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Duane Arnold Energy Center
3313 DAEC Road
Palo, IA 52324-9785

Operated by Nuclear Management Company LLC

September 22, 2000
NG-00-1504

Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
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Washington, DC 20555-0001

Subject: Duane Arnold Energy Center
Docket No: 50-331
Op. License No: DPR-49
Supplement to Duane Arnold Energy Center Environmental Report

File: A-117

Dear Sir(s):

Pursuant to the Code of Federal Regulations, Title 10, Sections 51.41 and 51.45, Nuclear Management Company (NMC) hereby submits the attached supplement to the Duane Arnold Energy Center (DAEC) Environmental Report. This supplement discusses the environmental effects associated with an uprate in licensed power from 1,658 MWth to 1,912 MWth including the effects associated with an increased level of fuel enrichment and burnup and transportation of such fuel and waste. NMC has concluded that the environmental effects of such a power increase are effectively bounded by the assumptions in the original DAEC environmental report.

The actual license amendment request for an increase in licensed power level will be made by a separate submittal, however, this supplement is being provided now to afford the Staff adequate time for review.

C001

The DAEC Operations Committee and Safety Committee have reviewed this supplement. No new commitments are made in this letter.

This letter is true and accurate to the best of my knowledge and belief.

NUCLEAR MANAGEMENT COMPANY, LLC

By Gary Van Middlesworth
Gary Van Middlesworth
DAEC Site General Manager

State of Iowa
(County) of Linn

Signed and sworn to before me on this 22nd day of September, 2000,

by Gary Van Middlesworth.

Nancy S. Franck
Notary Public in and for the State of Iowa

NANCY S. FRANCK

9-28-01
Commission Expires

Attachments: 1) Supplemental Environmental Report

cc: L. Sueper
Mike Wadley
B. Mozafari (NRC-NRR)
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NRC Resident Office
Docu
CTS

Duane Arnold
Energy Center

supplemental environmental report

September 2000

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1.0 EXECUTIVE SUMMARY

This exhibit presents an evaluation of the environmental impacts of the proposed Duane Arnold Energy Center (DAEC) thermal power uprate from 1658 MWt to 1912 MWt. The intent of this exhibit is to provide sufficient information for the Staff to evaluate the environmental impacts of power uprate in accordance with the requirements of 10 CFR Part 51.

The environmental impacts of power uprate are identified and compared against the environmental impacts which have been previously evaluated by the Staff in the Final Environmental Statement associated with the issuance of the DAEC operating license and in other related docketed correspondences. The results of this comparison show that the conclusions of the Final Environmental Statement remain valid for plant operation at 1912 MWt.

The environmental impacts identified by the Staff in the Final Environmental Statement are based on conservative assumptions for source terms and other environmental parameters. Since initial operations a variety of systematic environmental improvements have been implemented at DAEC that have further increased the margin of conservatism associated with these assumptions. By adjusting actual plant operating parameters for power uprate effects, it can readily be demonstrated that the previous assumptions and conclusions concerning the environmental impact of DAEC operation at present power levels continue to bound plant operation at power uprate conditions.

The DAEC power uprate is being implemented without consequential changes to the plant systems that directly or indirectly interface with the environment. This evaluation demonstrates that the changes in environmental impacts of plant operation that will result from power uprate are insignificant. The environmental impacts of power uprate are either well bounded by previously evaluated environmental impacts and criteria established by the Staff in the Final Environmental Statement or well bounded by other applicable regulatory criteria. As a result, approval of the power uprate will not significantly affect the environment.

2.0 INTRODUCTION

Alliant Energy - IES Utilities (Alliant) and the Nuclear Management Company (NMC) are committed to operating the Duane Arnold Energy Center (DAEC) in an environmentally sound manner. Plant activities involving design, construction, maintenance, and operation are conducted in strict compliance with environmental regulations and careful consideration of environmental consequences. Numerous controls and modifications have been implemented to prevent and reduce impacts to the environment, and extensive environmental monitoring programs have been instituted at DAEC. In keeping with this important obligation and in accordance with regulatory requirements, DAEC has conducted a comprehensive environmental evaluation of the proposed extended power uprate from 1658 MWt to 1912 MWt.

This environmental evaluation is provided pursuant to 10 CFR 51.41 and is intended to fully support the Commission in complying with the requirements of Section 102(2) of the National Environmental Policy Act (NEPA), as amended, for the proposed change to the DAEC-authorized operating power level. The evaluation provides information necessary to determine the environmental impact of those particular changes associated with the proposed power uprate at DAEC from 1658 MWt to 1912 MWt. This evaluation does not reassess the current environmental licensing basis or justify the environmental impacts of operating at the present power level.

The environmental impact of operation at the present power level has been reviewed and determined to be acceptable by the Atomic Energy Commission (AEC). In 1971, an Environmental Report (Ref 1) was submitted to the AEC as part of the application for an operating license for the DAEC. This report addressed the environmental impacts of construction and operation of the DAEC. The report was utilized by the AEC in preparing a Final Environmental Statement (Ref 2) in fulfillment of the requirements of NEPA. The NRC subsequently issued an operating license to DAEC authorizing operation up to a maximum power level of 1658 MWt

This evaluation demonstrates that the power uprate will not result in a significant increase in the environmental impacts of operation of the DAEC. The environmental impacts of DAEC operation with extended power uprate continue to be bounded by the FES or bounded by other appropriate regulatory criteria.

Since power uprate involves no significant environmental impacts as delineated by 10 CFR Sections 51.22(a), (c)(9) and as further described and evaluated herein, Alliant believes that sufficient evidence exists to justify application for a categorical exclusion as provided by 10 CFR 51.21. Accordingly, Alliant is hereby requesting that the Staff consider the proposed change in power level eligible for a categorical

exclusion.

3.0 OVERVIEW OF OPERATIONAL AND EQUIPMENT CHANGES

DAEC is a Boiling Water Reactor (BWR) that operates in a direct thermodynamic cycle between the reactor and the turbine. Under power uprate conditions, thermodynamic processes are changed to extract additional work from the turbine. Simply put, power uprate involves an increase in the heat output of the reactor to support increased turbine inlet steam flow requirements and an increase in the heat dissipated by the condenser to support increased turbine exhaust steam flow requirements. In order to support a power uprate to 1912 MWt, the reactor core operating range will be expanded by modifying the maximum extended load line limit. No changes in operating pressure or core flow are necessary to support power uprate. In the turbine portion of the heat cycle, increases in the turbine throttle pressure and steam flow will result in a slight increase in the heat rejected to the Cedar River. The environmental impacts of these operational changes are discussed herein.

Due to design and safety margins inherent in plant equipment, the proposed power uprate can be accomplished with relatively few modifications. The most significant changes involve replacement of the high pressure turbine, modification of the feedwater system, and replacement/modification of the main transformer. Other minor modifications to support power uprate are routine in nature and are being conducted within the plant boundary.

The modifications are being accomplished by standard maintenance and modification processes that are similar to those performed during normal outages. The majority of plant systems will not require any significant modifications.

4.0 PROPOSED.ACTION AND NEED

4.1. Proposed Action

The proposed action is an amendment to the DAEC Operating License to increase the licensed core thermal power level to 1912 MWt. The operational goal of this amendment is to increase electrical generating capacity. In conjunction with the plant designer, General Electric, the effects of a power uprate at DAEC have been comprehensively evaluated. This evaluation concluded that sufficient safety and design margins exist such that an increase in the rated core thermal power from 1658 to 1912 MWt can be accomplished without adverse impact on the health and safety of the public and without significant impact on the environment.

Although the maximum authorized power level proposed by this action and evaluated for environmental impact herein is 1912 MWt, the intent is to raise power level in increments.

4.2. Need for Proposed Action

Once per year, the North American Electric Reliability Council performs a forecast reliability assessment (ref 3) using information provided by the regional reliability councils such as Mid-Continent Area Power Pool (MAPP) and Mid-American Interconnected Network, Inc. (MAIN). This assessment includes a forecasted increase in expected customer peak demand, based on historical increases, of approximately 1.5% - 1.8% per year for the MAPP and MAIN regions through the 1999-2008 planning period. To meet this projected demand, generating capacity must increase by over 14,000 Mega Watts electric (MWe) in the MAPP and MAIN areas by 2008 to maintain a 12% operating margin for reliability.

Alliant has determined the need for additional generation resources in its territory through a comparison of the projected load growth to the generation and possible power purchases. A review by Alliant-Energy indicates the demand will continue to grow in the Alliant-Energy territories. Under current regulation, Alliant Energy's obligation to provide capacity is expected to increase by 2% per year. Additionally, 255 MWe of base-load purchased power contracts expire by July 2001. In the summer of 2001, a deficit of 150 MWe in the Alliant-Energy regions is anticipated.

In a regulated market, Alliant-Energy will need to replace existing purchased power contracts expiring in 2001 and beyond. Purchased power contracts are subject to uncertainties of future price movements and utility industry restructuring. There are two significant aspects of maintaining a flexible and robust supply portfolio. The first is to obtain low cost power. The second is to

maintain a portfolio with sufficient diversity to allow the utilities to respond to changes in the underlying cost of power, owned or purchased. The increase in capacity of DAEC provides Alliant-Energy 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.

In an unregulated market, power prices are anticipated to fall initially on an average annual basis. This is a consequence of underutilized base load capacity actively competing for sales in non-peak periods. On-peak prices will increase as the full price of peaking units is reflected in on-peak hours. The DAEC capacity uprate is not only a prudent investment under regulation; it remains so under deregulation.

Extended power uprate is an important step in improving the economic performance of DAEC during and after utility deregulation. The improved performance is accomplished by cost reductions in production and total bus bar cost per kilowatt hour (kWhr). Therefore, extended power uprate should enhance the value of DAEC as a generating asset. In the event deregulation does not occur, extended power uprate reduces costs to the ratepayers because the additional capacity will be installed for less than $0.02 per kWh. This is approximately half the cost projected for purchased power and one-third the cost of power produced from constructing a new combined cycle natural gas fueled facility.

In the initial period of regulated operation, the uprate project would help Alliant-Energy meet projected need for additional capacity. By 2001, expected demand will require the power generated by this uprate. Comparing DAEC to new Combustion Turbine Units, Combined Cycle, and Purchased Power agreements, increasing DAEC capacity is the lowest cost option for maintaining a highly reliable power supply.

5.0 SOCIOECONOMIC EFFECTS

Extended power uprate does not affect the size of the DAEC workforce and does not have a material effect upon the labor force required for future outages. DAEC currently employs over 500 people, many of whom are active in volunteer work. The DAEC contributions to local, state, and school taxes are of significant value to the local economy. The contribution to the state tax based on generation by the facility will increase commensurate with the power increase. The successful completion of the power uprate project will improve the DAEC's ability to cost effectively provide electricity, allowing Alliant-Energy to remain a strong partner within the community and the state of Iowa.

6.0 COST - BENEFIT ANALYSIS

The direct benefit of extended power uprate to Alliant-Energy's residential and commercial customers is that the program will supply an additional 80 MW of reliable electrical generating capacity. A cost-benefit analysis for this proposed project indicated the power from the uprate project could be produced for approximately one half the cost of purchased power and one third the cost of power produced following construction of a new combined cycle natural gas facility.

A quantitative study of environmental costs of alternatives is not necessary to recognize that significant environmental benefits can be derived from extended power uprate when compared to other options of adding capacity. As demonstrated herein, extended power uprate does not result in significant environmental costs. Unlike fossil fuel plants, DAEC does not routinely emit $S0_2$, NO_x., CO_2, or other atmospheric pollutants during normal operation. Routine operation of DAEC at extended power uprate conditions will not contribute to greenhouse gasses or acid rain. The environmental effects of the fuel cycle are shown by 10 CFR 51.51 and 51.52 to be very small, and the existing tables in part 51 encompass the extended power uprate level (see Section 9.0). While the project will produce additional spent nuclear fuel, the added amount is not appreciable and can be accommodated by the facility.

Based upon the discussion above, it is reasonable to conclude the DAEC extended power uprate project provides an economic advantage to other alternatives for added generation. Extended Power Uprate involves effective utilization of an existing asset with no environmental impact and is the preferable power replacement.

7.0 NON-RADIOLOGICAL ENVIRONMENTAL IMPACT

7.1. Terrestrial Effects

7.1.1. Land Use

The extended power uprate does not change the present DAEC land use. There are no plans to build facilities or materially alter the land use to support extended power uprate activities. Except for transportation of equipment and routine disposal of waste, power uprate maintenance activities are confined to the inner-plant security fenced area. Extended power uprate does not affectthe storage requirements for above ground or below ground tanks. Lands outside the inner security fence will not be affected by extended power uprate activities. Extended power uprate does not involve changes to any aesthetic resources and does not involve any impacts to lands with historical or archaeological significance.

The extended power uprate is not expected to require additional low-level radioactive waste storage facilities. The replaced turbine components will be decontaminated, as necessary, and recycled to the extent possible.

7.1.2. Transmission Facilities

7.1.2.1. Transmission Design and Equipment

No changes in operating transmission or power line right of way are required to support extended power uprate. Higher main transformer capacity will be necessary to deliver the additional power to the offsite grid. The stability of the offsite power system at DAEC is especially robust due to DAEC's grid location. In part due to DAEC main generator power factor changes at extended power uprate conditions, certain modifications to offsite substations are being planned to enhance stability at various grid locations. These upgrades are in keeping with Alliant-Energy's continuing program of systematic improvements in grid stability and commitments to the Mid-Continent Area Power Pool (MAPP) and Mid-America Interconnected Network (MAIN). Such changes will be within existing substations and will therefore not involve significant environmental impacts.

7.1.2.2. Shock Hazards

Power uprate does not increase the probability of shock from primary or secondary currents. Transmission lines are designed in accordance with the applicable shock prevention provisions of the National Electric Safety Code.

7.1.2.3. Electromagnetic Fields (EMF)

There is no scientific consensus regarding the health effects, if any, of exposure to electromagnetic fields (Ref 4). Chronic effects of EMF on humans are not quantified at this time, and no significant impacts to terrestrial biota have been identified (Ref 5). Notwithstanding the above, the following information is presented to show that power uprate does not involve significant increases in exposure to electromagnetic magnetic fields from transmission lines.

The increased generator output at DAEC will cause a corresponding current (and thus magnetic field) rise in the onsite transmission line between the DAEC main generator and the plant substation. This line, however, is located within the outer fenced boundary of the plant where public access is prohibited. The elevated line is primarily located over gravel-covered areas without foliage that are not frequented by humans or wildlife. EMF exposures will be maintained below the American Conference of Government Industrial Hygienists' Threshold Limit Value.

7.1.3. Miscellaneous Wastes

Sanitary wastes from DAEC are discharged directly to the DAEC Sewage Treatment Plant in accordance with a permit issued by the State of Iowa. Other waste sources at DAEC include hazardous waste generation from routine plant operations and air emissions from the plant heating boiler and diesel generators. Effluents from these pathways are controlled as required by county permits. Power uprate does not have any significant 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.

7.1.4. Cooling Tower Drift, Icing, and Fog

Estimates of cooling tower drift, ground fog frequency and icing, and their associated environmental impacts during operation at the current power level are provided in the DAEC Environmental Report (Ref. 1, Sec 3.2.3). These estimates were based on anticipated evaporation and drift rates of 2.25% and 0.5% of tower flow respectively. It was concluded that the total hours of fogging in nearby communities would increase by approximately 1.1 hours per year above the nominal 240 hours per year, while icing would be insignificant.

Extended power uprate will not change the cooling tower flow and drift rate but the evaporation rate is expected to increase to 2.99% (Ref. 32), using the assumptions in Reference 1. Assuming linearity with evaporation, this

would mean extended power uprate could cause an increase in the total number of hours of fogging in nearby communities of less than 1.1 hours.

The effect on icing would continue to be insignificant.

The actual effect on fogging, however, will be even less than this estimate because of modifications since initial DAEC operation. The cooling towers at DAEC have been upgraded by replacing the original wooden drift eliminators with polyvinyl chloride drift eliminators. Unlike the wooden drift eliminators, which allowed water droplets to return to the cooling tower air stream (and ultimately to exhaust air), the new drift eliminators channel water to the cooling towers cold water basin. Evaporative and drift losses have been markedly reduced. Consequently, the above estimate of the effect of extended power uprate on fogging is conservative.

A study conducted in 1983, before the installation of the polyvinyl chloride drift eliminators, conducted there was no indication of environmental damage due to cooling tower operation (Ref 6).

Drift, icing, and fog from the DAEC cooling towers has no discernible impacts on vegetation, agriculture, recreational activities, highway safety, air traffic, or river traffic. The Cedar River does not have significant salt content, and rainfall is sufficient to prevent undesirable chemical concentrations in the soil of trace chemicals from the drift

7.1.5. Noise

The extended power uprate will not result in significant changes to the character, sources, or energy of noise generated at DAEC. The new equipment necessary to implement power uprate will be installed within existing plant buildings. No significant increase in ambient noise levels is expected within the plant. This includes the upgraded HP turbine which will operate at the same speed as the original equipment. The FES conclusions for noise levels (Ref 2, Sec 5.1.2) remain bounding for extended power uprate conditions.

7.1.6. Terrestrial Biota

Extended power uprate will not change the previously evaluated land use at DAEC 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 extended power uprate conditions.

According to a recent review by the Iowa Department of Natural Resources, there are no known rare or endangered plant species within the area of the

site boundary. (Ref 7)

7.2. Hydrology

7.2.1. Groundwater

Extended power uprate does not affect groundwater resources nor does it involve an increase in the consumptive use of these resources at DAEC. Extended power uprate does not impact the well water system flow path nor does it require any additional cooling capacity for heat loads (Ref.33). Therefore, there is no impact on ground water usage from the extended power uprate.

The well water system consists of two Alluvial and two Silurian wells and supply headers combining into a common supply header at the plant buildings. Station groundwater use is governed by water appropriation limits of the Iowa Department of Natural Resources (IDNR). The DAEC usage is limited to 1575 million gallons per year (MGY) with the flow from all pumps not to exceed 3000 gallons per minute (gpm) (Ref. 8).

Over the last four years (1996 - 1999), normal system flow has averaged 1420 gpm with a peak of 1720 gpm. The average annual withdrawal during the same time period has been 762 MGY with a peak of 799 MGY (Ref 9,10, 11 &12).

7.2.2. Surface Water Appropriation

Surface water use at DAEC is in accordance with the water appropriation limits of the IDNR. Though power uprate will necessitate an increase in river water use, the increase is insignificant and DAEC will maintain its usage below the permitted amounts.

DAEC may withdraw a maximum of 12,575 MGY from the Cedar River at a rate of 27,000 gpm less the total well water withdrawal rate (Ref 8). Special operating restrictions apply at lower than average river flows if the withdrawal will reduce the river flow to less than 500 cfs.

During normal operation, the river water and well water systems supply the total makeup water to the circulating water system. The circulating water makeup and blow-down flow rates vary as a function of evaporation, drift, and cycles of concentration. The well water system makeup flow to the circulating water system remains the same under extended power uprate (Ref 33). The river water system supplies any increase in makeup flow.

Extended power uprate will have no impact on the number of cooling tower concentration cycles nor on the cooling tower flow rate. To accommodate the additional heat removal demands, the evaporation rate and makeup flow will increase. The additional makeup from the river will be about 18%

(Ref 32). Table 7-1 presents: usage limits; and nominal, maximum and extended power uprate makeup values for comparison. As can be seen power uprate is well within the current water usage permit.

Table 7-1

IDNR Limits and Actual River Water Usage

	Flow (gpm)	Annual Withdrawal (MGY)
IDNR Permit*	24,000	12,575
Four Year Average**	5,680	3,000
Four Year Maximum**	11,020	3,030
Uprate Average	6,700	3,540
Uprate Maximum	13,000	3,580

* Listed limit of 24,000 gpm assumes well water rate is at its maximum limit of 3,000 gpm.
** 1996 through 1999 data (Ref 9, 10, 11 &12)

7.2.3. Discharges

Surface water and wastewater discharges are regulated by the State of Iowa. The National Pollutant Discharge Elimination System (NPDES) permit is periodically reviewed and re-issued by the IDNR. The present NPDES permit for DAEC authorizes discharges from two outfalls, only one of which is impacted by extended power uprate. The description and effluent limits for the impacted outfall are presented in Table 7-2.

Extended power uprate will have no impact on the number of cooling tower concentration cycles. This will be maintained at the current range of 3.5 to 4.0. Thus, the concentration of pollutants in the effluent stream will remain the same. Total discharge in pounds per day will increase linearly with blowdown flow. It is anticipated that the blowdown flow will increase 18% as a result of extended power uprate. Typical discharges are well below the current limits so there will be no need to modify the NPDES permit to implement power uprate.

Table 7-2

NPDES Discharge Limit Summary and Actual Values For Discharges of Cooling Tower Blowdown from the Recirculating Water System and Storm Runoff

Parameter (Units)		Effluent Limit (Ref 13)		Actual Values *	
		Concentration	Mass	Concentration	Mass
Flow (MGD)	30 Day Ave Daily Max	7.84 8.77	N/A	2.62 6.62	N/A
PH (STD Units)		6.0 to 9.0	N/A	7.5 to 8.5	N/A
Chlorine[2] (mg/l and lbs./day)	30 Day Ave Daily Max	0.21 0.31	13.0 20.0	<0.05 <0.05	<0.93 <2.54
Chromium (mg/l and lbs./day)	30 Day Ave Daily Max	0.20 0.20	13.0 13.0	0.023 0.046	0.41 0.84
Zinc (mg/l and lbs./day)	30 Day Ave Daily Max	1.0 1.0	65.0 65.0	0.59 0.99	10.6 18.1

* Actual values are from 1996 through 1999 as reported on a monthly basis to the IDNR. A less than value (<) for mass means the parameter was undetectable, but assumed to be at the detection limit for the entire day.

DAEC monitors groundwater as part of the IDNR permit. The four wells are sampled quarterly for tritium, gamma-emitting radionuclides and chemical contaminants. No radioactive or chemical contamination has been detected in any of the wells. Power uprate has no effect on the contamination levels, radioactive or non-radioactive, of these wells.

7.2.4. Increase in Circulating Water Discharge Temperature

Blowdown from the circulating water system is discharged from the cold water side of the system and is directed back to the Cedar River via the dilution structure. The temperature of this effluent is limited by the NPDES permit issued by the IDNR (Ref 13). At extended power uprate conditions, the heat rejected by the condenser increases, resulting in a corresponding increase in the circulating water discharge temperature. The increase heat load discharged to the Cedar River will have a negligible impact on the river ecology.

The Environmental Report (Ref 1, Sec 3.1.1) concluded the blowdown water would normally cause a 0.1 to 0.2 °F temperature rise in the Cedar River below the mixing zone. Under extreme low flow and river temperature conditions (i.e. January), the increase was calculated to be 1.1 °F. These calculations assumed a constant discharge rate of 4,000 gpm matched with monthly fluctuations in river flow, river temperature and blowdown temperature. The FES concluded that this increase in water temperature would have a negligible effect on river organisms and biota (Ref 2, Sec 5.4.2).

The assumptions made in the Environmental Report were conservative. The actual average blowdown flow rate is 1,570 gpm, far below the assumed value of 4,000. Also, the actual monthly average and monthly maximum blowdown temperatures are at least 12 and 5 degrees respectively cooler than the seasonal adjusted values used in the calculation. In winter, the season during which DAEC discharges would have the greatest impact on river water temperature, the actual average blowdown temperature is 30 degrees less than that assumed in the environmental report. Exdended power uprate increases the blowdown discharge temperature by 1.6 °F, while the blowdown flow increases by 18% to 1850 gpm (Ref 32). The increased values for blowdown temperature and flow are still bounded by the calculation of the Environmental Report. Consequently, the conclusions in the FES are still valid.

Finally, the NPDES permit issued by the IDNR limits discharge temperatures at the end of the discharge canal to 100°F and limits the increase in river temperature beyond the mixing zone to 9°F (Ref 13). Extended power uprate will not involve any changes to the IDNR discharge temperature limits. Temperature monitoring of the discharge canal is continuous and DAEC has consistently operated in conformance with the permit's thermal discharge requirements.

7.2.5. Cedar River Water Quality

Water quality upstream and downstream of the plant has been addressed in considerable detail in annual ecological reports from 1971 to 1999. Based on over 25 years of water quality monitoring, DAEC operation has not adversely affected the water quality of the Cedar River downstream of the plant (Ref 14). There is no indication that discharges from DAEC have caused any detrimental effects to the aquatic biota.

Water quality monitoring programs have been established in accordance with the NPDES permit effluent limitations and monitoring. Each outfall

identified in the permit requires continuous flow rate monitoring. Modifications of the non-radiological drain systems are not required due to power uprate, and biocide/chemical discharges will be consistent with existing permit limits. Power uprate will not introduce any new contaminants or pollutants and will not significantly increase the amount of any potential contaminants presently allowed for release by the IDNR.

7.2.6. Cedar River Thermal Plume

The FES concluded that the thermal plume would be small (i.e. less than one acre in area) and involve less than 25% of the total river width (Ref 2, Section 3.4.4). Although extended power uprate will increase the discharge temperature and flow, it will not notably increase the plume size.

Under worst case summer conditions, the 2°F isotherm was predicted to extend 74 feet downstream of the discharge point and have a width of 35 feet. Under worst case winter conditions, the 2°F isotherm was predicted to extend 246 feet downstream with a 70 foot width. The assumptions and data used in the thermal plume analysis are the same as those used in the calculations of the increase in circulating water discharge temperature. As discussed in Section 7.2.4 above, the assumed discharge flow and temperatures are significantly greater than typical DAEC operating values (See Table 7-3). Consequently, the actual thermal plume is smaller than that predicted in the FES.

Table 7-3

Data for Thermal Plume Analyses

	January		**July**		**Aug 89**
Parameter	Assumed	Average	Assumed	Average	Actual
Discharge Flow (gpm)	4000	1490	4000	1576	1500
Discharge Temp. (°F)	72.2	35.8	91.5	78.6	80.1
River Flow (cfs)*	300	1252	300	4263	326
River Temp. (°F)	34.1	34.1	77.9	77.9	77.0
*Average River flows based on 1961 - 1990 US Geological Survey records					

Further evidence of the conservative nature of these assumptions and

results can be found in the thermal plume mapping conducted in August of 1989. During the mapping, the reactor was at 100% power. Table 7-3 provides pertinent data on river and discharge temperatures and flows at the time of the mapping. Although the 2°F isotherm extended between 100 and 150 feet downstream, it was restricted to within 10 feet of the bank. At 150 feet downstream, there was no detectable plume (Ref 15). The total plume area (i.e. no temperature difference) was less than that predicted for the 2°F isotherm in the FES.

Under extended power uprate the discharge temperature will increase by 1.6°F, while the flow will increase by 18% to around 1850 gpm. For both the summer and winter cases, the changes are bounded by the FES.

7.2.7. Cold Shock

The risk of fish being killed by cold shock will continue to be bounded by the FES. Cold shock results when the warm water discharge from a plant abruptly stops due to an unplanned shutdown. The probability of an unplanned shutdown is independent of power uprate. As discussed in 7.2.4 above, the discharge canal temperature at extended power uprate conditions is at least 10 degrees less than the value assumed in the Environmental Report. Consequently, the actual area of elevated temperatures is much smaller than predicted in the report. Although power uprate will increase the discharge canal temperature, the plume size will not increase appreciably and will be smaller than that analyzed in the FES. Consequently, the increase in risk of fish mortality due to cold shock will not be significant, and the total risk will continue to be bounded by the FES.

7.2.8. Impingement and Entrainment

Ecological studies conducted from 1972 through 1998 indicate that the DAEC has not adversely impacted the Cedar River Water quality. The diversity of benthic organisms which colonize artificial substrates has been similar upstream and downstream of the intake structure in all studies. Fish impingement totals are typically less than 500 fish per year and are considered to be very low considering the size and composition of the fish population in the river. Although impingement can increase significantly, during periods of drought, the effect of extended power uprate on the impingement and entrainment of organisms will be insignificant even though intake flow will increase by 18% (Refs. 15 and 32).

8.0 RADIOLOGICAL ENVIRONMENTAL IMPACT

8.1. Radioactive Waste Streams

The radioactive waste systems at DAEC are designed to collect, process, and dispose of radioactive wastes in a controlled and safe manner. The design bases for these systems during normal operation limit discharges in accordance with 10 CFR 20 and to satisfy the design objectives of Appendix I to 10 CFR 50. These limits and objectives will continue to be adhered to under extended power uprate.

In addition, operation at extended power uprate conditions does not result in any changes in the operation or design of equipment in the solid waste, liquid waste, or gaseous waste systems. The safety and reliability of these systems is unaffected by power uprate. Neither the environmental monitoring of any of these waste streams, nor the radiological monitoring requirements of the DAEC Technical Specifications and/or Offsite Dose Assessment Manual will be affected by extended power uprate. Furthermore, extended power uprate does not introduce any new or different radiological release pathways nor does it increase the probability of an operator error or equipment malfunction that would result in an uncontrolled radioactive release. The specific effects of power uprate on each of the radioactive waste systems are evaluated below.

8.1.1. Solid Waste

DAEC continually tracks the volume of solid radwaste generated. In addition, DAEC has a volume reduction program with a mission to continually identify and assess new volume reduction techniques. For calendar years 1998 and 1999, the low level solid radwaste volume at DAEC was 27 and 39 cubic meters respectively. This is below the median BWR values of 79 and 85 cubic meters in 1998 and 1999 respectively (Ref 16).

The largest volume contribution to radioactive solid wastes is due to spent resins from process wastes. Equipment wastes from operational and maintenance activities, chemical wastes, and reactor system wastes also contribute to solid waste generation. Extended power uprate does not significantly affect the amount or type of equipment and chemical wastes. The effect of extended power uprate on process wastes and reactor system wastes is evaluated below.

8.1.1.1. Process Wastes

Power uprate conditions are expected to result in no more than a 10% increase in the process wastes generated from operation of the Reactor Water Cleanup (RWCU) filter/demineralizers and the

condensate demineralizers (Ref 35).

The changeout limits for the RWCU and Condensate Demineralizer systems filter/demineralizers are based on differential pressure and effluent chemistry. It is expected that more frequent backwashes will occur at extended power uprate conditions due to an increase in the flow rate through both systems. The purity of the influent and filter performance are not expected to change. DAEC estimates the increase in backwashes to be approximately 8 to 10% of the current value (Ref 35).

The assumed increase in demineralizer/ filter backwashes at extended power uprate conditions will result in no more than an additional 3 cubic meters of resin waste per year. This would result in total generation rates of approximately 36 cubic meters per year. This total is about one half the current industry median value and is also well below historical radwaste generation values at DAEC.

Table 8-1

DAEC Radwaste Burial Volumes (cubic meters per year)

	Resin	Total
1981	210	697
1991	67	106
Current	27	33
Power Uprate	30	36

Note: Current values based on 1998 and 1999 actuals.
Power Uprate values based on 10% increase over current resin values.

The small increases in solid wastes from the processes described above will not result in waste volumes substantially above present levels. Moreover, in light of DAEC's successful and ongoing efforts to reduce radioactive wastes, the projected increase in solid waste generation from process wastes under extended power uprate conditions described above is not significant and is insufficient to reverse the continuing downward trend in the production and activity of activated corrosion products.

8.1.1.2. Reactor System Wastes

DAEC plans to load 152 fresh fuel bundles in the initial refueling to commence operation under extended power uprate. This is

approximately thirty bundles more than the current refueling cycle. Because of the mitigating effects of extended burnup and increased U-235 enrichment on fuel throughput under power uprate operating conditions, the number of irradiated fuel assemblies discharged from the reactor will not increase during subsequent reloads. Ultimately, the twenty-four month cycle will result in one less fuel reload before license expiration. These wastes are currently stored in the spent fuel pool and are not shipped offsite The need for additional spent fuel storage capacity is being addressed in a separate project. Power uprate has no material impact on this project.

The volume and activity of waste generated from spent control blades and in-core ion chambers may increase slightly under the higher flux conditions associated with power uprate conditions. This increase, however, is expected to be mitigated by anticipated future developments, such as improved longer-lived local power range monitor (LPRM) strings, improved lower-cobalt content control rod blades, and longer fuel cycles.

The annual environmental impact of low and high level solid wastes has been generically evaluated by the NRC Staff for a 1000 MWe reference reactor. The estimated activity content of these wastes is given by Table S-3 in 10 CFR 51.51 and is bounding for DAEC at extended power uprate operating conditions.

Given the information above, the environment impact due to generation of solid radwaste from power uprate conditions is insignificant.

8.1.2. Liquid Radwaste

Although Alliant is authorized to discharge liquid radwaste, it has administratively operated DAEC as a zero radioactive liquid release plant since 1978. No change is expected in the zero release policy as a result of extended power uprate.

Filter backwashing provides input to the liquid radwaste system from dewatering of sludges. Increasing reactor thermal power will increase decanted inputs due to the expected 8 to 10% increases in Reactor Water Clean-Up condensate demineralizer backwash frequency. (See Section 8.1.1.1 above). Alliant will continue with its policy of not releasing radioactive liquids to the environment, so this slight increase in input to the liquid radwaste system will be recycled instead of discharged, and therefore will not affect the environmental.

Extended power uprate conditions will not result in significant increases in the volume of fluid from other sources to 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 recirculation pump seal flow or any other normal equipment drain path. In addition, there will be no impact to the Dirty Radwaste, or Chemical Waste subsystems of the Liquid Radwaste System as a result of extended power uprate since the operating modes and the inputs to these subsystems are independent of extended power uprate (Ref 35).

8.1.3. Gaseous Wastes

During normal operation, radioactive gaseous effluents are released through the Reactor Building Ventilation, Turbine Building Ventilation and the Offgas systems. These effluents include small quantities of noble gases, halogens, particulates and tritium. The dose to individuals from normal gaseous effluent releases at DAEC are well within the guidelines of 10 CFR 50 Appendix I and the limits of 10 CFR 20 for all airborne radioactive nuclides. The effluent radioactivity, in curies, of noble gases, iodine, and particulates discharged from DAEC has been reduced steadily and is significantly below discharges during initial operating conditions. The FES estimated a 33,000 Ci/yr noble gas and a 0.6 Ci/yr Iodine-131 releases rate for the DAEC. (Ref. 2, Sec 3.5.2). The actual average release rate for the last three years at DAEC (1997-1999) has been 48 Ci/yr noble gases and 0.0009 Ci/yr iodines and particulates (Refs. 17, 18 & 19).

The effect on the environment from gaseous effluents under power uprate conditions is further analyzed below for the offgas stack and reactor building pathways.

8.1.3.1. Offgas Stack

The offgas stack receives gaseous effluent from the Steam Jet Air Ejector (SJAE) Offgas System and the Steam Packing Exhauster System. The effect of power uprate on the gaseous wastes processed by the offgas stack is not significant.

The radioactivity in this pathway is continually monitored to assure doses to members of the public are maintained within federal limits. Typical stack release rates are 1.5 μCi/sec for noble gasses and 2.0 E-6 μCi/sec for I-131 (Ref 17, 18 & 19). The alarm setpoint for the stack monitoring system is determined by the Offsite Dose Assessment Manual (ODAM) as stated by Technical Specification 3.3.6. The noble gas setpoint is 25,000 μCi/sec. Continual releases

at this level would result in offsite doses below 10 CFR 20 limits.

Assuming that extended power uprate will result in an increase in the release rate that is linearly proportional to power, the resultant effluent increase in noble gas and I-131 activity is 0.3 and 4 E-7 μCi/sec respectively. The stack gas effluents for noble gases, and halogens, at extended power uprate conditions are well below that previously evaluated by the FES (Ref 2, Sec 3.5.2). See Table 8-2 below.

Particulate and tritium release rates were not quantified in FES, but have been an insignificant contributor to dose. Assuming that the particulate and tritium release rates are approximately proportional to the power increase, their contribution to dose will remain insignificant.

The Standby Gas Treatment System is used to exhaust the primary containment during containment venting and the reactor building during system testing. During startup, the mechanical vacuum pump discharges to the stack. From plant operating experience, there is no significant increase in gaseous effluent levels during primary containment venting or mechanical vacuum pump operation when compared to nominal stack releases. This is consistent with Section 3.5.2 of the FES. Consequently, operation of the offgas stack in these modes under extended power uprate conditions will not result in a significant increase in gaseous effluent release levels.

For these reasons, the effect of extended power uprate on radioactive gaseous effluents from the offgas stack pathway is negligible, and compliance with the release limits of 10 CFR 20 and the guidelines of Appendix I to 10 CFR 50 is maintained with significant margin.

8.1.3.2. Reactor Building Ventilation

Gaseous releases through the reactor building are dependent on the radioactivity and concentration of airborne particles and gases from leakage of contaminated systems. Leakage is independent of extended power uprate. For most systems with leakage that can reasonably be expected to contribute to reactor and turbine building airborne radioactivity (e.g. secondary systems), the increase in radioactive species due to extended power uprate is theoretically neutralized by a relative decrease in the concentration. This decrease in concentration results from a proportional increase in the steam flow rate at extended power uprate conditions. No credit is

assumed for this mitigating effect in determining the gaseous release rate at extended power uprate conditions.

The design basis of the reactor building ventilation system is based on compliance with the 10 CFR 20 release limits and the guidelines of Appendix I to 10 CFR 50. As with the offgas stack, the radioactivity in this pathway is continually monitored, and alarm setpoints are determined in accordance with the Offsite Dose Assessment Manual (ODAM). Typical release rates at current power levels are no detectable noble gases and I-131 levels of 1.9 E-06 μCi/sec (Ref. 17, 18 & 19). Extended power uprate is expected to result in an increase in the release rate that is linearly proportional to power level, resulting in an effluent increase in I-131 activity of 4 E-7 μCi/sec. Noble gas release rates will still be below detectable values.

Conservatively neglecting neutralization effects and also conservatively assuming an increase in activity that is proportional to power, the effect of extended power uprate is insignificant for this pathway. The predicted extended power uprate release rate is well below that assumed for the reactor building vent gaseous waste stream by the Staff (Ref. 2, Sec 3.5.2 & Ref. 20 Sec 2.1.1). See Table 8-2 below.

Table 8-2

Gaseous Activity Release
μCi/sec

	Off Gas Stack		**Reactor Building Vent**	
	Noble Gases	**I-131**	**Noble Gases**	**I-131**
ODAM Alarm	25,000	N/A	1,300	N/A
UFSAR*	15,100	0.91	2,600	0.075
FES Assumption	1000	1.3E-03	None	3.8E-04
Nominal Value**	1.5	2.0E-06	None Detected	1.9E-06
Power Uprate	1.8	2.4E-06	None Detected	2.3E-06

* Design objective based on annual average release rate
** Ref 17, 18 & 19

Given the above, the effect of extended power uprate on gaseous radioactive effluents from the offgas stack and reactor building vent

pathways is negligible, and continued compliance with the release limits of 10 CFR 20 and the design objectives of Appendix I to 10 CFR 50 is maintained with significant margin.

8.2. Radiation Levels and Offsite Dose

8.2.1. Operating And Shutdown In-Plant Radiation

Over the last seven years, the occupational dose to DAEC workers has decreased at a rate of 15% per year (based on a rolling three year average). Although extended power uprate will involve potential increases in radiation levels, these potential increases are more than compensated for by physical plant improvements and administrative controls, and the continuing downward trend in occupational exposures at DAEC is expected to continue.

DAEC was conservatively designed with respect to shielding and radiation sources. In the shielding analysis, assumed concentrations for reactor water fission and corrosion products were 4 μCi/cc and 0.06 μCi/cc respectively (Ref 22). The normal values of both reactor water fission and corrosion products are 0.01 μCi/cc. With expected increases in operating activity proportional to the proposed power increase, the design shielding assumptions remain bounding with significant margin at extended power uprate conditions.

The original design was based on an assumed value for N-16 concentration of 100 μCi/g (Ref 22). To support the injection of hydrogen into the feedwater, a special test was conducted in 1989 to evaluate the impact and efficacy of injection rates of up to 45 scfm. The results of this test led to an injection rate of 6 scfm, which yields an acceptable recirculating system electro-chemical potential and no discernable N-16 dose rate increase (Ref 23). Between October 1994 and October 1996, the hydrogen injection rate was increased to 15 scfm to extend corrosion protection to portions of the core internals, with a resultant increase in dose rates of 3.3 times that of no hydrogen injection. Although occupancy in some areas was restricted, no shielding modifications were required to maintain radiation levels within acceptable levels. Since 1996, DAEC has undertaken a noble metals injection program to protect the core internals from corrosion with reduced hydrogen use. As a result, the current operational hydrogen injection rate is 6.0 scfm. The 20% increase in the N-16 dose rate (Ref. 34) from extended power uprate is well bounded by DAEC's experience with hydrogen water chemistry and will not have an impact upon the acceptability of the shielding design.

The equilibrium activity concentration of corrosion products that have plated out on reactor coolant piping and other surfaces may theoretically increase by the square of the power uprate increase. This is primarily due to the linear increase in corrosion products in the primary system from the feedwater flow increase and the linear increase in activation events from the core average flux increase. However, this potential increase is mitigated by four major dose reduction programs at the DAEC:

- Oxygen injection in the condensate system started in 1987
- Recirculating system chemical decontaminations in 1990, 1992, 1993, and 1995,
- Stellite reduction efforts started in 1993,and
- Depleted zinc addition started in 1994.

As a result of these efforts, the concentration of soluble C0-60 in the reactor water has decreased from 1.3E-04 μCi/ml in early 1987 to 2.7 E-05 μCi/ml in 2000. The potential increase in the volume and activity of activated corrosion products at extended power uprate operating conditions will not negate these efforts and equilibrium activity concentrations are expected to continue to decline under extended power uprate conditions. Consequently, operating and shutdown radiation levels will not increase and are expected to continue to decline under extended power uprate conditions.

Moreover, with higher fuel burnup at extended power uprate operating conditions, occupational exposure is expected to decrease proportionally to the increase in burnup (Refs. 24 & 25).

The plant radiation protection program will be used to maintain individual doses consistent with ALARA policies and well below the established limits of 10 CFR 20. 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 controlled under the radiation protection program. Administrative dose control limits are established well below regulatory criteria and provide significant margin to that allowed by regulatory dose limits. Administrative dose limits are not routinely exceeded under present power conditions.

8.2.2. Offsite Doses at Power Uprate Conditions

The slight increase in normal operational gaseous activity levels under extended power uprate does not affect the large margin to the offsite dose limits established by 10 CFR 20. In addition, doses from liquid effluents are currently zero and will remain zero under extended power uprate conditions.

The DAEC Technical Specifications implement the guidelines of 10 CFR 50 Appendix I which are well within the 10 CFR 20 limits. Adjusting present values for projected extended power uprate increases, the estimated off site dose at extended power uprate conditions is presented in Table 8-3 below. The offsite dose is not changed significantly and continues to be well within the conservative Technical Specification dose limits.

Table 8-3

Annual Radiological Effluent Doses

	Nominal Values *	**Uprate Values**	**Appendix I Limit**
Noble Gas Gamma Air Dose (mrad)	2.2E-03	2.6E-03	10
Noble Gas Beta Air Dose (mrad)	1.3E-02	1.6E-02	20
Particulate & Iodine (Thyroid mrem)	5.7E-03	6.8E-03	15
* Refs. 26, 27, 28 & 29			

Extended power uprate does not involve significant increases in offsite dose from noble gases, airborne particulates, iodine, or tritium. Radioactive liquid effluents are not routinely discharged from DAEC. In addition, radiation from shine is not presently a significant exposure pathway (Refs. 26, 27, 28 & 29), and is not significantly affected by extended power uprate.

Extended power uprate does not create any new or different sources of offsite dose from DAEC operation, and extended power uprate does not involve significant increases in present radiation levels. Therefore, under extended power uprate conditions, off site dose will remain well within regulatory criteria and will not have a significant impact.

8.3. Radiological Consequences Of Accidents

Section 7.1 of the FES identifies nine classes of postulated accidents at DAEC that were evaluated to determine the associated environmental impact. Accidents in this context include those events evaluated for environmental consequences by the FES in addition to design basis accidents contained in the DAEC Safety Evaluation Report (Ref 30).

The FES used information provided by DAEC to determine the environmental impacts of the accidents. The following discussion addresses the impact of extended power uprate on the assumptions and conclusions for the environmental accident classes. Comparisons are made, where applicable, with the accident analyses previously submitted in the DAEC Environmental Report.

8.3.1. Class 1 - Small Leaks Inside Containment

In accordance with AEC guidance for environmental reports at the time, Class I accidents were not considered by the FES. These accidents are initiated by small spills and leaks below the Technical Specification limits inside the primary containment or secondary containment. These leaks are bounded by those analyzed under Class 8 - LOCA Inside or Outside Containment. The FES considered that an incident of this type would cause releases that are commensurate with routine effluents (Ref 2 Sec 7.1). Because of plant improvements, the activity concentrations of reactor coolant are considerably less than that predicted by the FES. The above conclusion remains valid.

8.3.2. Class 2 Miscellaneous Small Leaks Outside Containment

The postulated Class 2 accident is a continuous steam leak equivalent to 7 gpm leak on the turbine building floor that releases through the turbine building roof vent. Extended power uprate does not increase the probability of occurrence or severity of this event.

Under extended power uprate conditions the gaseous activity concentration of the reactor coolant will not increase above the assumptions used by the FES in the original analyses. These analyses assumed a coolant concentration consistent with an offgas rate of 25,000 μCi/sec as measured thirty minutes downstream of the reactor. The resultant I-131 release to the environment was determined to be 0.01 μCi/sec (Ref 1 Sec 10.1).

The activity concentrations at extended power uprate are well bounded by the assumptions used in the original FES analyses. Operational defects of modern fuel are significantly less than those associated with earlier fuel. (See Section 8.1.3 above.) The diffusion and equilibrium components of the offgas mixture are significantly less than that expected at initial

licensing. The current 30 minute, 100% power offgas mixture, as measured prior to any treatment, is 1,600 μCi/sec (sum of all measured radionuclides). The activity is expected to increase in linear proportion to power under extended power uprate conditions. Adjusting for the power increase, the resultant value is 1,900 μCi/sec at 30 minutes. This value is significantly below the base value of 25,000 μCi/sec used in the original FES analyses. Consequently, the dose conclusions of Table 7.2 of the FES for small leaks remain bounding for extended power uprate, and the radiological consequences of this class of accident are not increased.

8.3.3. Class 3 Radwaste System Failures

Accidents of this nature are included in Table 7.2 of the FES and consist of:

- radwaste system failures due to a single operator error or single equipment malfunction (Class 3.1),
- a release of a waste-gas storage tank (Class 3.2) and
- a release of liquid radwaste storage tank (Class 3.3).

DAEC analyzed the latter two events as Class 8 accidents because of their low probability of occurrence. However, they will be addressed as Class 3 accidents herein to conform to the Staff's views in 1973.

8.3.3.1. Class 3.1 Equipment Leakage or Malfunction

DAEC selected two events to represent Class 3. 1: a liquid radwaste discharge-operator error; and a gaseous waste discharge drain line failure

8.3.3.1.1. Liquid Radwaste Discharge

Section 10.2.1 of the Environmental Report describes the assumptions used in analyzing this event. The release is the result of an inadvertent pumping of the waste sample tank to the discharge canal. The liquid, having a concentration of 3.0 E-03 μCi / cc is pumped at a rate of 50 gpm for 20 minutes. The event is initiated by one of the following three single operator errors.

- The operator commences pumping without taking a batch sample.
- A batch sample is incorrectly analyzed or the results are incorrectly communicated, prior to discharge.
- The operator pumps the wrong tank.

This accident was postulated because liquid radwaste discharges were expected to be routine. However, changes to the liquid radwaste system and changes in DAEC's liquid radwaste discharge policies make this event extremely unlikely for both current power and extended power uprate operating conditions. Liquid radwaste discharge is not routinely performed at DAEC.

Since 1978, the DAEC has been administratively operated as a zero radioactive liquid discharge plant and liquid radwaste is not discharged to the canal. There are several manual valves in the liquid radwaste discharge line which are maintained shut and locked. In addition, a keyed switch in the radwaste control room operates a third valve. The keys to these valves are not controlled by the individual who would discharge the tank, but rather by personnel in a different department. Consequently, inadvertent pumping of liquid radwaste would require a sequence of events involving multiple unlikely personnel errors, and is considered to be implausible.

The probability of this postulated environmental accident would not be affected by the extended power uprate.

8.3.3.1.2. Gaseous Radwaste Discharge

Section 10.2.2 of the Environmental Report describes the assumptions used in analyzing this event. The release is the result of a loss of a drain line water seal, and the inventory is based on a thirty minute old diffusion mix equivalent to 25,000 μCi/sec.

As stated in 8.3.3 above, this assumed mix is an order of magnitude above the expected values under extended power uprate.

Consequently, the dose conclusions of Table 7.2 of the FES for equipment failures remain bounding for extended power uprate.

8.3.3.2. Class 3.2 Release of Waste Gas Storage Contents

Section 10.7.5 of the Environmental Report describes this accident. The accident is the result of a hydrogen ignition in the first charcoal bed. The offgas system is designed to withstand the pressure from such a hydrogen detonation, so the source term is limited to the inventory in the first bed. This inventory is based on a thirty minute old diffusion mix equivalent to 25,000 μCi/sec.

As stated in 7.3.3 above, this assumed mix is more than an order of magnitude above the expected values under extended power uprate.

Extended power uprate will not increase the probability of this accident nor will it involve operation above the release rates assumed by the Staff, and consequently the previously analyzed

dose rates continue to bound operation at extended power uprate conditions.

8.3.3.3. Class 3.3 Release of Liquid Waste Storage Tank Contents

According to Section 10.7.4 of the Environmental Report, this accident involves a catastrophic failure of a condensate storage tank, simultaneous with a breach of the containment basin. The entire tank contents, with an assumed activity of 1E-05 μCi/ml, is released to the discharge canal and enters the Cedar River within ten minutes. The subsequent dose from such an event was determined to be a small fraction of that received from natural sources.

The nominal concentration of activity in the condensate storage tanks is about 1E-05 μCi/ml. Extended power uprate will not have a material impact on the effectiveness of the liquid waste processing system or on the generation and activity level of liquid wastes at DAEC. Subsequent doses resulting from such an accident will still be a small fraction of that received from natural sources. Consequently, the conclusions arrived at by the Staff in the FES will remain valid for extended power uprate conditions.

8.3.4. Class 4 Events that Release Radioactivity into Primary System

The Environmental Report (Ref. 2, Sec. 10.3) states that no Class 4 events were identified for DAEC. Table 7.2 of the FES, however, includes dose estimates for fuel cladding defects and off-design transients that induce fuel failures above those expected. The assumptions for these dose estimates are not provided in the FES. As explained above, the incidence and extent of fuel cladding defects have been significantly reduced since initial operation due to industry improvements. In addition, operational limits are established at DAEC for each cycle to prevent transients from inducing fuel damage. These limits involve significant margin to fuel failure. Appropriate limits will continue to be imposed under extended power uprate conditions. Therefore, FES estimates will remain bounding for power uprate.

8.3.5. Class 5 Events that Release Radioactivity into Secondary System

Class 5 accidents apply only to Pressurized Water Reactors (PWRs). A justification for not including Class 5 accidents is presented in Section 10.4 of the Environmental Report. Extended power uprate does not impact this justification.

8.3.6. Class 6 Refueling Accidents Inside Containment

The consequences of two events have been addressed which bound this class of accident: dropping a heavy load onto the core, and dropping a

spent fuel cask. The latter was considered by the FES as a Class 7 accident and is addressed in Section 8.3.7.2 below. Only dropping a heavy object onto the core is evaluated here.

This accident assumes an equipment failure allows a fuel bundle and refueling mast to drop onto the core from the maximum permissible height. This event was chosen because the fuel assembly is the only heavy object that is routinely suspended over the core, and if dropped, could damage the core.

For the refueling accident, the Environmental Report estimates the integrated dose to the 50-mile population to be 0.94 rem. To update these results to reflect extended power uprate conditions two parameters used to determine this dose need to be addressed. First, the estimate needs to be increased by approximately 20% because of the increase in core inventory associated with extended power uprate. Second, the estimate needs to be increased by 11% to account for the change in population (Ref. 30 & 31). Adjusting for the increased core inventory and the 1990 population the dose is estimated to be 1.25 rem. This dose is extremely small when compared to the cumulative annual dose due to naturally occurring and manmade background radiation, which, when adjusted for the 1990 population is on the order of 250,000 rem. Thus, the conclusion that this event is not significant with regard to environmental effects remains valid.

The FES estimated the fraction of 10 CFR 20 limits at the site boundary resulting from this event as < 0.001, and the dose to the population within a 50-mile radius as < 0.1 rem (Ref. 2; Table 7.2). Adjusting these estimates for extended power uprate and change in population will not alter the conclusion that the environmental risks due to these postulated radiological accidents at DAEC remain exceedingly small under extended power uprate conditions.

The radiological consequences of this accident were reanalyzed using an alternate source term. The original analysis described in the Environmental Report (Ref. 1) assumed a 7 x 7 pin fuel type and resulted in perforation of a maximum of 49 rods. The reanalysis assumed a 10 x 10 fuel type (GE14 fuel) and results in perforation of 151 pins. The reanalysis made a number of assumptions which increased the conservatism of the results:

1. Fuel movement was assumed beginning 60 hours after reactor shutdown rather than 4 days as considered in the environmental report.
2. Partition factors assumed for the fuel pool in the reanalysis were reduced from 10E4 used in the environmental report to 160.
3. Plateout factor of 4 in secondary containment credited in the environmental report was not credited in the reanalysis.

4. No credit was taken for filtration systems as was done in the environmental report.
5. No credit was taken for holdup in the secondary containment.
6. The release was assumed to occur over a 2 hour period.
7. Extended power uprate results in an increase in core inventory.

The reanalysis was based on more rigorous methods and acceptance criteria which have replaced those used in 1971. The reanalysis is based on 95% confidence level atmospheric dispersion models and dose rates from multiple release paths at the Exclusion Area Boundary (EAB) and Low Population Zone (LPZ). The acceptance criteria are reflected in Regulatory Guide (RG) 1.183 (Ref. 36). The worst two hour dose at the EAB was predicted to be 1.80 rem Total Effective Dose Equivalent (TEDE). The acceptance criteria is 6.3 rem TEDE. The 30 day LPZ dose was calculated to be 0.43 rem TEDE, which is significantly below the acceptance criteria of 6.3 rem TEDE.

8.3.7. Class 7 Accidents to Spent Fuel Outside Containment

The Environmental Report considered the movement of a spent fuel cask on a railroad flatcar from the time the flatcar leaves the reactor building until it reaches the site boundary as the only accident in this class. The FES included the fuel cask drop in this class. As stated earlier, the latter accident was originally considered as Class 6 by the Environmental Report, but is being addressed here to maintain consistency with the FES classification.

8.3.7.1. Spent Fuel Movement on Site

Spent fuel movement outside containment is always done with the fuel inside a cask. It was concluded that engineering and administration cautions pertaining to the movement of spent fuel on site essentially preclude a cask from dropping due to instability, improper attachment to a flatcar, or a derailment. These cautions are not affected by extended power uprate. If a shipping cask were dropped, it would be from such a height that the cask would easily sustain the drop.

Although a cask could conceivably be damaged by fire, the site arrangement precludes movement of the car into areas of appreciable fire hazard. Extended power uprate introduces no changes to this conclusion

Fires due to wheel bearing overheating were discounted as unlikely, given the low velocity at which cask movement occurs. Extended power uprate does not affect the procedures for cask handling. The

Environmental Report concluded that doses to the public due to onsite movement of spent fuel outside containment are not expected. Extended power uprate does not affect this conclusion.

8.3.7.2. Dropping a Spent Fuel Cask

A fully loaded spent fuel cask is assumed to be dropped while being lowered to a waiting flatcar. This event was chosen to represent this category because it demonstrates the potential for dropping a fuel cask from the maximum height in the plant, potentially compromising cask integrity. The cask is assumed to drop less than 99 ft to a yielding surface (the flatcar and points below), resulting in a release of 1000 Ci of noble gases. The Environmental Report concludes that the consequences of this event are negligible and will have no significant impact on the environment.

Extended power uprate does not modify any equipment used to handle spent fuel casks, and thus, will not affect the frequency of this event. However, since extended power uprate increases core inventory, the potential to increase the consequences of the event exists. Again when using a multiplier of 1.18 to account for the increased noble gas inventory due to extended power uprate and adjusting for the 1990 population, the resulting 50-mile cumulative dose will be < 0.013 rem. This dose remains negligible when compared to the 1990 adjusted 50-mile cumulative annual dose resulting from background radiation (250,000 rem). Thus, the conclusion that the accident does not have a significant impact upon the environment remains valid when considering the effects of extended power uprate.

The FES estimated the 50 mile population dose at 10 rem. Using the 1.18 multiplier for the increased core inventory due to extended power uprate, and the 1.11 multiplier for the change in population, this estimate increases to 13 rem. The dose to the 50-mile population resulting from this event remains small when compared to the dose to the same population resulting from background radiation (250,000 rem/year). The FES conclusion that the environmental risks due to postulated radiological accidents at DAEC are exceedingly small remains valid for extended power uprate.

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

The environmental impact analysis made in the FES for Class 8 accidents was based on information provided in the Environmental Report. These accidents included the Recirculation Line Suction Break, the Main Steam Line Break, and the Control Rod Drop Accident. The off gas accident and the radwaste tank failure which were originally analyzed as Class 8 in the Environmental Report, are evaluated in Sections 8.3.2 and 8.3.3 respectively.

The methodology used to determine the offsite doses for environmental impacts of Class 8 was based in part on subjective and realistic assumptions and the FES results were expressed in estimated fractions of 10 CFR 20 limits. 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 extended power uprate, DAEC is using contemporary and conservative NRC-approved methods for calculating accident dose for design basis accidents, consistent with the DAEC environmental design bases and the appropriate regulatory acceptance criteria.

The updated radiological consequence analysis (Ref. 37) for design basis accidents presented herein supersedes the Environmental Report analysis of the environmental impact of SAR design basis accidents (LOCA, MSLB, CRDA, and RFA). 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 10 CFR 50 Appendix A for control room habitability. The results of these analyses demonstrate that extended power uprate has an insignificant environmental impact. The accident doses for postulated environmental accidents under extended power uprate conditions remain well within regulatory guidelines.

These accidents were conservatively analyzed by assuming an initial power level of 1950 MWt. This postulated power level is 102% of a bounding analytical power level of 1912 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.

Loss of Coolant Accident (30 day release)		
Location	**Dose (rem TEDE)**	**Acceptance Criteria (rem TEDE)**
EAB (worst 2 hour dose)	0.250	25
LPZ (30 day dose)	0.601	25

Main Steam Line Break (puff release)		
Pre-Incident Iodine Spike		
Location	**Dose (rem TEDE)**	**Acceptance Criteria (rem TEDE)**
EAB (worst 2 hour dose)	0.67	25
LPZ (30 day dose)	0.19	25
Equilibrium Iodine Activity		
Location	**Dose (rem TEDE)**	**Acceptance Criteria (rem TEDE)**
EAB (worst 2 hour dose)	0.067	2.5
LPZ (30 day dose)	0.019	2.5

Rod Drop Accident (24 hour release)		
Location	**Dose (rem TEDE)**	**Acceptance Criteria (rem TEDE)**
EAB	0.06	6.3
LPZ	0.04	6.3

Fuel Handling Accident (2 hour release)		
Location	**Dose (rem TEDE)**	**Acceptance Criteria (rem TEDE)**
EAB	1.8	6.3
LPZ	0.43	6.3

The tables demonstrate that offsite dose levels under extended power uprate conditions are well within regulatory guidelines. The assumptions are conservative with respect to extended power uprate operating conditions, shielding, and dose, and the methodologies have been previously approved by the NRC.

Given the above, the radiological consequences of design basis accident under extended power uprate conditions are within the acceptance criteria of 10 CFR 100 and do not involve any significant impact to the human environment.

8.3.9. 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 DAEC FES. The Staff did not evaluate these sequences on the premise that sufficient design conservatism, quality assurance, testing, and multiple physical barriers were in place such that the probability of a severe environmental accident is small, and the environmental risk of a Class 9 accident was extremely low. Extended power uprate will not involve any changes that affect the validity of the above conclusion.

8.4. Other Potential Environmental Accidents

Extended power uprate does not significantly change the inventory, storage, usage, or control requirements for chemicals, industrial gases, oil, oil products, or other hazardous substances. Extended power uprate will not require the introduction or use of any new hazardous substances. Extended power uprate will not result in a significant increase in the probability or consequences of an oil spill, chemical spill, industrial gas release, or other event involving a non-radioactive hazardous substance.

9.0 ENVIRONMENTAL EFFECTS OF URANIUM FUEL CYCLE ACTIVITIES AND FUEL AND RADIOACTIVE WASTE TRANSPORTATION

Table S-3 of 10 CFR 51.51 and S-4 of 10CFR 51.52 were adopted after DAEC received its operating license. Consequently, the DAEC FES does not contain a uranium fuel cycle environmental analysis similar to Table S-3. The impact of transportation is addressed in the Environmental Report and FES, although the conclusions are not presented in the form of Table S-4.

The data presented in Tables S-3 and S-4 are, in part, based on an average burnup assumption of 33,000 MWd/MtU and a U-235 enrichment assumption of 4 wt.%. Under extended power uprate conditions, fuel consumption is expected to increase such that the batch average burnup of the fuel assemblies will be in excess of 33,000 MWd/MtU but less than 60,000 MWd/MtU. To support extended burnup, the U-235 enrichments levels will also increase to greater than 4 wt.% but less than 5 wt.%. The NRC has previously evaluated the impact of increased burnup to 60,000 MWd/MtU with U-235 fuel enrichment to 5% wt.% on the conclusions of Table S-3 (Ref. 18). Although some radionuclide inventory levels and activity levels are projected to increase, the NRC noted that little or no increase in the amount of radionuclides released to the environment during normal operation was expected. The NRC determined that the incremental environmental effects of increased enrichment and burnup on transportation of fuel, spent fuel, and waste were not significant. In addition, the NRC recognized the salient environmental benefits of extended burnup such as reduced occupational dose, reduced public dose, reduced fuel requirements per unit electricity, and reduced shipments. The NRC concluded that the environmental impacts described by Table S-3 were bounding and were also applicable for burnup levels to 60,000 MWd/MtU and U-235 enrichment levels up to 5 wt.%.

10.0 DECOMMISSIONING EFFECTS

The environmental effects of decommissioning were not evaluated in the FES. Such concerns are to be addressed in a decommissioning plan. A decommissioning plan for DAEC will be submitted in accordance with regulatory requirements. Extended power uprate does not affect the ability to maintain sufficient financial reserves for decommissioning.

The potential impact of extended power uprate on decommissioning is due to increases in feedwater flow rate and increased neutron fluence. These effects could increase the amount of activated corrosion products and consequently increase post-shutdown radiation levels. For reasons cited in Section 8.1.1.1 herein, however, the potential increases in activated corrosion products are obviated by other ongoing plant improvements.

11.0 CONCLUSIONS

Extended power uprate does not result in significant impacts to the environment. It does not result in significant new environmental hazards in addition to those previously evaluated. The environmental impacts and adverse effects identified by the Summary and Conclusions Section of the FES for DAEC operation at 1658 MWt continue to bound plant operation at extended power uprate conditions. The proposed changes do not, individually or cumulatively, affect the human environment. There is no significant change in the types or amounts of plant effluents. Extended power uprate does not involve significant increases in individual or cumulative occupational radiation exposure.

The effect of power uprate on the environment does not prevent continued compliance with any environmental permit. None of the license conditions for environmental protection will be changed for extended power uprate. No effluent limits will be exceeded, and the present large margins to these limits will not be significantly changed. Extended power uprate does not involve an increase in the discharge of hazardous substances, contaminants, or pollutants and does not involve the use of any new hazardous substances, contaminants, or pollutants.

Extended power uprate does not involve any changes to air quality or water quality. It does not result in any changes to land use and has an insignificant effect on groundwater and surface water use. The amount of water withdrawn and consumed from the Cedar River remains within that previously evaluated. The slight increase in discharge canal temperature has an insignificant effect on river temperature and will not result in any significant changes to aquatic biota. Extended power uprate will not involve new or different discharges of contaminants and does not involve changes to any bio-accumulation effects for aquatic organisms. The quality of drinking water is not affected.

Extended power uprate does not involve any changes to wildlife habitat and does not result in any significant changes to aquatic or terrestrial biota. There are no deleterious effects on the diversity of biological systems or the sustainability of species due to extended power uprate. Extended power uprate does not involve additional changes to the stability or integrity of ecosystems. Extended power uprate does not affect the previous conclusions on impingement or entrainment. Extended power uprate does not affect DAEC's compliance with Sections 316(a) or 316(b) of the Federal Water Pollution Control Act.

Extended power uprate does not significantly change any doses to the public from radiological effluents, and offsite doses will continue to be well within regulatory limits. The Safety Evaluation for the DAEC concluded that the release of radioactive material in liquid and gaseous effluents from the DAEC will meet the requirements of 10 CFR 50 for keeping such effluent levels to unrestricted areas as

low as reasonably achievable and will result in doses that are a small percentage of the 10 CFR 20 limits (Ref. 30, Sec. 11.8). This conclusion was based on assumptions for effluent releases that bound releases expected for extended power uprate. Occupational dose will be maintained well within regulatory limits, and changes in radiation levels will not significantly increase the dose to the DAEC work force. For accident dose, the methodology for certain design basis accidents was updated. This updated methodology is consistent with methods previously approved by the NRC, and the resultant dose is well within the applicable regulatory limits. Extended power uprate does not involve significant increases in the probability or consequences of previously evaluated environmental accidents.

This environmental evaluation has demonstrated that extended power uprate does not involve environmental impacts that differ significantly from those previously evaluated for the present authorized power level. Where environmental impacts differ from those previously evaluated, these impacts have been shown to be insignificant and well within regulatory environmental acceptance criteria.

12.0 References

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