AmerGen
An Exelon/British Energy Company

Clinton Power Station
R.R. 3 Box 228
Clinton, IL 61727-9351
Phone: 217 935-8881

RS-01-271

November 21, 2001

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Clinton Power Station, Unit 1
Facility Operating License No. NPF-62
NRC Docket No. 50-461

Subject: Additional Health Physics Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station

References: (1) Letter from J. M. Heffley (AmerGen Energy Company, LLC) to U.S. NRC, "Request for License Amendment for Extended Power Uprate Operation," dated June 18, 2001

(2) Letter from J. B. Hopkins (U.S. NRC) to O. D. Kingsley (Exelon Generation Company, LLC), "Clinton Power Station, Unit 1 – Request For Additional Information (TAC No. MB2210)," dated November 14, 2001

In Reference 1, AmerGen Energy Company, LLC (i.e., AmerGen) submitted a request for changes to the Facility Operating License No. NPF-62 and Appendix A to the Facility Operating License, Technical Specifications (TS), for Clinton Power Station (CPS) to allow operation at an uprated power level. The proposed changes in Reference 1 would allow CPS to operate at a power level of 3473 megawatts thermal (MWt). This represents an increase of approximately 20 percent rated core thermal power over the current 100 percent power level of 2894 MWt. The NRC in Reference 2 requested additional information regarding the proposed changes in Reference 1. The attachment to this letter provides the requested information pertaining to NRC Questions 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7, 8.8, 8.9, and 8.10 of Reference 2. Responses to the remaining NRC questions in Reference 2 will be provided separately.

A001

Should you have any questions related to this information, please contact Mr. Timothy A. Byam at (630) 657-2804.

Respectfully,

K. A. Ainger for

K. R. Jury
Director – Licensing
Mid-West Regional Operating Group

Attachments:

Affidavit
Attachment: Additional Health Physics Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Clinton Power Station
Office of Nuclear Facility Safety – Illinois Department of Nuclear Safety

STATE OF ILLINOIS	)	
COUNTY OF DUPAGE	)	
IN THE MATTER OF	)	
AMERGEN ENERGY COMPANY, LLC	)	**Docket Number**
CLINTON POWER STATION, UNIT 1	)	**50-461**

SUBJECT: **Additional Health Physics Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station**

AFFIDAVIT

I affirm that the content of this transmittal is true and correct to the best of my knowledge, information and belief.

K. A. Ainger

K. A. Ainger
Manager – Licensing
Mid-West Regional Operating Group

Subscribed and sworn to before me, a Notary Public in and for the State above named, this 21st day of November, 2001.

Timothy Byam

Notary Public

"OFFICIAL SEAL"
Timothy A. Byam
Notary Public, State of Illinois
My Commission Expires 11/24/2001

ATTACHMENT

Additional Health Physics Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station

Question 8.1

Extended Power Uprate (EPU) submittal Section 6.3.3 states that the normal radiation levels around the spent fuel pool (SFP) may increase slightly, primarily during fuel handling operations. Explain the reason for and the magnitude of these postulated increases in dose rate levels in the area of the SFP. Verify that these postulated dose rate increases will be bounded by the current radiation zone designations in the SFP area. If this postulated dose rate increase is due to higher activation of spent fuel assemblies, discuss any effects that the storage of these spent fuel assemblies in the SFP may have on dose rates in accessible areas adjacent to the sides or bottom of the SFP.

Response 8.1

The increase in dose rate following extended power uprate (EPU) in the area around the spent fuel pool on the 755' Elevation of the Fuel Building is due primarily to a slight increase in activated corrosion products transferred from the reactor water to the spent fuel pool water along with fuel assemblies and as crud buildup on the spent fuel. The activity produced in the reactor water following EPU is expected to increase in proportion to power, or possibly slightly higher as discussed in the response to Question 8.2 below. However, due to the continued operation of the fuel pool cooling and cleanup system, the activity in the spent fuel pool water and its associated dose rate is expected to return to normal levels shortly after refueling.

The activity in the spent fuel following EPU, as discussed Section 8 of Attachment E to Reference 1, is expected to increase in proportion to the increase in power level. The movement of a recently discharged fuel assembly may cause an increase in dose rate directly above the fuel assembly in proportion to the increase in power. The maximum height that a fuel assembly may be raised in the pool is limited so that the dose rate at the fuel pool surface is well below the design basis dose rate for this area. There will be no change in the maximum height that a fuel assembly may be raised following EPU, so there will be no change in the radiation zone designation for the SFP area.

For those areas adjacent to the sides of the SFP where the dominant source of radiation is the spent fuel, it is expected that any dose rate increase following EPU will be limited by the increase in power level. Note that dose rates will also be affected by the distribution of fuel assemblies in the SFP, so it is expected that the actual increase in dose rate will be lower than the increase in power level. A review of the radiation zones in the vicinity of the spent fuel pool indicated that there is sufficient margin in the basis for the radiation zones to accommodate the increase in power level following EPU, so no radiation zone designations will be changed.

Question 8.2

Section 8.4.2 states that there may be an increase in the activated corrosion product production, but does not quantify the expected increase in dose rates from the increase in activated corrosion products. Provide the following information: 1) the expected magnitude of the dose rate increases associated with this increase in activated corrosion product production, 2) what plant areas will be affected by this increase in dose rates *from the increased level of activated corrosion products, 3) what affects this will have on occupancy levels in the affected areas, and 4) what affect this increase in activated corrosion product levels will have on curie loading for resin waste shipments.*

Response 8.2

Activated corrosion products result from neutron activation of metallic materials in the reactor water in the core region. Since the production rate of activated corrosion products is directly related to neutron flux, which increases in proportion to increases in reactor power, it is expected that the increase in production rate due to the increase in neutron flux would be the same as the increase in power level (i.e., a maximum of 20%).

In addition to the increase in neutron flux, the production rate of activated corrosion products will also be affected by any change in the concentration of metallic materials in the reactor water. At Clinton Power Station (CPS), the feedwater flow will increase by nearly 22% with EPU, but the reactor water cleanup (RWCU) system flow will remain at the pre-EPU value. Since the rate at which metallic materials are added to the reactor water (i.e., feedwater flow) is increasing while the rate at which they are removed (i.e., RWCU flow) remains constant, it is expected that the concentration of metallic materials in the reactor water will increase. A second and less significant effect of the higher feedwater flow is that the condensate polishers may not be as efficient at the higher flow rate, leading to higher impurity concentrations in the feedwater. It is estimated that the maximum increase in the concentration of metallic materials will be 11.3%. When the increase in concentration of metallic materials is combined with the increase in neutron flux, the production rate of activated corrosion products could increase as much as 34%. It should be noted that this increase in the concentration of metallic materials is a bounding value that was developed primarily to estimate the impact on the radwaste processing system.

The dose rate increases due to the increase in activated corrosion products are expected to occur in the vicinity of equipment handling reactor water. During normal operation, the contribution of activated corrosion products to dose rates from reactor water is small compared to fission products and coolant activation products in the reactor water, so the increase in dose rates is expected to be limited by the increase in power level. Since activated corrosion products are the primary contributors to crud buildup, it is expected that the dose rates near these systems will increase under post shutdown conditions in proportion to the increase in activated corrosion products, or slightly more than the increase in power level. In addition, the radwaste systems used to remove metallic materials from the reactor water (the RWCU filter/demineralizers) will be removing more activity. However, since more frequent backflushes may be required, the actual increase in dose rates from the filter/demineralizers will generally be less than the increase in power level.

The areas likely to see higher radiation levels due to increases in activated corrosion products are inside the drywell adjacent to the recirculation and RWCU piping, in the Auxiliary Building in the cubicles containing the RWCU pumps, and in containment areas containing the RWCU heat exchangers and filter/demineralizers.

The areas expected to be affected by the increase in dose rates due to increases in activated corrosion products are already identified as radiologically controlled areas and are not normally occupied. Access to these areas is controlled under current plant radiation protection procedures to maintain radiation exposures as low as reasonably achievable (ALARA), and any significant changes to radiation levels will be identified by special radiation surveys as described in the response to Question 8.5, below. The increase in dose rates may result in increased radiation exposure, but the increase in radiation levels is not expected to be large enough to restrict operations in these areas, hence the occupancy levels should be unaffected.

The activated corrosion products will be removed by the RWCU filter/demineralizers. The increase in concentration of metallic materials and other impurities in the reactor water may result in more frequent replacement of the filter media, increasing the volume by an estimated 11.3%. The activity will also be increased by the increase in power level, so the total increase in curie loading on the demineralizers will be approximately 34%. The estimated increase in volume and activity of the filter media is not expected to impact the ability to dispose of these materials.

Question 8.3

Section 8.5.2 states that the post-operation radiation levels in most areas of the plant are expected to increase by no more than the percentage increase in power level. This section also states; however, that there are a few areas near the reactor water piping and liquid radwaste equipment where the expected radiation level increase could be slightly higher. Provide the specific locations of these areas where higher dose rates are predicted, give the reasons for the expected increase in radiation levels in these areas, and state the percentage increase in dose rates expected.

Response 8.3

Changes in post-operation radiation levels following EPU are due to changes in radioactivity in spent fuel, neutron activation products in the vicinity of the reactor vessel, activated corrosion products deposited in process systems (i.e., crud buildup) and stored radwaste. The increase in each type of activity is related to neutron flux, which increases in proportion to reactor power, so it is expected that any increases would be limited by the increase in power level.

One potential exception to the relationship between reactor power and activity increase is the production of activated corrosion products in the reactor water. As discussed above in the response to Question 8.2, the feedwater flow will increase by nearly 22% with EPU, but the RWCU flow will remain at the pre-EPU value. Since the rate at which metallic materials are added to the reactor water (i.e., feedwater flow) is increasing while the rate at which they are removed (i.e., RWCU flow) remains constant, it is expected that the concentration of metallic materials in the reactor water will increase. This will lead to an increase in activated corrosion products due to the increase in the concentration of metallic materials that will be in addition to the increase due to higher neutron flux. A second and less significant effect of the higher feedwater flow is that the condensate polishers may not be as efficient at the higher flow rate, leading to higher impurity concentrations in the feedwater.

The increased concentration of activated corrosion products in the reactor water may lead to increased crud build up in systems handling reactor water, which will increase the post operation radiation levels in the vicinity of the affected equipment. It is estimated that the maximum increase in concentration of activated corrosion products will be 11.3%. This is a bounding value that was developed primarily to estimate the impact on the radwaste processing system. It does not account for any changes in plant operations to adjust for changes in the reactor water chemistry.

The combined effect of the increase in neutron flux and the increase in concentration of metallic materials will result in a maximum increase of 34% in the post operation dose rates in limited areas of the plant. The areas likely to see increases in post-operation radiation levels greater than the increase in power following EPU are inside the drywell adjacent to the recirculation and RWCU piping, in the Auxiliary Building cubicles containing the RWCU pumps, and in containment areas containing the RWCU heat exchangers and filter/demineralizers. The areas are already identified as radiologically controlled areas under post-operation conditions, so the slight increases in radiation level due to increased crud buildup will not cause a change to the Updated Safety Analysis Report (USAR) radiation levels. Any operational impacts will be evaluated and controlled in accordance with current plant radiation protection procedures.

Question 8.4
Section 8.5.3 states that access to vital areas needed for accident mitigation will not be significantly affected by the EPU. Provide a list of vital areas requiring post-accident occupancy per NUREG-0737, Item II.B.2. For each of these vital areas, provide the calculated pre-uprate and post-uprate mission doses to an operator performing vital tasks following a loss-of-coolant accident (LOCA). Verify that the mission doses to personnel in these vital areas, as well as the calculated dose estimates for personnel performing required post-accident duties in the plant's Technical Support Center, are within the dose guidelines of general design criteria 19 (10 CFR Part 50, Appendix A).

Response 8.4
The following vital areas are identified in USAR, Appendix D, item II.B.2.

- Main Control Room (MCR)
- Technical Support Center (TSC)
- Sampling station
- Sample analysis areas (Counting Room and Radiation Chemistry Laboratory)

In the MCR, the total post-LOCA operator dose from external sources under pre-EPU conditions is 0.46 rem. Under EPU conditions, the operator dose from external sources increases to 0.59 rem. Over the 30-day post-LOCA period, the average dose rate in the control room under EPU conditions is less than 1 millirem per hour. This is much less than the 15 millirem per hour average dose rate limit identified in NUREG-0737, "Clarification of TMI Action Plan Requirements," for continuously occupied areas.

The TSC is located adjacent to and within the same habitability envelope as the MCR. Therefore, the average post-LOCA dose rate from external sources is expected to be less than 1 millirem per hour, which is less than the NUREG-0737 limit of 15 millirem per hour.

The sampling station and sample analysis areas are not expected to be continuously occupied, so the dose guidelines of 10 CFR Part 50, Appendix A, General Design Criterion (GDC) 19, "Control Room," will apply to any tasks performed in these areas. The only mission performed in these areas is to obtain a sample, transport the sample to the sample analysis area, and perform the sample analysis. The total operator mission dose under pre-EPU conditions is estimated to be 0.61 rem whole body and 1.92 rem to the extremities. Increasing these doses to account for the increase in source term under EPU results in an operator dose of approximately 1 rem whole body and 2.5 rem to the extremities. These doses are well within the 5 rem whole body limit from GDC 19.

<u>Question 8.5</u>
Section 8.5 states that the EPU will result in an increase in radiation levels in most areas of the plant during both normal and post-operations. Describe what measures will be taken (e.g. special surveys of area radiation levels) during the power ascension to 20% above the current 100% power level to assure that all radiation areas are properly designated, posted, and controlled, in a timely manner, as required by Part 20 and plant technical specifications.

<u>Response 8.5</u>
CPS radiation protection procedures require station personnel to evaluate radiation conditions in the plant and perform radiation surveys to establish or verify radiation levels, postings, and boundaries for personnel access. The EPU startup test plan includes direction to monitor plant radiation levels in affected areas at various power levels during the ascension to rated power. Radiation surveys in affected areas, as defined in plant procedures, are performed both during and after startup from plant outages where the conduct of the outage may have caused a change in the area radiation levels. A change may have been due to outage duration, plant modification, or other effects. Based on the modifications planned for EPU implementation, and the increase in power level with its attendant expected increase in flux levels, these surveys will be performed to verify, change, or establish proper radiological controls within the plant.

<u>Question 8.6</u>
The submittal for the proposed 20% EPU states that outage-related modifications to support the implementation of these proposed changes will be made during the next two planned refueling outages. Provide an estimate of the additional occupational dose that will result from these planned modifications.

Response 8.6
EPU modifications planned for the Spring 2002 refueling outage are currently in the design preparation phase. When the designs are complete, work orders will be prepared. As part of the work order review process, radiation protection personnel will review the work to be performed and prepare a detailed radiation dose estimate as part of the radiation work permit process. This will also include any necessary radiological controls to be established for the conduct of the work. These detailed dose estimates have not been completed for the EPU modifications scheduled for installation in the next refueling outage (i.e., Spring 2002). Based on a preliminary review of the currently planned scope of power uprate modifications in the next outage, the total dose is roughly estimated at 5 man-rem. The principal contributors to this dose are expected to be the main turbine replacements and the installation of test equipment for vibration monitoring.

Question 8.7
In Section 8.1 and Table 8-1 of the Environmental Report for the EPU, you use the actual waste release quantities and effluent doses for the year 2000 as a basis for calculating the estimated waste quantities and effluent doses for the EPU. It is not clear from this data how the year 2000 data compares with waste release quantities and effluent doses for previous years at Clinton Power Station (CPS). Provide this data for the previous five-year period for CPS and show that the estimated waste quantities and effluent doses for the EPU (using this expanded data set) are still conservative when compared to the Final Environmental Statement values and 10 CFR Part 50 Appendix I limits.

Response 8.7
Waste generation data for the year 2000 is representative of plant operation for future years. Due to the extended shutdown that began in the fall of 1996 and ended in mid-1999, data for waste generation during the five years prior to implementation of power uprate is not relevant to the level of waste generation during normal power operation. In addition, due to the changes in plant ownership, management, and operating philosophy, data prior to 1996 is not representative of current conditions at CPS.

Question 8.8
Section 8.1.1 of the Environmental Report lists the actual and projected volumes of low-level solid radwaste generated at CPS for the years 2000 and 2001, respectively. Provide an estimate of the projected percentage increase in volume of low-level solid radwaste generated at CPS following EPU.

Response 8.8

In calendar year 2000, CPS generated and transported 111.7 cubic meters of low-level solid radwaste. Of the total quantity, 40.15 cubic meters consisted of resin generated in the RWCU system and the condensate polishing system. As reported in the Environmental Assessment for EPU, the resin generation is expected to increase by less than 20%. As the ratio of resin to other low-level waste is expected to be the same and assuming the maximum 20% increase, the increase in resin volume generated would be 8.3 cubic meters based on the total quantity of resin generated in the year 2000. This constitutes an estimated 7.4% increase in the total waste generation for EPU based on the quantity of low-level solid radwaste generated and transported in calendar year 2000.

Question 8.9

Section 8.2.2 of the Environmental Report states that radiation from shine (offsite) is not significantly affected by the EPU. Provide the present nominal value for the skyshine external dose component (before EPU) and the estimated value following EPU and compare these values to the 25 mRem whole body dose limit of 40 CFR 190. Describe how this external dose component for skyshine is calculated (i.e., is it a calculated dose, is it dependent upon plant power level). Identify the dose receptor for this skyshine component (i.e., is the dose receptor a member of the public located offsite).

Response 8.9

Calculated estimates of the contribution of skyshine to the annual population dose are provided in the CPS USAR Section 12.4.2 for pre-EPU conditions. The pre-EPU man-rem estimates at the site boundary and the equivalent annual dose for continuous occupancy are listed in Table 8.9-1. The receptor for this dose estimate is a member of the public located at the closest point on the site boundary, which is in the East sector at a distance of 3800 feet from the plant stack. The total annual whole body dose is estimated to be 2.2 mrem, which is less than 10% of the 40 CFR 190 limit of 25 mrem. The skyshine dose is approximately 40% of the estimated dose. The skyshine component of the annual dose was calculated using the SKYSHINE computer code assuming design basis Nitrogen-16 (N-16) sources in the turbine and associated piping.

As discussed in Section 8.4.1 of Attachment E to Reference 1, the activation products in the steam, which include N-16 and are the major contributors to direct radiation, are expected to increase following EPU in proportion to the increase in power. However, the design basis activities used to develop Table 8.9-1 are considered bounding for EPU and therefore will not change following EPU.

The actual annual dose to a member of the public based on environmental measurements, as reported in the Annual Radioactive Effluent Release Report and as summarized in Section 8.2.2 of the EPU Environmental Report, is a small fraction of the design basis values presented in the USAR and of the 40 CFR 190 limits. An increase in the direct dose due to EPU, which is expected to be no more than 20%, will not significantly increase the already small annual dose to the public.

Additional Health Physics Information Supporting the License Amendment Request to Permit Uprated Power Operation at Clinton Power Station

Table 8.9-1

Estimated Annual Whole Body Doses at the Site Boundary Pre-EPU Conditions

Source	Population Dose[1] (man-rem/year)	Annual Dose[2] (mrem/year)
Skyshine[3]	2.7E-6	0.9
Gaseous Effluents	3.9E-6	1.3
Total	6.6E-6	2.2
(40 CFR 190 Limit)		(25)

[1] Occupancy is assumed to be 0.5 hours/week
[2] Based on 100% occupancy
[3] Includes 3.1E-7 man-rem from direct radiation from water storage tanks

Question 8.10
Describe any programs that CPS has implemented or plans to implement to counteract any potential increases in dose rates resulting from the proposed EPU. Examples of some initiatives that other licensees have implemented to reduce the level of activated corrosion products and to further inhibit the buildup of corrosion products in the reactor coolant system include the use of noble metals injection, zinc injection, cobalt reduction, and chemical decontaminations of various plant systems and components.

Response 8.10
CPS implemented zinc injection in December 2000. In the long term, this is expected to have a significant effect on local area dose rates in the plant. Noble metal injection is also currently planned for the next refueling outage in the spring of 2002.

REFERENCES

1. Letter from J. M. Heffley (AmerGen Energy Company, LLC) to U.S. NRC, "Request for License Amendment for Extended Power Uprate Operation," dated June 18, 2001