process, and dispose of radioactive gaseous, liquid, and solid waste in accordance with the requirements of 10CFR20 and Appendix I to 10CFR50. These radioactive waste treatment systems are discussed in the FES. The power uprate will not affect the environmental monitoring of these waste streams or the radiological monitoring requirements contained in licensing basis documents. The power uprate does not result in any changes in operation or design of equipment in the gaseous, liquid, or solid waste systems. The power uprate will not introduce new or different radiological release pathways and will not increase the probability of an operator error or equipment malfunction that will result in an uncontrolled radioactive release. Changes in the gaseous, liquid, and solid waste streams for radiological environmental impact of the power uprate, are set forth below.

4.4 Gaseous Radioactive Waste Impacts

During normal operation, the gaseous effluent systems control the release of gaseous radioactive effluents to the site environs, including small quantities of noble gases, halogens, particulates, and tritium. Routine offsite releases from station operation remain below the limits of 10CFR20 and Appendix I to 10CFR50 (10CFR20 includes the requirements of 40CFR190). The gaseous waste management systems include the offgas

system and various building ventilation systems. The power uprate assumes an increase in the release rate that is linearly proportional to the power increase. An increase in gaseous effluents will, therefore, occur. The resultant effluent increases in noble gas and iodine-131 activity are 4.98E-02 µCi per second and 0.00E+00 µCi per second, respectively. A release rate of zero is assumed for iodine because no iodine has been released over the past three years. The estimated dose values will be below Appendix I requirements after the power uprate. These dose levels are very small and have no significant impact on human health. The estimated dose increase is tabulated as follows:

Table 3

Gaseous Releases			
	gamma Air (mrad)	**beta Air** (mrad)	**ITP** (mrem)
2000	1.45E-04	4.25E-04	1.22E-02
1999	1.19E-03	3.76E-03	2.37E-02
1998	5.97E-04	1.80E-03	7.46E-03
Average	6.44E-04	2.00E-03	1.45E-02
Uprate Value	6.92E-04	2.15E-03	1.56E-02

Therefore, the conclusions in the FES will remain valid under power uprate conditions. Averaging ANO's dose for the three most recent years shown in Table 3 and adding the effect of power uprate on gamma in air and beta in air results in power uprate dose rates of 6.92E-04 and 2.15E-03 millirad per year (mrad/yr), respectively. Comparing these dose rates to same type dose rates in FES Table 5.7 demonstrates that ANO-2 is not only far below the RM-50-2[1] design objective values of 10 and 20 mrad/yr for gamma and beta but that the power uprate dose rates for gamma and beta are about 86 and 884 times lower, respectively, than the calculated dose for gamma (0.06 mrad/yr) and beta (1.9 mrad/yr) listed in the FES table. A 3-year average allows averaging with and without refueling outages.

Similarly, the three-year average plus projected power uprate dose rate for iodine, tritium and particulates (ITP) is 1.56E-02 millirem per year (mrem/yr). Again this power uprate ITP dose rate is not only far below the RM-50-2 design objective dose rate of 15 mrem/yr but is also about 192 times lower in dose consequence than the 3.0 mrem/yr calculated dose for ITP in the FES table.

These low dose rates projected for power uprate, when combined with the most recent 3-year average, clearly demonstrate that ANO-2 has been successful in maintaining a very

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[1] Guides on Design Objectives proposed by the NRC staff on February 20, 1974; considers does to individuals from all units on site. From "Concluding Statement of Position of the Regulatory Staff," Docket No. RM-50-2. Feb. 20, 1974, pp. 25-30, U.S. Atomic Energy Commission, Washington, D. C.

low exposure to plant personnel and the public of both gaseous and liquid (see below) effluent doses.

4.5 Liquid Radioactive Waste Impacts

The liquid radwaste system is designed to process and recycle, to the extent practicable, the liquid waste collected. Annual radiation doses to individuals are maintained below the guidelines in 10CFR20 and 10CFR50, Appendix I. There will be no change in the release policy as a result of the power uprate.

The following table illustrates the activities released to the environment over the past 3 years. Even if these activities were increasing linearly for the power uprate, the resultant activities are still well below any of the ANO reporting limits.

Table 4

Liquid Releases				
	Tritium (Curies)	**Gas** (Curies)	**Particulate** (Curies)	**Non-Gamma** (Curies)
2000	4.99E+02	2.01E-01	2.59E-01	2.82E-04
1999	5.88E+02	2.28E-02	8.52E-02	4.39E-04
1998	6.86E+02	7.92E-02	5.29E-01	4.44E-03
Average	5.91E+02	1.01E-01	2.91E-01	1.72E-03
Uprate Value	6.35E+02	1.08E-01	3.13E-01	1.85E-03

The power uprate conditions will not result in significant increases in the volume of fluid from other sources flowing into the liquid radwaste system. The reactor will continue to be operated within its present pressure control band. Valve packing leakage volume into the liquid radwaste system is not expected to increase. There will be no changes in reactor coolant pump seal flow or the flow of any other normal equipment drain path. In addition, there will be no impact on the dirty radwaste or chemical waste subsystems of the liquid radwaste system as a result of the power uprate since the operation and the inputs to these subsystems are independent of power uprate. No significant dose increase in the liquid pathway will result from the power uprate. Therefore, the conclusions in the FES will remain valid under power uprate conditions as demonstrated by the following comparison.

Averaging ANO's dose for the three most recent years shown in Table 4 and adding the effect of power uprate on the liquid effluents dose rate to the total body, or any organ, for all pathways results in a calculated dose of 1.04E-2 mrem/yr. Comparing this dose to the liquid effluent doses in FES Table 5.7 demonstrates that ANO-2 is not only far below the

RM-50-2 design objective of 5 mrem/year but that the power uprate dose rate is about thirty (30) times lower than the calculated dose of 0.31 mrem/yr listed in the FES table.

4.6 Solid Radioactive Waste Impacts

The solid radioactive waste system collects, monitors, processes, packages, and provides temporary storage facilities for radioactive solid wastes prior to offsite shipment and permanent disposal. ANO-2 has implemented procedures to assure that the processing and packaging of wet and dry solid radioactive waste and irradiated reactor components are accomplished in compliance with regulations. Entergy continually tracks the volume of solid radioactive waste generated at the site, however the total is not broken down to a specific unit. From 1995 to the present ANO-1 & 2 generated 78,787 ft^3 of low level radioactive waste for an average of about 12,097 ft^3 per year. In 2000, ANO generated a peak volume of 25,107 ft^3 of low-level radioactive waste. The majority of the waste was generated as a result of the ANO-2 replacement steam generator outage.

Wet Waste - The largest volume contributor to radioactive solid wet waste is low specific activity spent secondary resin. Historically this has accounted for more than 50% of the total volume of wet radioactive waste generated annually. Since the completion of the ANO-2 RSG outage no secondary resin has been found to be radioactive. This should not change with power uprate. The remainder of the wet waste is primary resins, filters, and oil and sludge from various contaminated systems. The power uprate will not involve changes in either reactor water cleanup flow rates or filter performance. Implementation of the power uprate will not have a significant impact on the volume or activity of wet radioactive solid waste at ANO-2.

Dry Waste - ANO continually tracks the volume of dry radioactive waste generated and continually looks for new ways to minimize the volume of waste generated. Dry waste consists primarily of air filters, contaminated paper products and rags, contaminated clothing, tools and equipment parts that cannot be effectively decontaminated, and solid laboratory wastes. The activity of much of this waste is low enough to permit manual handling. Dry waste is collected in containers located throughout the plant, packaged and removed to a controlled area for temporary storage. Because of its low activity, dry waste can be stored until enough is accumulated to permit economical transportation to an offsite processing facility for volume reduction or a burial ground for final disposal. Waste volumes (ft^3) generated at ANO are listed below and represent the combined generation for ANO-1 and 2.

Table 5

ANO-1 and 2 Total Radioactive Waste Generated (ft^3)

Year	Compactible DAW	Metals	Sec Resin	Primary Resin	Filters	Oil	Other
1995	10,464	1,507	1,865	397	265	201	561
1996	4,785	309	1,050	110	1,332	150	0
1997	5,522	980	1,058	1,094	176	0	0
1998	6,314	2,101	648	50	0	36	829
1999	8,954	1,265	955	110	132	230	230
2000	18,095	2,559	888	650	478	698	1,739
2001	4,658	576	420	0	0	71	168

Table 6

ANO-1 and 2 Radwaste Burial Volumes (ft^3 per year)

	Resin	Total
1982	4,821	30,229
1992	1,057	6,180
2000	0	5,210
2001	0	1,520

As indicated in Table 5 the vast majority of waste generated at ANO is compactible dry active waste (DAW). Due to the nature of the materials in this waste stream it is not expected to change significantly as a result of power uprate. In light of ANO's continuing efforts to reduce radioactive wastes, any projected increase in solid waste generation under power uprate conditions described above is not significant and is not sufficient to reverse the continuing downward trend in the production and activity of dry wastes.

Irradiated Reactor Components - Irradiated reactor components such as in-core detectors and fuel assemblies, must be disposed of after the life of the component. The volume and activity of waste generated from spent control element assemblies and in-core detectors may increase slightly under the higher flux conditions associated with power uprate conditions.

ANO-2 plans to load 80 fresh fuel bundles in the initial refueling to commence operation under the power uprate. This is 12 bundles more than required for the current refueling cycle. The number of irradiated fuel assemblies discharged from the reactor should not increase during subsequent reloads for comparable energy requirements. These irradiated fuel assemblies are currently stored in the spent fuel pool or dry cask storage.

Implementation of the power uprate will not have a significant impact on the volume or activity of the irradiated reactor components at ANO.

Given the information above, the environmental impact due to generation of solid reactor system waste from power uprate is insignificant.

4.7 Dose Impacts

In-plant and offsite radiation was evaluated as part of the environmental impacts of the power uprate.

4.7.1 In-plant Radiation:

Increasing the rated power at ANO-2 might increase the radiation levels in the reactor coolant system. However, physical plant improvements and administrative controls, such as shielding, RCS chemistry, and the plant radiation protection program will compensate for these potential increases. Over the past 7 years, ANO-2 has continued to decrease the occupational dose to workers. In years with refueling outages the dose decreased by 55% from 175 rem in 1995 to 79 rem in 1999. Dose for the unit increased in 2000 due to the length and scope of the RSG outage. Non-outage year doses at ANO have gone from 49 rem in 1996 to 35 rem in 1998 to 9 rem in 2001. ANO expects to continue this downward trend while operating under the power uprate conditions.

The plant radiation protection program will be used to maintain individual doses consistent with ALARA policies and well below the established limits of 10CFR20. Routine plant radiation surveys required by the radiation protection program will identify increased radiation levels in accessible areas of the plant and radiation zone postings and job planning will be adjusted if necessary. Time within radiation areas is monitored and controlled under the radiation protection program. Administrative limits are provided for occupational dose at levels well below the limits given in the Code of Federal Regulations (10CFR20). The administrative limits for occupational doses are:

Table 7

ANO-2 Occupational Dose Limits	
2,000 mrem/year*	Whole Body Dose (TEDE)
40,000 mrem/year	Organ dose (TODE)
12,000 mrem/year	Dose to Lens of Eye (LDE)
40,000 mrem/hear	Dose to Skin of Whole Body
40,000 mrem/year	Dose to Extremities

*TEDE administrative control may be extended up to 4500 mrem/year

These administrative limits provide a significant margin to regulatory dose limits under normal operating and outage conditions. Administrative dose limits were not routinely exceeded under present power conditions.

4.7.2 Offsite Doses

The slight increase in normal operational gaseous activity levels under the power uprate will not affect the large margin to the offsite dose limits established by 10CFR20. In addition, doses from liquid effluents, currently low, will remain low under power uprate conditions.

The ANO-2 Technical Specifications implement the guidelines of 10CFR50, Appendix I, which are within the 10CFR20 limits. Adjusting current values for projected power uprate increases, the offsite dose at power uprate conditions is estimated to be 6.92E-04 millirads for noble gas gamma air, 2.15E-03 millirads for noble gas beta air, and 1.56E-02 thyroid millirem for particulates and iodine. Appendix I limits are 10 millirads, 20 millirads, and 15 thyroid millirem, respectively. The offsite dose will continue to be within the technical specification dose limits.

The power uprate will not involve significant increases in an offsite dose from noble gases, airborne particulates, iodine, or tritium. Radioactive liquid effluents are not routinely discharged from ANO-2. In addition, as stated by the Radiological Environmental Monitoring Program for ANO-2, radiation from shine is not now a significant exposure pathway, and it will not be significantly affected by the power uprate.

The estimated doses from both the liquid and gaseous release pathways resulting from power uprate conditions are within the design objectives specified by 10CFR50, Appendix I, and the limits of 10CFR20.

4.7.3 Accident Analysis Impacts

The following is an assessment of the Class 6 through Class 9 accidents judged to be relevant to the power uprate. The facility accident considerations in the ANO-2 FES were based on the WASH-1400 studies published on August 20, 1974 and October 30, 1975. No explicit recognition of the ER facility accident information was sited in the FES.

4.7.3.1 Class 6 Refueling Accidents Inside Containment

The consequences of two events have been addressed which bound this class of accident: dropping a heavy object onto a fuel assembly in the core, and a fuel bundle drop with failure of a full row of pins. The latter was considered by the ER as a Class 7 accident and is addressed in section 4.7.3.2 below. Dropping a heavy object onto a fuel assemble in the core was evaluated in the ER and will be assessed below based on the Class 7 accident addressed in section 4.7.3.2.

The ER considered a heavy object drop onto a fuel assembly in the core based on the following assumptions:

1. all noble gas and iodine gap activity of one average fuel assembly is released into the water,
2. prior to the incident, 100 hours of decay occurs,
3. iodine scrubbing in the water results in a DF of 500,
4. all activity is discharged in 2 hours, and
5. the ventilation filters remove 99% of the iodine.

The Class 7 fuel bundle drop evaluation presented in section 4.7.3.2.1 will bound the thyroid dose at the site boundary for a heavy object drop onto a fuel assembly in the core based on the conservative assumptions with respect to iodine scrubbing. The Class 7 fuel bundle drop evaluation only assumed 60 pins failed versus 236 pins (4 times more) for the heavy object drop. The event described in section 4.7.3.2.1 assumed a DF of 100 for iodine scrubbing in water. This is 5 times lower than that assumed in the ER, which covers the difference in fuel pins making the Class 7 fuel bundle drop bounding with respect to the thyroid dose. The whole body dose for the heavy object drop onto a fuel assembly in the core can be conservatively estimated by increasing the whole body dose from the Class 7 fuel bundle drop by a factor of 4. A whole body dose of 400 mrem and Thyroid dose of 53 rem are thus assessed for this event. Both of these considerations are within the acceptance criteria. As noted in section 4.7.3.2, the Class 7 fuel bundle drop evaluation also contains additional conservative assumptions over the ER assessment. Based on the noted conservative assumptions, these doses are well within the acceptance criteria.

The ER also estimates the integrated dose to the 50-mile population. Adjusting these estimates for the increased source term due to power uprate and changes in population per Supplement 3 would not alter the conclusion that the environmental risks due to these postulated radiological accidents at ANO-2 remain exceedingly small under power uprate conditions.

4.7.3.2 Class 7 Accidents to Spent Fuel Outside Containment

The consequences of three events in the ER have been addressed which bound this class of accident: fuel assembly drop in the fuel storage pool, heavy object drop onto fuel rack, and fuel cask drop.

4.7.3.2.1 Fuel Assembly Drop in Fuel Storage Pool

The fuel assembly drop was considered a Class 7 accident in the ER and is bounded by the Chapter 15 analysis discussed in section 7.3.15 of Enclosure 5 to the Application for License Amendment to Increase Authorized Power Level. The original analysis described in the ER assumed:

1. an average power level exposure for three cycles,
2. four rows or 60 damaged pins released all gas and iodine gap activity into the water,
3. prior to the incident, 72 hours of decay occurs,
4. iodine scrubbing in the water results in a DF of 500,
5. iodine plate out of 50% credited,
6. all activity is discharged in 2 hours, and
7. the ventilation filters remove 99% of the iodine.

The reanalysis for Chapter 15 as presented in section 7.3.15 of the power uprate submittal made a number of assumptions, which increased the conservatism of the results:

1. Fuel movement was assumed beginning 100 hours after reactor shutdown rather than 72 hours as considered in the ER. The 100 hours is consistent with the technical specification 3.9.3.a limits for fuel movement. Although this change in assumptions is non-conservative, it is still considered conservative because the limit is controlled by the technical specifications,
2. partition factors assumed for the fuel pool in the reanalysis were reduced from 500 used in the ER to 100,
3. plate out factor of 50% credited in the ER was not credited in the reanalysis,
4. no credit was taken for filtration systems as was done in the ER,
5. four rows or 60 damaged pins released all gas and Iodine gap activity into the water,
6. the release was assumed to occur over a 2-hour period,
7. power uprate results in an increase in core inventory, and
8. a pin peaking factor of 1.7 was assumed.

The reanalysis is based on 95% confidence level atmospheric dispersion models versus 50-percentile criterion. The two-hour whole body dose at the EAB was predicted to be 100 mrem and the thyroid dose was 53 rem. Both of these considerations are within the acceptance criteria. As noted above, this evaluation also contains additional conservative assumptions over the ER assessment. Based on the noted conservative assumptions, these doses are well within the acceptance criteria.

The ER also estimates the integrated dose to the 50-mile population. Adjusting these estimates for the increased source term due to power uprate and changes in population per Supplement 3 would not alter the conclusion that the environmental risks due to these postulated radiological accidents at ANO-2 remain exceedingly small under power uprate conditions.

4.7.3.2.2 Heavy Object Drop On Fuel Rack

Dropping a heavy object onto a fuel rack was evaluated in the ER and will be assessed below based on the Class 7 accident addressed in section 4.7.3.2.1, fuel assembly drop in fuel storage pool, above.

The ER considered the dropping of a heavy object onto the fuel rack based on the following assumptions:

1. all noble gas and iodine gap activity of one average fuel assembly is released into the water,
2. prior to the incident, 30 days of decay occurs,
3. iodine scrubbing in the water results in a DF of 500,
4. all activity is discharged in 2 hours, and
5. the ventilation filters remove 99% of the iodine.

The Class 7 fuel bundle drop evaluation presented in the ER bounded the results of this assessment. Even though a fuel bundle drop only considers the failure of 60 pins versus a full assembly, the 30 day decay for the heavy object drop versus 3 days of decay for the fuel bundle drop significantly reduces the source term available for release. Additionally, the heavy object drop onto a fuel assembly in the core addressed in section 4.7.3.1 also bounds this event as the section 4.7.3.1 event is based on 100 hours of decay versus thirty (30) days of decay. The results of both of these events considered above are within the acceptance criteria. Also, as noted above, these evaluations contain additional conservative assumptions over the ER assessment. Based on the noted conservative assumptions, the above doses are well within the acceptance criteria.

4.7.3.2.3 Dropping a Spent Fuel Cask

A fully loaded spent fuel cask is assumed to be dropped while being lowered to a railroad car. The final movement of the spent fuel in shipping it offsite involves lowering the spent fuel cask through a vertical equipment handling shaft to a railroad car. Operational procedures based on safe handling practices and periodic inspections of the fuel handling crane will make the possibility of a free-fall drop of the cask occurring in this vertical shaft highly unlikely. The offsite doses that would result from a fuel cask drop of 50 feet were evaluated in the ER assuming:

1. the cask holds 15 fuel assemblies,
2. the operating time of the assemblies is 3 years,
3. design power of 2908 MWt for all assemblies,
4. noble gas release of 25% and iodine release of 10%,
5. prior to the incident, 100 days of decay occurs,
6. iodine plate out of 50% credited, and
7. none of the solid fission products are released from the fuel.

Currently, neither unit ships spent fuel offsite and there are no plans to do so. As such, no dropped spent fuel shipping cask accident doses were considered for the power uprate project. ANO does utilize a ventilated storage cask (VSC) design for the current ANO-2 fuel. An analysis of a drop of this cask design was considered at uprated conditions assuming:

1. the cask holds 24 fuel assemblies,
2. cask movement occurs not sooner than five years after the fuel is removed from the reactor,
3. a radial peaking factor of 1.7,
4. all of the gap activity in the damaged rods is released and consists of 10% of the noble gases other than Kr-85, 30% of the Kr-85, and 13.5% of the total radioactive iodine,
5. design power of 3087 MWt, and
6. none of the solid fission products are released from the fuel.

The result of this analysis is a calculated site boundary thyroid dose of zero due to the short half-life of radioactive iodine. The estimated whole body dose for 24 assemblies is 12.1 mrem site boundary dose. These values are well within the acceptance criteria. This design is applicable for uprated conditions given the license restrictions with respect to burnup, enrichment, linear heat rate and decay heat levels are met. Thus, the conclusion that the accident does not have a significant impact upon the environment remains valid when considering the effects of the power uprate.

4.7.3.3 Class 8 Accident Initiation Events Considered in the Design Basis Evaluation in the SAR

The ER included the Loss of Coolant Accident, the Rod Ejection Accident, and the Steam Line Break Accident. The methodology used to determine the offsite doses for environmental impacts of Class 8 was based in part on conservative and realistic assumptions. It is difficult to recreate this methodology, and the value of recreating it is questionable in light of subsequent changes in dose calculation methodology. Therefore, for power uprate, ANO-2 is using conservative NRC approved methods for calculating accident dose for design basis accidents, consistent with the ANO-2 Final Safety Analysis Report (FSAR) design bases and the appropriate regulatory acceptance criteria.

The updated radiological consequence analysis for design basis accidents presented herein supersedes the ER analysis of the environmental impact of FSAR design basis accidents (LOCA, Rod Ejection, and MSLB). The postulated design basis accidents were modeled and analyzed to determine numerical dose outcomes under power uprate conditions for direct comparison with regulatory limits. The radiological consequences of these design basis accidents represent the worst case environmental consequences. The regulatory acceptance criteria for these accidents is delineated by 10 CFR 100 for offsite doses and by General Design Criterion (GDC) 19 of 10CFR50 Appendix A for control room habitability. The results of these analyses demonstrate that the power uprate has an insignificant environmental impact. The accident doses for postulated environmental accidents under the power uprate conditions remain within regulatory guidelines.

These accidents were conservatively analyzed by assuming an initial power level of 3087 MWt. This postulated power level is 102% of the requested operating power level

of 3026 MWt. The analysis used 95% confidence atmospheric dispersion factors rather than the 50% confidence levels permitted by NUREG-1555. The results of these studies are presented in the following tables.

Table 8

Loss of Coolant Accident (30 day release)		
Location	Whole Body Dose(rem)	Thyroid Dose (rem)
EAB (2 hour dose)	3.	83
LPZ (30 day dose)	0.3	19

Table 9

Main Steam Line Break		
Pre-Existing Iodine Spike		
Location	Whole Body Dose (rem)	Thyroid Dose (rem)
EAB (2 hour dose)	0.05	10
LPZ (8 hour dose)	0.007	2
Event Generated Iodine Spike		
Location	Whole Body Dose (rem)	Thyroid Dose (rem)
EAB (2 hour dose)	0.05	9
LPZ (8 hour dose)	0.02	3
No Iodine Spike Activity		
Location	Whole Body Dose (rem)	Thyroid Dose (rem)
EAB (worst 2 hour dose)	0.03	5
LPZ (30 day dose)	0.003	0.3

Table 10

Rod Ejection Accident		
Location	Whole Body Dose (rem)	Thyroid Dose (rem)
EAB	1.0	48
LPZ	0.2	15

The tables demonstrate that offsite dose levels under power uprate conditions are within regulatory guidelines. The assumptions are conservative with respect to power uprate operating conditions, shielding, and dose.

Given the above, the radiological consequences of design basis accidents under power uprate conditions are within the acceptance criteria of 10CFR100 and do not involve any significant impact to the human environment.

4.7.3.4 Class 9 Severe Accidents

The environmental effects of severe accidents outside the design basis of protection and engineered safety systems were not evaluated in the ANO-2 ER. The power uprate will not significantly increase the probability or consequences of accidents and will not result in a significant increase in the radiological environmental impact of ANO-2 under accident conditions.

4.8 Fuel Cycle and Transportation Impacts

The power uprate will involve an increase in the average enrichment of the fuel bundle. The environmental impacts of the fuel cycle and of transportation of fuel and wastes are described in Table S-3 and S-4 of 10CFR51.51 and 10CFR51.52, respectively. The ANO-2 FES section 5.5.3 discusses the Uranium Fuel Cycle and transportation impact of the fuel at original issuance of the operating license. An NRC assessment (53FR30355, dated August 11, 1998) evaluated the applicability of Table S-3 and S-4 to higher burnup cycles. The assessment concluded that there is no significant change in environmental impacts for fuel cycles with uranium enrichments up to 5.0 weight-percent U-235 and burnups less than 60 gigawatt-day per metric ton of uranium (GWd/MTU) from the parameters evaluated in Tables S-3 and S-4. In Operating License amendment 178 dated January 14, 1997, ANO-2 was granted the ability to increase the fuel enrichment from 4.1% to 5.0%. The environmental effects of this fuel enrichment increase were considered at that time. Since the fuel enrichment for the power uprate will not exceed 5.0 weight-percent U-235 and the rod average discharge exposure will not exceed 60 GWd/MTU, the environmental impacts of the proposed power uprate will remain bounded by these conclusions and will not be significant.

5.0 SUMMARY

The power uprate will not significantly increase the probability or consequences of an accident, will not introduce any new radiological release pathways, will not result in a significant increase in occupational or public radiation exposures, and will not result in significant additional fuel cycle environmental impacts. Accordingly, it is concluded that no significant radiological environmental impacts are associated with the proposed action. Table 11 on the following page summarizes the radiological environmental impacts of the power uprate.

Table 11

Summary of Radiological Environmental Impacts of Power Uprate	
Surface Water	No change in radiological impact to surface water
Groundwater:	No change in radiological impact to ground water
Radiological Waste Stream Impacts:	No changes in design or operation of waste streams
Gaseous Waste:	An increase in release rate that is linearly proportional to the power increase will be expected.
Liquid Waste:	No change in ANO-2 liquid release policy.
Solid Waste:	
Wet Waste:	No appreciable change in radioactive secondary resins expected due to PU
Dry Waste:	No significant changes in dry waste foreseen.
Irradiated Components:	No significant changes in irradiated components foreseen.
Dose Impacts:	
Inplant Radiation	Even though some elevated RCS activity levels, inplant exposures are controlled to mitigate worker exposures.
Offsite Doses	Slight increase in gaseous activity levels possible, but doses will remain ALARA and within Part 20 limits
Accident Analysis Impacts:	No increase in the probability of an accident. Some increase in consequences of an accident but still within NRC acceptance limits.
Fuel Cycle and Transportation:	Increase in bundle average enrichment; impacts will remain within the conclusions of Table S-3 and Table S-4 of 10CFR51.