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Exelon Nuclear

52.17

July 23, 2004

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

Subject: Exelon Generation Company, LLC (EGC) Application for an Early Site Permit (ESP) Environmental Requests for Additional Information (TAC No. MC1125)

Re: U.S. NRC Letter to Exelon *(Requests for Additional Information (RAI) Regarding the Environmental Portion of the Early Site Permit (ESP) Application for the Exelon Generation Company Site (TAC No. MC1125))*, dated May 11, 2004

Enclosed, as requested in the referenced letter, are responses to the RAIs associated with the environmental portion of the EGC ESP application. Also enclosed is a CD-ROM containing information as indicated in responses to various RAIs. Any planned changes to the application are identified following the response to each RAI.

A copy of both the letter and the enclosures are also being transmitted to the U.S. NRC Region III office by copy to this letter.

Should you have any questions, please contact Thomas Mundy (610-765-5662) or William Maher (610-765-5939) directly.

Sincerely,

Marilyn C. Kray
Vice President, Project Development

Enclosures 1. Reponses to Environmental RAIs
2. CD-ROM with associated electronic files

cc: U.S. NRC Regional Office (w/ enclosures)
Mr. Thomas Kenyon (w/ enclosures)

D073

AFFIDAVIT OF MARILYN C. KRAY

State of Pennsylvania

County of Chester

The foregoing document was acknowledged before me, in and for the County and State aforesaid, today by Marilyn C. Kray, who is Vice President, Project Development, of Exelon Generation Company, LLC. She has affirmed before me that she is duly authorized to execute and file the foregoing document on behalf of Exelon Generation Company, LLC, and that the statements in the document are true to the best of her knowledge and belief.

Acknowledged and affirmed before me this 23rd day of July, 2004.

My commission expires 10-6-07.

Vivia V. Gallimore

Notary Public

(SEAL)

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Vivia V. Gallimore, Notary Public
Kennett Square Boro, Chester County
My Commission Expires Oct. 6, 2007
Member, Pennsylvania Association Of Notaries

U.S. Nuclear Regulatory Commission
July 23, 2003, Enclosure 1

Responses to Environmental RAIs

Responses to the following environmental RAIs are provided in this enclosure:

E1.0-1 [1]
E1.0-1 [2]
E1.0-1 [3]
E1.0-1 [4]
E1.0-1 [5]
E1.0-1 [6]
E1.0-1 [7]
E1.0-1 [8]
E1.0-1 [9]

E2.4-1

E3.4-1

E3.5-1

E3.7-1

E3.8-1
E3.8-2
E3.8-3
E3.8-4
E3.8-5
E3.8-6
E3.8-7
E3.8-8
E3.8-9
E3.8-10
E3.8-11
E3.8-12
E3.8-13
E3.8-14

E4.3-1
E4.3-2

E4.4-1
E4.4-2

E4.5-1

E5.2-1
E5.2-2
E5.2-3
E5.2-4
E5.2-5

E5.3-1

E5.4-1

E7.1-1
E7.1-2
E7.1-3
E7.1-4
E7.1-5

E7.2-1
E7.2-2
E7.2-3
E7.2-4

E9.3-1
E9.3-2
E9.3-3
E9.3-4

NRC Letter Dated: 05/11/2004

NRC RAI No. E1.0-1 [1]

E1.0-1 Clarify those items in the Exelon Generation Company (EGC) ESP ER that the staff identified needed clarification during the March 2 - 3, 2004 environmental site audit. (See Attachment 2 of the site audit summary).

Item [1] Exelon should clarify instrumentation used to measure sediment thickness and lake water levels (Table 6.7-1 of the ER).

EGC RAI ID: R4-1

EGC RESPONSE:
The instrumentation to measure sediment thickness and lake levels are:

- Sediment thickness will be measured with a survey rod (or equivalent instrument)
- Lake levels will be measured with a Miltronics Ultrasonic Level Meter and recorder (or equivalent instrument)

Table 6.7-1 will be revised to reflect this clarification.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
Revise Chapter 6, Table 6.7-1:

The current text in column "Instrumentation Used" that currently reads (for both instruments):

Marsh McBirney Flowmeter (or equivalent instrument)

to read:

Sediment thickness will be measured with a survey rod (or equivalent instrument)

Lake levels will be measured with a Miltronics Ultrasonic Level Meter and recorder (or equivalent instrument)

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E1.0-1 [2]

E1.0-1 Clarify those items in the Exelon Generation Company (EGC) ESP ER that the staff identified needed clarification during the March 2 - 3, 2004 environmental site audit. (See Attachment 2 of the site audit summary).

Item [2] Exelon should clarify second sentence of Section 6.1.1.2 of the ER regarding temperature monitoring of Clinton Lake.

EGC RAI ID: R4-2

EGC RESPONSE:
The second sentence of Section 6.1.1.2 of the ER regarding temperature monitoring of Clinton Lake will be revised by deleting the word "minimum".

ASSOCIATED EGC ESP APPLICATION REVISIONS:
Revise Chapter 6, Section 6.1.1.2 (second sentence) to read:

The proposed preapplication monitoring will include the collection of monthly temperature measurements from general locations described below and presented in Figure 6.1-1.

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E1.0-1 [3]

E1.0-1 Clarify those items in the Exelon Generation Company (EGC) ESP ER that the staff identified needed clarification during the March 2 - 3, 2004 environmental site audit. (See Attachment 2 of the site audit summary).

Item [3] Exelon should clarify the number of police stations in Clinton, Illinois.

EGC RAI ID: R4-3

EGC RESPONSE:
In ER, Chapter 2, Section 2.5.2.7, the number of police departments will be revised from three to two police departments that serve the City of Clinton and from 76 to 75 police departments in the region.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
Revise Chapter 2, Section 2.5.2.7 from:

Within the vicinity, there is one fire department and three police departments that serve the City of Clinton.

to read:

Within the vicinity, there is one fire department and two police departments that serve the City of Clinton.

Revise Chapter 2, Section 2.5.2.7 from:

In the region, there are 89 fire departments and 76 police departments.

to read:

In the region, there are 89 fire departments and 75 police departments.

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E1.0-1 [4]

E1.0-1 Clarify those items in the Exelon Generation Company (EGC) ESP ER that the staff identified needed clarification during the March 2 - 3, 2004 environmental site audit. (See Attachment 2 of the site audit summary).

Item [4] Exelon should clarify Section 4.5.3.2 of the ER regarding type of perimeter readings.

EGC RAI ID: R4-4

EGC RESPONSE:
ER, Chapter 4, Section 4.5.3.2, Direct Radiation Measurements, will be revised to clarify the text regarding Environmental Thermoluminescent Dosimeters (TLDs) used to measure the ambient gamma radiation levels at locations in and around the CPS.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
Replace ER, Chapter 4, Section 4.5.3.2 with text shown below:

4.5.3.2 Direct Radiation Measurements

Environmental thermoluminescent dosimeters (TLDs) are used to measure the ambient gamma radiation levels at many locations in and around the CPS. A total of 216 TLD measurements were made throughout the year 2001. The average quarterly dose from indicator location(s) was 18.1 mrem. At control locations, the average quarterly dose was 16.9 mrem. These quarterly measurements ranged from 13.1 mrem to 21.9 mrem for indicator TLDs and 15.0 mrem to 19.5 mrem for control TLDs (Campbell, 2002a). From these observations, when factoring in the statistical variances, it is concluded that there was no increase in environmental gamma radiation levels resulting from plant operations at the CPS (Campbell, 2002a). In addition, real time dose rate measurements obtained at the protected area fence line during the third quarter of 2002 varied from 6.2 microrem/hr in the southeastern corner of the protected area to 56 microrem/hr directly west of the Turbine Building.

Table 4.5-1 provides a listing of quarterly TLD readings (net dose in mrem) for each of the 11 protected area fence line TLDs for each of the calendar quarters between the second quarter 2001 through the first quarter 2003 (eight quarters of data). The TLD fence line locations are shown on Figure 4.5-1. The average dose over this period considering the 11 TLD protected area fence line locations and correcting for average plant capacity factor is approximately 25 mrem.

Using the average dose rate of the 11 TLD fence line locations over this two year period is considered both reasonable and conservative for estimating the dose to the construction workers since this operating period is representative of the longer term operation of the CPS. Also when considering the construction of a future ESP plant at this site the majority of the time the construction workers will be located much farther from the CPS operating radiation sources than reflected in the fence line values. The principal source of radiation from CPS operation is the N-16 radiation emanating from the turbine building. As shown the highest dose rates occur opposite (west) the turbine building at TLD dose points 1 & 11 (Figure 4.5-1). Lowest values occur in the south-southeast direction (dose points 6, 7, & 8) in the direction of the ESP footprint (Power Block

Structure Area). The average dose rate at the protected area fence is estimated at 7.2 to 12.1 microrem/hr. The protected area fence line dose rates occur at distances of approximately 100 to 1000 ft from the CPS Turbine Building. The Exelon ESP facilities will be located more than 1000 ft from the CPS sources. Therefore the above listed average dose rates can be expected to be reduced to background. Skyshine studies for other BWR plants demonstrate that the dose rates may be reduced by a factor of 3 to 5 due the increased distance.

Replace existing Table 4.5-1 with the following new Table 4.5-1.

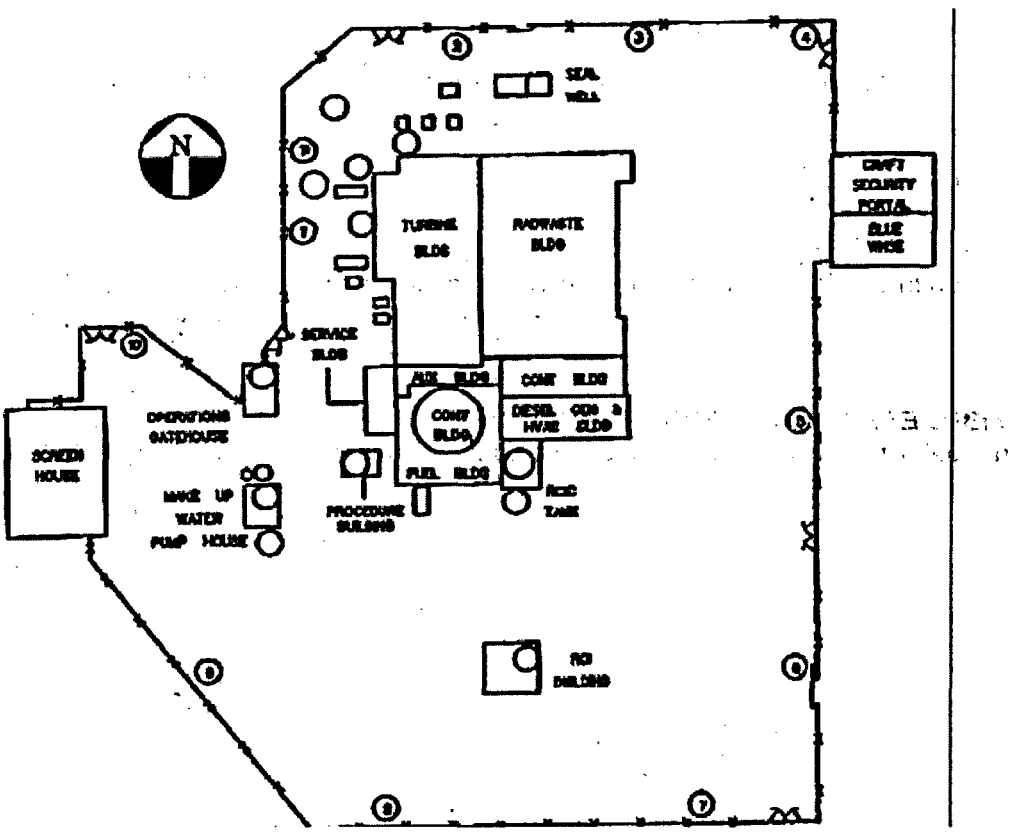
Table 4.5-1, TLD Measurement Clinton Protected Area Fenceline: Net Dose

Average Capacity Factor %	97.2	98.1	98.5	99.8	59.8	97.6	99.9	99.7
Time Period	2nd Qtr 2001	3rd Qtr 2001	4th Qtr 2001	1st Qtr 2002	2nd Qtr 2002	3rd Qtr 2002	4th Qtr 2002	1st Qtr 2003
Location	Net Dose (mrem)	Net Dose (mrem)	Net Dose (mrem)*	Net Dose (mrem)	Net Dose (mrem)	Net Dose (mrem)*	Net Dose (mrem)	Net Dose (mrem)
Protected Area Fence # 1	35	25	91	51	25	63	66	62
Protected Area Fence # 2	18	14	75	23	18	35	33	22
Protected Area Fence # 3	23	16	94	38	21	38	42	36
Protected Area Fence # 4	2	3	82	3	5	17	11	9
Protected Area Fence # 5	6	2	81	17	6	25	16	10
Protected Area Fence # 6	1	1	70	0	4	17	8	3
Protected Area Fence # 7	2	1	73	0	4	26	6	4
Protected Area Fence # 8	2	2	77	0	3	25	5	5
Protected Area Fence # 9	1	1	77	0	3	19	6	4
Protected Area Fence # 10	6	4	73	9	9	36	14	11
Protected Area Fence # 11	28	24	96	17	17	69	52	42

Note: 4th Quarter 2001 and 3rd Quarter 2002 TLDs were inadvertently irradiated during shipment. Use of this data is considered conservative but is not a true reflection of actual exposure incurred during these quarters.

Add new Figure 4.5-1.

Figure 4.5-1, Protected Area TLD Locations



ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E1.0-1 [5]

E1.0-1 Clarify those items in the Exelon Generation Company (EGC) ESP ER that the staff identified needed clarification during the March 2 - 3, 2004 environmental site audit. (See Attachment 2 of the site audit summary).

Item [5] Exelon should correct Section 4.5.4 of the ER from 0.045 mrem to 0.045 rem.

EGC RAI ID: R4-5

EGC RESPONSE:
The values reported in Section 4.5.4 have been revised as identified in the response to RAI No. E1.0-1 [6].

ASSOCIATED EGC ESP APPLICATION REVISIONS:
Revise Section 4.5.4, Annual Construction Worker Doses, as identified in the response to RAI No. E1.0-1 [6].

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E1.0-1 [6]

E1.0-1 Clarify those items in the Exelon Generation Company (EGC) ESP ER that the staff identified needed clarification during the March 2 - 3, 2004 environmental site audit. (See Attachment 2 of the site audit summary).

Item [6] Exelon should clarify the whole body dose equivalent values given in Table 4.5-1 of the ER.

EGC RAI ID: R4-6

EGC RESPONSE:
Table 4.5-1 (now Table 4.5-2) and Section 4.5.4 will be revised to clarify the estimated construction worker doses.

Construction worker doses are conservatively estimated based upon the following:

- The estimated exposures to the construction worker resulting from the operation of CPS via the gaseous release pathway described in Section 4.5.3.1 and the direct radiation exposure as presented in Section 4.5.3.2
- An exposure period of 2080 hours per year
- An assumed work force of 3,150 people (see Table 1.4-1, Section 18.4 of the SSAR)
- No credit for the reduction in dose rate due the distance from the protected area fence line to the EGC ESP construction areas

As indicated in Section 4.5.3.1, the Annual Radioactive Effluent Release Report for 2002 reported that the highest calculated doses (total body, skin, and thyroid doses) to a member of the public from the release of gaseous effluents from the operation of CPS was less than 3 µrem per year which was based on an occupancy rate of 243 hr/yr. The dose was based on the public use of a road in the southeast sector of the CPS plant site Adjusting this exposure for an increase in the worker site occupancy of 2080 hrs/yr during construction results in an estimated dose of (2080/243)* (3 µrem per year) equals 0.03 mrem.

Section 4.5.3.2 indicates that based on CPS protected area fence line TLD measurements, the annual average dose to construction workers from direct and skyshine radiation exposure is approximately 25 mrem, and based on recent direct survey data in the range of 6.2 to 56 µrem per hour. Revised Table 4.5-2 presents the estimated doses to construction worker compared to the public dose criteria of 10CFR20.1301. This comparison demonstrates compliance with 10 CFR20.1301 criteria and for concluding that future construction workers would not need to be classified as radiation workers.

The annual collective dose to the construction work force (3150 persons) is estimated to be 80 person-rem based on the 8 quarters of TLD data.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
Replace the current Section 4.5.4, Annual Construction Worker Doses, with the following:

4.5.4 Annual Construction Worker Doses

Construction worker doses are conservatively estimated based upon the following:

- The estimated exposures to the construction worker resulting from the operation of CPS via the gaseous release pathway described in Section 4.5.3.1 and the direct radiation exposure as presented in Section 4.5.3.2
- An exposure period of 2080 hours per year
- An assumed work force of 3,150 people (see Table 1.4-1, Section 18.4 of the SSAR)
- No credit for the reduction in dose rate due the distance from the protected area fence line to the EGC ESP construction areas

As indicated in Section 4.5.3.1 the Annual Radioactive Effluent Release Report for 2002 reported that the highest calculated doses (total body, skin, and thyroid doses) to a member of the public from the release of gaseous effluents from the operation of CPS was less than 3 µrem per year which was based on an occupancy rate of 243 hr/yr. The dose was based on the public use of a road in the southeast sector of the CPS plant site. Adjusting this exposure for an increase in the worker site occupancy of 2080 hrs/yr during construction results in an estimated dose of (2080/243)* (3 µrem per year) equals 0.03 mrem.

Section 4.5.3.2 indicates that based on CPS protected area fence line TLD measurements that the annual average dose to construction workers from direct and skyshine radiation exposure is approximately 25 mrem and based on recent direct survey data in the range of 6.2 to 56 µrem per hour. Table 4.5-2 presents the estimated doses to construction worker compared to the public dose criteria of 10CFR20.1301. This comparison demonstrates compliance with 10 CFR20.1301 criteria and for concluding that future construction workers would not need to be classified as radiation workers.

The annual collective dose to the construction work force (3150 persons) is estimated to be 80 person-rem based on the 8 quarters of TLD data.

Replace existing Table 4.5-2 with revised Table 4.5-2:

TABLE 4.5-2. Comparison of Construction Worker Public Dose to 10 CFR 20.1301 Criteria

Type of Dose	Annual Dose Limits 10 CFR 20.1301	Estimated Dose
Total effective dose equivalent	100 mrem	25 mrem
Maximum dose rate in any hour	2 mrem/hr	< 1 mrem/hr

Revise the references for Section 4.5 as follows:

Delete the reference for 40CFR190.

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E1.0-1 [7]

E1.0-1 Clarify those items in the Exelon Generation Company (EGC) ESP ER that the staff identified needed clarification during the March 2 - 3, 2004 environmental site audit. (See Attachment 2 of the site audit summary).

Item [7] Exelon should clarify the second sentence in Section 3.8.2.6 of the ER regarding characteristics under normal operations.

EGC RAI ID: R4-7

EGC RESPONSE:
The second sentence of Section 3.8.2.6 will be clarified to indicate that the ER statement of "Three of these characteristics, fuel form, U235 enrichment, and fuel rod cladding, have no direct transportation impact on the health and the environment" relates to the fact that these parameters are not used by the RADTRAN-V transportation risk assessment code when assessing transportation risks under normal transport conditions. These parameters are only used by the code and are only applicable when assessing risks under abnormal transport conditions.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
Revise the second sentence of Section 3.8.2.6 of the ER from:

Three of these characteristics, fuel form, U235 enrichment, and fuel rod cladding, have no direct transportation impact on the health and the environment.

to read:

Three of these characteristics, fuel form, U235 enrichment, and fuel rod cladding, have no direct transportation impact on the health and the environment since these parameters are not used when assessing transportation risks under normal transport conditions.

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E1.0-1 [8]

E1.0-1 Clarify those items in the Exelon Generation Company (EGC) ESP ER that the staff identified needed clarification during the March 2 - 3, 2004 environmental site audit. (See Attachment 2 of the site audit summary).

Item [8] Exelon should clarify information regarding the southern transmission line corridor.

EGC RAI ID: R4-8

EGC RESPONSE:
As shown on Figure 2.2-4, the southern transmission route from the EGC ESP Site parallels the existing 345kV transmission line operated by Illinois Power. It runs from CPS southeast for approximately 2.6 miles and then due south for approximately 6 miles to its connection with the Latham-Rising transmission line. New construction is not anticipated from this point to the Rising substation.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E1.0-1 [9]

E1.0-1 Clarify those items in the Exelon Generation Company (EGC) ESP ER that the staff identified needed clarification during the March 2 - 3, 2004 environmental site audit. (See Attachment 2 of the site audit summary).

Item [9] Exelon should clarify truck shipment totals over a 40-year period in Section 3.8.3.4 of the ER for PBMR and GT-MHR fuel.

EGC RAI ID: R4-9

EGC RESPONSE:
The ER, Section 3.8.2.4, will be revised to clarify the numerical values shown in the section for truck shipment totals.

ER Section 3.8.2.4 discusses the type and number of shipments for the gas-cooled reactor technologies and the values used for the reference LWR. The calculations for the gas-cooled reactors are based on the following assumptions:

- Forty (40) years of operation and Low Level Waste (LLW) generation
- One (1) initial core load – shipment prior to operation
- Thirty-nine (39) annual core reloads during the 40 years of operation
- Forty-two (42) spent fuel shipments (approximately equal in size to the annual core reload shipments) – three (3) shipments are after final shutdown of the reactor

Adjustment of the yearly average through normalization to an equivalent electrical generation (i.e., the GT-MHR shipments were reduced by 12% and the PBMR shipments were reduced by 30%). The calculated numbers of shipments were then rounded to the next whole number.

The following table summarizes the revised estimate.

Shipment type	Number of Shipments		
	LWR	GT-MHR	PBMR
Initial Core Load	18	51	44
Annual Reload	6	20	20
Annual Spent Fuel	60	38	16
Low Level Waste	46	6	9
Total for 40 years of Operation	4612	2667	1861
Yearly Average	115	67	47
Adjusted Yearly Average	115	59	33

Due to the revised method of the normalization, the normalized values for each shipment type will be omitted from the revised ER Section 3.8.2.4.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
Replace ER, Section 3.8.2.4, Risk Contributors – Shipments, with the following:

This section discusses the type and number of shipments for the gas-cooled reactor technologies and the values used for the reference LWR. The calculations discussed below for the gas cooled reactors are based on the following assumptions:

- Forty (40) years of operation and Low Level Waste (LLW) generation
- One (1) initial core load – shipment prior to operation
- Thirty-nine (39) annual core reloads during the 40 years of operation
- Forty-two (42) spent fuel shipments (approximately equal in size to the annual core reload shipments) – three (3) shipments are after final shutdown of the reactor

The reference LWR assumed an initial core loading of 100 MTU for a PWR and 150 MTU for a BWR. These quantities resulted in 18 truck shipments. For the new gas-cooled reactor technologies, the numbers of shipments were 44 for the PBMR and 51 for the GT-MHR.

The reference LWR assumed an annual reload of 30 MTU. This quantity resulted in 6 truck shipments. For the new gas-cooled reactor technologies, the number of annual reload shipments was 20 for both the PBMR and the GT-MHR over a 39 year period.

With respect to the number of spent fuel shipments by truck, the reference LWR assumed 60 shipments annually. For the two gas-cooled reactor technologies, the number of shipments is considerably less. The PBMR requires 16 annual shipments while the GT-MHR requires 38 truck shipments annually. It is assumed that there will be 39 years of annual spent fuel shipments. In addition, the final core will be shipped following the final shutdown of the reactor.

The reference LWR assumed 10 rail shipments annually of spent fuel. Since the gas-cooled reactor technologies are not planning to ship their spent fuel by rail, no comparison is required. However, based on the above comparison indicating that fewer truck shipments would be necessary, fewer than 10 rail shipments annually would also be expected by this mode. This could be reduced further if DOE decided to use larger and higher capacity rail transport casks for gas-reactor spent fuel.

The reference LWR also considered transporting spent fuel by barge and assumed five shipments annually. Since the gas-cooled reactor technologies are not planning to ship their spent fuel by barge, no comparison is required.

The reference LWR assumes 46 shipments annually of low-level radioactive waste. The gas cooled reactor technologies will make far fewer shipments. The PBMR will require 9 shipments and the GT-MHR will require only 6 shipments annually for the 40-year duration of operation. These results assume that 90 percent of the LLW can be shipped at 1,000 ft^3 per truck, and the remaining 10 percent can be shipped at 200 ft^3 per truck.

The Table S-4 value, traffic density in trucks per day, for the reference LWR is given as less than one per day. Both the gas-cooled reactor technologies would also have less than one shipment per day. In fact, the new gas-cooled reactor technologies would have far fewer shipments per year. The reference LWR bounding annual value for truck shipments is 115 based on a 40-year average. The 40-year average for the PBMR is 47 (1861 shipments over 40 years) while the 40-year average for the GT-MHR would be 67 (2667 shipments over 40 years). This is conservative since all shipments would actually be over a period of about 45 or 46 years considering that the final spent fuel shipments could not take place until at least 5 years beyond the 40-year life of the plant. In addition, truck shipments for each of the gas reactors would be normalized based on electrical generating capacity (the PBMR shipments are reduced by 30% and the GT-MHR shipments are reduced by 12%) yielding as few as 33 per year for the PBMR and only 59 per year for the GT-MHR.

The rail density in cars per month for the reference LWR is given as less than three per month. Since the gas-cooled reactor technologies are not planning to make any shipments by rail, no comparison is needed. However, as noted above, if DOE decided to use rail transport for spent fuel instead of truck, fewer than three shipments per month would be expected.

In addition, revise the following sentence of Section 3.8.2.6, first paragraph, from:

For example, on an average annual basis, the new reactor technologies require 69 to 105 fewer total truck shipments.

to read:

For example, on an average annual basis, the new reactor technologies require 56 to 72 fewer total truck shipments.

Finally, the specific line item for reload shipments per year in ER Table 3.8-2 will be revised as follows to correct the number of unirradiated PBMR fuel reload shipments per year.

Table 3.8-2, Gas-Cooled Reactor Transportation Impact Evaluation

Reactor Technology	**Reference LWR (single Unit 1100 Mwe)**	**GT-MHR (4 modules) (2400 MWt total) (1140 MWe total)**	**PBMR (8 modules) (3200 MWt total) (1320 MWe total)**	**Comments**
# of Reload Shipments/year	6	20 shipments (520 elements per reload per 1.32 years x 4 modules; 80 elements per truck)	20 shipments (120,000 fuel spheres per module x 8 modules, 48,000 spheres per truck)	30 MTU annual reload

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E2.4-1

E2.4-1 **Section 2.4.1.1.4 (Wetland and Floodplain Forest)** - Provide a map of the EGC ESP site showing the habitats discussed in the ER, including the 4 less-than-1-acre wetlands mentioned in ER Section 4.3.1.4.2.4. Include an overlay of the EGC ESP facilities and laydown yards, indicating their likely location if constructed.

EGC RAI ID: R3-1

EGC RESPONSE:

Figure 2.2-1 of the Environmental Report shows land use and habitat types at the site. Among the types and uses illustrated are woody and herbaceous wetlands. Within the site boundary of Figure 2.2-1, the wetlands mentioned in Section 4.3.1.4.2.4 are visible. Additionally, there is an overlay of the EGC ESP facilities. Section 4.1.1.1 identifies these four minor areas within the site boundary as being palustrine unconsolidated bottom. Section 4.1.1.1 goes on to state that construction activities, which includes laydown and disposal of fill material, will be such that these wetlands are not impacted.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E3.4-1

E3.4-1 **Section 3.4.2.3 (Normal Heat Sink), Section 3.4.2.4 (Ultimate Heat Sink), and Section 4.2.1.2.1 (Construction Along Clinton Lake)** – In several locations, the ER states that the new intake structure will be next to the existing Clinton Power Station (CPS) intake structure. During the site visit in March 2004, an Exelon representative indicated that he did not think the intake structure could go next to the CPS intake structure because of existing piping. Confirm that the planned location for the proposed EGC ESP intake structure is next to the CPS intake structure.

EGC RAI ID: R3-2

EGC RESPONSE:
The proposed location for the new intake structure is approximately 65 feet west of the existing structures to facilitate construction and maintain the independence of the systems.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
Revise ER, Chapter 3, Section 3.4.2.3, third paragraph from:

Pumps for the makeup water will be located in a new intake structure, and positioned next to the CPS intake structure.

to read:

Pumps for the makeup water will be located in a new intake structure, which will be maintained at a nominal distance (approximately 65 feet) between the structures to facilitate construction and maintain the independence of the structures.

Also, revise ER, Chapter 4, Section 4.2.1.2.1, first sentence from:

The proposed location of the new intake structure is next to the existing intake structure for the CPS.

to read:

The proposed location for the new intake structure will be approximately 65 feet west of the existing structures to facilitate construction and maintain the independence of the systems. Figures 2.1-3 through 2.1-5 show the location of the new intake structures.

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E3.5-1

E3.5-1 **Section 3.5.2 (Gaseous Radioactive Waste Management System)** – This section presents a listing of normal radioactive gaseous effluents in Table 3.5-3; however, it does not specify which reactor designs were considered in development of the bounding gaseous effluent. Clarify what reactor designs were considered in the development of the bounding gaseous effluents.

EGC RAI ID: R3-3

EGC RESPONSE:
The reactor designs considered are the same reactor designs identified in Section 1.1.3, "Reactor Information."

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E3.7-1

E3.7-1 **Section 3.7 (Power Transmission System) and Section 5.6.1 (Terrestrial Ecosystems)** - Provide the right-of-way (ROW) management plan for the existing transmission and distribution system (ER and ESRP Sections 3.7). The ROW management plan for the existing system will be used to project impacts to terrestrial ecological resources that could result from operation and maintenance of transmission line corridors for the EGC ESP facility, assuming the same ROW management plan is applied to those corridors (ER and ESRP Sections 5.6.1).

EGC RAI ID: R3-4

EGC RESPONSE:
The existing transmission and distribution system is owned and operated by Illinois Power. EGC has been in contact with individuals responsible for ROW management and have been advised by these individuals that Illinois Power does not have a written ROW management plan for transmission and distribution lines. They do have a policy regarding vegetation management in transmission ROW but not in a written format. The basic points of the policy are as follows:

Routine maintenance of ROW is conducted every four years unless required sooner due to problems. Routine maintenance consists of clearing vegetation that encroaches on the line exclusion area.

No vegetation over 10 feet tall is allowed in the wire zone.

Transmission ROW is inspected by helicopter three times each year, with two inspections including Illinois Power Forestry Department representatives. These inspections identify encroachment problems in need of immediate attention.

There is an annual visual inspection of high-risk areas, such as residential areas, for vegetation related problems.

These basic points expand upon and support information in the ER Section 5.6, Transmission System Impacts. Subsections 5.6.1, 5.6.1.3, 5.6.2 and 5.6.2.3 refer to maintenance in accordance with the transmission operator's standard procedures. The above policy is consistent with that stated in the ER.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E3.8-1

The following information is requested to support development of RADTRAN 5 computer code input files to model shipments of advanced reactor irradiated fuels to calculate incident-free exposures and accident risks. To assist in modeling the advanced reactor irradiated fuel and packaging systems, provide the following:

E3.8-1 **Radionuclide content of advanced design irradiated fuel** – For the IRIS reactor design, provide a detailed listing of all radionuclides and their inventories (e.g., Curies per metric ton uranium (Ci/MTU) or other suitable unit that can be used to calculate the inventories of each radionuclide in irradiated fuel shipments). In addition, for the ACR-700 reactor design, provide a detailed listing of all actinide radionuclides and their inventories. Explain the technical basis for the data (how the information was obtained) and the accuracy of the data.

EGC RAI ID: R3-5

EGC RESPONSE:
Detailed listings of radionuclides and their five-year decay inventories were provided by the reactor designers and included in the supporting documentation for the ESP application.

Isotopic listings of the spent fuel inventories were not required in order to conduct the comparison to Table S-4 and the reference LWR. With the exception of Kr-85, the comparison required only summary information for fission products, actinides, and total activity (see Section 3.8.2). In addition to the summary information, the reactor vendors were asked the following:

"Note: If available, please provide a complete set of the ORIGEN run results (or other applicable code for the appropriate reactor type) detailing the spent fuel inventories after a 5 year decay period."

The vendor responses varied. Several of the vendors provided isotopic listings of the inventories; a few provided the computer runs. In all cases, what was provided by the vendors can be found in the "Early Site Permit Environmental Report Sections and Supporting Documentation," NRC Accession No. ML040580285. In the case of the IRIS, only summary information was provided. For the ACR-700, AECL provided the computer analysis for just the fission product inventory. The multiple fission product output occur because the ACR-700 fuel bundle has four rings.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E3.8-2

E3.8-2 **Detailed information about the advanced fuel designs** – Provide information to support a preliminary comparative evaluation of the abilities of the advanced fuel designs to withstand structural and thermal accident conditions relative to current design fuel assemblies. In particular, provide the following information on the advanced fuels:

a. Fuel mechanical and thermal properties

b. For the fuel cladding:

1. material(s) used and form/manufacturing processes,
2. physical dimensions, and
3. mechanical and thermal properties

c. Investigation/analysis of fission product transport within and out of the fuel matrix

d. Irradiation and temperature effects on the mechanical and thermal properties discussed above

e. Assumptions about packaging that would be used as inner containers (i.e., overpack) inside a conceptual shipping cask

f. Expected release fractions from the fuel during accident conditions - if this information is given as a comparison to light-water-cooled reactor (LWR) fuels release fractions, provide the basis for the comparison

EGC RAI ID: R3-6

EGC RESPONSE:

ABWR, AP1000, IRIS, ESBWR, ACR-700

As discussed in Section 3.8.1, these LWR designs satisfy the 10 CFR 51.52 (a) conditions for use of Table S-4 or have impacts shown by sensitivity analysis to be bounded by Table S-4. The environmental impacts of transportation of fuel and radioactive wastes are represented by the values given in 10 CFR 51.52 (c), Table 4. For this reason, no further detail on the fuel characteristics for these LWRs is provided.

GT-MHR

References 1 and 2 below provide information on the GT-MHR. Spent fuel cask modeling assumptions are discussed in the response to RAI No. E3.8-3. Due to the high temperature capability of the GT-MHR fuel, General Atomics anticipates that the fission product release characteristics during credible transportation accidents would be less than LWR fuels. Additional information on the release characteristics during normal operations of the MHTGR can be found in

the MHTGR PSID (Reference 2).

PBMR

Reference 3 provides information on the PBMR.

REFERENCES:

1. PC-000507, GT-MHR Plant Parameter Envelope Supporting Early Site Permitting, General Atomics, April 2003. Contained in the Idaho National Engineering and Environmental Laboratory Engineering Design File 3747, May 2003 (NRC Accession Number ML040580285).

2. Preliminary Safety Information Document for the Standard Modular High Temperature Gas-Cooled Reactor, DOE-HTGR-86-024, General Atomics, February 1992.

3. November 29, 2002, Letter from A.P. George and F. Curtolo, Pebble Bed Modular Reactor (Pty) Ltd., to Michael Cambria, Parsons Energy and Chemicals, "ESP-8: Reactor Vendor Questionnaire." Contained in the Idaho National Engineering and Environmental Laboratory Engineering Design File 3747, May 2003 (NRC Accession Number ML040580285).

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E3.8-3

E3.8-3 **Information about the designs of shipping casks for advanced reactor irradiated fuels** – Provide capacities and dimensions of the shipping casks being modeled. It is assumed that the advanced LWR irradiated fuels would be shipped in casks similar to the current generation. For advanced non-LWR irradiated fuels, provide information about irradiated fuel handling, fuel behavior regarding failure and release fractions, and shipping cask concepts. Include all references and provide the basis for all assumptions made.

EGC RAI ID: R3-7

EGC RESPONSE:

ABWR, AP1000, IRIS, ESBWR, ACR-700

As discussed in Section 3.8.1, these LWR designs satisfy the 10 CFR 51.52 (a) conditions for use of Table S-4 or have impacts shown by sensitivity analysis to be bounded by Table S-4. The environmental impacts of transportation of fuel and radioactive wastes are represented by the values given in 10 CFR 51.52 (c), Table 4. For this reason, no further detail on the fuel characteristics for these LWRs is provided.

GT-MHR

The GT-MHR spent fuel was modeled as being shipped in a 42-element shipping cask by rail. A preliminary design of the multi-purpose canister (MPC) was initially performed for the Plutonium Consumption-Modular Helium Reactor (PC-MHR) in FY-95 for the DOE. Reference 1 below is the MPC preliminary design report. The application of the MPC design to the GT-MHR spent fuel was evaluated for DOE in Reference 2.

PBMR

The PBMR was modeled based on shipping 24,000 fuel spheres per container with two 6-m long containers per truck. The total mass of one of the containers with fuel is 15,900 Kg. This information was provided in reference 3.

REFERENCES:

1. GA/DOE-082-95, letter report from D.A. Alberstein to Howard R. Canter, "PC-MHR Spent Fuel Disposal Multipurpose Canister Preliminary Design Report", October 1995.

2. PC-000502/0, Assessment of GT-MHR Spent Fuel Characteristics and Repository Performance, General Atomics, April 2002.

3. November 29, 2002, Letter from A.P. George and F. Curtolo, Pebble Bed Modular Reactor (Pty) Ltd., to Michael Cambria, Parsons Energy and Chemicals, "ESP-8: Reactor Vendor Questionnaire." Contained in the Idaho National Engineering and Environmental Laboratory Engineering Design File 3747, May 2003 (NRC Accession Number ML040580285).

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E3.8-4

The following are specific questions related to Section 3.8 of the ER:

E3.8-4 General – Provide a transportation risk assessment for gas-cooled reactor spent fuel shipments using an accepted methodology, such as RADTRAN V. Provide justification that the best available information has been used to generate the RADTRAN input values, and that those values are appropriate for gas-cooled fuel shipments. Provide a comparison of the results of that assessment with the spent fuel shipment risk estimates contained in NUREG-0170, *Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes.*

EGC RAI ID: R3-8

EGC RESPONSE:
RADTRAN V highway runs were conducted for a GT-MHR and a PBMR spent fuel shipment from Maine Yankee Nuclear Plant to Yucca Mountain. The TRAGIS Routing Engine Version 1.4.15, which uses the 2000 Census data, provided the routing information and the population densities. The analysis was conservative using the 10 CFR 71 regulatory limits of 2 mrem/hr in the cab and 10 mrem/hr at 2 meters from the cask. The input values were taken primarily from the Yucca Mountain Final EIS in particular the *Transportation Health and Safety Calculation/Analysis Documentation in Support of the Final EIS for the Yucca Mountain Repository.* Specifically, the values for the high integrity high-temperature gas-cooled reactor SNF referred to a type 8 were used. The results of these runs are provided in the output files that echo the input files as well. These files are provided as separate attachments. A comparison of the incident free results with NUREG-0170 is provided in the Table below.

	NUREG-0170 (1) (person-rem/ shipment)	GTMHR RADTRAN V Results(2) (person-rem/ shipment)	PBMR RADTRAN V Results(3) (person-rem /shipment)	Difference between RADTRAN V results and NUREG-0170
Passengers	0	0.000	0.000	0.000
Crew	0.123	0.157	0.157	0.034
Attendants	0.000	0.000	0.000	0.000
Handlers	0.200	0.102	0.102	-0.098
Off-Link	0.015	0.012	0.012	-0.003
On-Link	0.007	0.081	0.081	0.073
Stops	0.019	0.177	0.177	0.158
Storage	0.005	0.000	0.000	-0.005
Totals	0.369	0.529	0.529	0.160

1. Based on 1530 spent fuel truck shipments for the year 1985
2. GT-MHR Spent Fuel from Maine Yankee to Yucca Mountain
3. PBMR Spent Fuel from Maine Yankee to Yucca Mountain

The major difference is the dose during stops. Approximately 25% of this difference is attributable to the RADTRAN V simulations included inspections at the beginning and the end of the trip. NUREG-0170 did not include these inspections. The remaining difference can be attributed to greater distance traveled, hence more refueling stops, and the different methodologies used to calculate the stop doses. This evaluation used 1996 truck stop data (*Investigation of Radtran Stop Model Input Parameters for Truck Stops,* SAND96-0714C) and modeled public doses in two concentric rings: 1 m to 14 m and 30m to 800m. The population in the inner ring used the results of the Stop Model study while the population in the outer ring used route specific 2000 Census population data weighted by a 3% urban, 26% suburban and 71% rural distribution. The NUREG-0170 study modeled just one ring, 10 to 2600 feet, and used three fixed population densities.

Factors contributing to the increased on-link population dose are NUREG-0170 assumed a 2500 km shipment distance with a 5% urban, 5% suburban and 90% rural population. This evaluation used updated 2000 census information showing a 3% urban, 26% suburban and 71% rural population and a 4,733 km shipment distance.

In addition to the incident free results, the RADTRAN V runs also included accident results. Due to the preliminary nature of the gas-cooled reactor fuel designs, it is premature to provide a meaningful comparison with NUREG-0170. The RADTRAN V runs were made with the gas-cooled fuel values provided in the Yucca Mountain FEIS. Specifically, the values for the high integrity high-temperature gas-cooled reactor spent nuclear fuel referred to as type 8 were used. As such, these runs provide a reasonable estimate of what the GT-MHR and PBMR results might look like. It is important to remember that the gas-cooled reactor spent fuel shipments are no different from any other spent fuel shipments in that all shipments are required to meet NRC and DOT regulations. These regulations address design and performance standards for the casks and specify radiological performance criteria for both normal transport and severe accident conditions. Compliance with these regulations is mandatory and ensures that shipments will be conducted in a manner that will ensure minimal environmental impact.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E3.8-5

E3.8-5 General question – For the light water reactor designs, what is the bounding value for (1) the number of truck shipments of irradiated fuel annually per unit, and (2) MTU of spent fuel per truck cask?

EGC RAI ID: R3-9

EGC RESPONSE:

ABWR, AP1000, IRIS, ESBWR, ACR-700

The LWR bounding value for the number of truck shipments of irradiated fuel annually is 33 (the ESBWR value) based on 1 MTU (7 assemblies) per truck cask.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E3.8-6

E3.8-6 **Section 3.8.1 (Light-Water-Cooled Reactors)** – This section states that the AP1000 is a single unit. This is contrary to other sections in the ER which state that the plant parameter envelope assumed two AP1000 units in the evaluation. For example, ER Section 3.5.1 states that two AP1000 units were used in developing the bounding radioactive liquid effluent release. Clarify why two AP1000 units weren't considered in the evaluation of transportation impacts.

EGC RAI ID: R3-10

EGC RESPONSE:
Since the analyses were normalized to a reference 1000 MWe LWR plant, it was only necessary to use a single AP1000 plant.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E3.8-7

E3.8-7 **Section 3.8.1, p. 3.8-4, top of page (Light-Water-Cooled Reactors)** - Provide justification for the statement that the Department of Energy (rather than licensees) would make the decision on transport mode.

EGC RAI ID: R3-11

EGC RESPONSE:
As part of its obligations under the Nuclear Waste Policy Act [Section 302(a)(1)] and per 10 CFR 961, DOE will take title to, transport, and dispose of nuclear fuel. Thus, DOE is responsible for determining the transport mode.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E3.8-8

E3.8-8 **Section 3.8.2.2, p. 3.8-6, last paragraph (Gas-Cooled Reactors - Analysis)** - The ER states that adjustments have been made on the basis of electrical output, but on p. 3.T-17, the note to Table 3.8-2 states that results were not adjusted. Describe all adjustments or normalizations that have been made (e.g., decay time, shipment, electrical generation, etc.).

EGC RAI ID: R3-12

EGC RESPONSE:
Table 3.8-2 was generated based on the standard configuration for each of the new reactor technologies. Section 3.8.2.2 describes the adjustment made to normalize the new designs to 880 MWe for comparison with the reference LWR. The normalization to 880 MWe was the only adjustment or normalization made.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E3.8-9

E3.8-9 **Section 3.8.2.5, p. 3.8-10, first paragraph (Risk Contributors - Contents)** - The ER states that the reference LWR used a 90-day decay time, but on p. 3.T-16, 150 days is entered for decay time prior to shipment in the Reference LWR column of Table 3.8-2. What reference LWR decay time was used for the impact evaluation? In addition, what gas-cooled reactor radionuclide inventory was used for the impact evaluation?

EGC RAI ID: R3-13

EGC RESPONSE:
As was done in the WASH-1238, Table 3.8-2 uses 150 days for the reference LWR when calculating impacts. The 90-day decay time is the minimum decay time specified in 10 CFR 51.52.

The gas-cooled reactor radionuclide inventory used was based on a five-year decay time.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E3.8-10

E3.8-10 **Section 3.8.2.5, p. 3.8-9, first paragraph (Risk Contributors - Contents)** - Justify the applicability of the depletion code used to calculate the isotopic content of spent fuel for the new reactor designs.

Explain the in-core differences between a commercial LWR and the new reactor designs and how these differences affect the performance of the depletion calculation. These differences may include: initial enrichment, fuel configuration, type of moderator, specific power, fuel temperature, moderator temperature, and the presence of soluble, burnable and integral poisons.

EGC RAI ID: R3-14

EGC RESPONSE:

ABWR, AP1000, IRIS, ESBWR, ACR-700

As discussed in Section 3.8.1, these LWR designs satisfy the 10 CFR 51.52(a) conditions for use of Table S-4 or have impacts shown by sensitivity analysis to be bounded by Table S-4. The environmental impacts of transportation of fuel and radioactive wastes are represented by the values given in 10 CFR 51.52(c), Table 4. For this reason, no further detail on the fuel characteristics for these LWRs is provided.

GT-MHR

Information on the GT-MHR is provided in Reference 1. The General Atomics (GA) methodology for computing the GT-MHR radionuclide inventories and resulting decay heat was the same as that used for the 350 MWt MHTGR submitted to the NRC in Reference 2, the MHTGR Preliminary Safety Information Document. This methodology uses a point-depletion model with 1100 nuclides including 123 heavy metal isotopes, 112 structural and impurity isotopes, and 862 fission product nuclides using cross section data from ENDF/B-V files. The model provides up to four capture parents for each nuclide, plus two (n, 2n) parents, with fractional yields for all.

The GT-MHR model includes burnout effects for all fission products. GA expects a standard deviation of approximately 4% in the decay heat calculation consistent with the ENDF/B-IV data uncertainties in ANSI/ANS-5.1 - 1979.

The NRC and Oak Ridge National Laboratory reviewed the GA methodology as part of the PSID pre-application licensing activities. The review concluded that the calculated decay heat rates were acceptable for use in conceptual design and analysis (Reference 3).

PBMR

The methodology used to generate the PBMR values is described in Reference 4 as follows.

The fission product and actinide activities have been calculated for different fuel spheres and different burn-up values. Using ORIGEN-S with 302 MW 6 pass ORIGEN-S library, the

activities were calculated for the following parameters:

PBMR Parameters

Parameter	Case 1	Case 2
Reactor Power (MW)	400	400
Burn-Up (GWD/TU)	92	133
Reactor Fuel Spheres	451,545	451,545
Full Power Days	~935	~1351
Fuel Sphere U Mass (g)	9	9
Enrichment (%)	9.6	12.9
Reactor Flux, < 0.5 ev ($n.cm^{-2}.s^{-1}$)	6.82E+13	6.35E+13

Note that the ORIGEN-S cross section library was generated with the reactor spectrum calculated for the following conditions:

Dynamic central column PBMR model

Equilibrium core based on 8.46% enriched fuel spheres and 80 GWD/TU burn-up

Therefore, this ORIGIN-S cross-section library is not directly applicable for the conditions in Cases 1 and 2, but was used for scoping purposes. The neutron flux was chosen such that the spent fuel burn-up was reached.

In core differences between new reactor designs and various LWR designs have the same effects. These differences affect the neutron spectrum and resulting actinide production and fission rates between various fissile and fertile isotopes.

REFERENCES:

1. PC-000507, GT-MHR Plant Parameter Envelope Supporting Early Site Permitting, General Atomics, April 2003, Contained in the Idaho National Engineering and Environmental Laboratory Engineering Design File 3747, May 2003 (NRC Accession Number ML040580285).

2. Preliminary Safety Information Document for the Standard Modular High Temperature Gas-Cooled Reactor, DOE-HTGR-86-024, General Atomics. February 1992.

3. NUREG-1338, Draft Pre-application Safety Evaluation Report for the Modular High-Temperature Gas-Cooled Reactor, U.S. Nuclear Regulatory Commission, March 1989.

4. Calculational Record MF100-016344-2053, "Scoping Calculation: Spent Fuel Activities After 5 Years Decay, "PBMR, 6/03/2003. Enclosure to April 13, 2004 Letter from Marilyn C. Kray, Exelon Nuclear, to Document Control Desk, U.S. Nuclear Regulatory Commission, "Submission of Requested Information" (NRC Accession Number ML041110024).

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E3.8-11

E3.8-11 **Section 3.8.2.5, p. 3.8-10, third paragraph (Risk Contributors - Contents)** - The ER provides a comparison of reference LWR actinide and gas-cooled fuel inventories that states that the actinide inventory in Ci/MTU for the gas-cooled fuel exceeds that of the reference LWR, and that the pebble bed modular reactor (PBMR) would have essentially the same MTU per cask as the reference LWR. Provide the basis for the total actinide inventory per gas-cooled fuel truck cask. Does the increased actinide inventory call for additional cask shielding relative to that needed for reference LWR fuel? If so, does the added shielding affect cask payload and the number of shipments by truck, as shown in Table 3.8-2 on p. 3.T-16?

EGC RAI ID: R3-15

EGC RESPONSE:

GT-MHR, PBMR

The basis for the actinide inventory for both gas-cooled reactors is provided in the response to RAI E3.8-10.

As stated in Section 3.8.2.5, the MTU per cask for the GT-MHR is 0.16044. This is one third of the LWR shipment capacity of 0.5 MTU per cask. Based on this comparison, the actinide inventory per shipment is about half (53 percent) for the GT-MHR versus the reference LWR and there should be no need for additional cask shielding relative to the LWR.

The PBMR information is provided in Reference 1. PBMR Ltd has advised that it has not yet evaluated shipping cask design.

REFERENCE:

1. November 29,2002 Letter from A.P. George and F. Curtolo, Pebble Bed Modular Reactor (Pty) Ltd., to Michael Cambria, Parsons Energy and Chemicals, "ESP-8: Reactor Vendor Questionnaire." Contained in the Idaho National Engineering and Environmental Laboratory Engineering Design File 3747, May 2003 (NRC Accession Number ML040580285).

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E3.8-12

E3.8-12 **Section 3.8.2.6, p. 3.3-11, second paragraph (Gas-Cooled Reactors - Discussion)** - The ER quotes NUREG/CR-6703, *Environmental Effects of Extending Fuel Burnup Above 60 Gwd/MTU* [gigawatt days/MTU], (p. 3), regarding actinide dose contribution; however, the quoted text relates to pressurized water reactor (PWR) fuels burned in the presence of burnable poison rod assemblies. Describe the relevance of this information to the type of gas-cooled reactor spent fuel shipments contemplated in the ER.

EGC RAI ID: R3-16

EGC RESPONSE:
The information from NUREG/CR-6073 was intended to clarify that the issue that needs to be evaluated is the cask isotopic inventory and not how the fuel was used in the reactor. What is important for the transportation evaluation is the identity of the radionuclides and their respective quantities.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E3.8-13

E3.8-13 **Section 3.8.2.6, p. 3.8-12, second paragraph (Gas-Cooled Reactors - Discussion)** - For each gas cooled reactor technology proposed, demonstrate/quantify how the increased actinide activity in the fuel impacts neutron dose.

EGC RAI ID: R3-17

EGC RESPONSE:
The second paragraph of Section 3.8.2.6 discusses the increased actinide activity and corresponding requirement for increased neutron shielding. It also quotes NUREG/CR-6703, "because neutrons are effectively attenuated by low density materials such as plastics and water, it is believed that minor modifications can be made to the shipping casks to allow them to transport the higher burn-up fuel at full load."

The neutron dose from gas cooled reactor spent fuel, which is not quantifiable at this point in time, is dependant not only on the source term (cask loading) but also the cask design (i.e., specific neutron shielding characteristics of the new cask). At this time, since the cask has not been designed, quantification of the neutron dose is not possible. The casks would be certified by the NRC prior to use and would meet applicable Department of Transportation (DOT) regulations.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E3.8-14

E3.8-14 **Section 3.8.2.6, p. 3.8-12, second paragraph (Gas-Cooled Reactors - Discussion)** - Justify the representation that only minor modifications to the amount of neutron shielding on the transportation packages will allow them to be used for fuel with a significantly higher neutron source term.

Address the effect of additional neutron shielding on other design aspects of the package performance such as the ability to reject the thermal heat load, the method for attaching the shielding, and the size of the impact limiter which affects the package's performance during a drop accident. Address the effect of additional shielding on package diameter, impact limiter size, rail or truck bed width, package weight, cask capacity, and number of shipments needed.

Address how the neutron source term for gas-cooled reactor fuel will be distributed when the fuel is shipped, and how that distribution might affect the shielding design of the transportation cask.

EGC RAI ID: R3-18

EGC RESPONSE:
The justification for only minor modifications arises from statements made in NUREG/CR-6073, which are captured in Section 3.8.2.6 and are as follows:

"From NUREG/CR-6073, "Environmental Effects of Extending Fuel Burn-up Above 60 GWd/MTU," we learn that 'none of the actinides contributes more than one percent of the external dose from an iron transport cask, and as a group, the actinides do not contribute significantly to the dose from transportation accidents. In fact, increasing the activities of Pu-238, Pu-239, Pu-240, Am-241, Cm-242, and Cm-244 by more than a factor of 1000 only increased the cumulative dose for a transportation accident during shipment of 43 GWd/MTU spent fuel from the northeast to Clark County, NV from 0.0358 to 0.0359 person-mSv/shipment (3.58E-03 to 3.59E-03 person-rem/shipment)."

"NUREG/CR-6073 states, "because neutrons are effectively attenuated by low-density materials such as plastics and water, it is believed that minor modifications can be made to shipping casks to allow them to transport the higher burn-up fuel at full load."

As discussed in the response to RAI E3.8-11, the actinide inventory per shipment will be less for the GT-MHR, and essentially the same for the PBMR, as compared to the reference LWR.

Details of the final cask design for the PBMR fuel are not currently available.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E4.3-1

E4.3-1 **Section 4.3.1 (Impacts to Terrestrial Ecosystems from Construction)** - Provide an estimate of the total number of acres that would be disturbed by construction of the EGC ESP facilities and laydown yards, etc., including an estimate of the number of acres that would be permanently lost (displaced by structures) and that would be temporarily lost (e.g., laydown yards). Provide an estimate of the number of acres of each habitat type that would be disturbed, including an estimate of the number of acres of each habitat type that would be permanently lost (displaced by structures) and that would be temporarily lost (e.g., laydown yards).[1]

[1]Alternatively, provide electronic versions of aerial photos that display the habitats on the EGC ESP Site and a GIS layer of polygons representing EGC ESP facilities and laydown yards, etc., that can be superimposed on the aerial photos to derive the above estimates.

EGC RAI ID: R3-19

EGC RESPONSE:
The EGC ESP Facility will reuse approximately 93 ac of this previously disturbed or developed land. The footprint for the facility and the adjacent staging and laydown areas are mainly comprised of disturbed areas (impervious surfaces, crushed stone, and existing pavement and structures). Within the site boundary, 100% (461 ac) has been graded or otherwise developed for operation of the existing nuclear power plant.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
Revise ER Chapter 4, Section 4.3.1.2, first paragraph, to read as follows:

Staging, laydown, and construction of the EGC ESP Facility will occur adjacent to the CPS. The footprint for the facility, and the adjacent staging and laydown areas is mainly comprised of disturbed areas (impervious surfaces, crushed stone, and existing pavement and structures). Within the site boundary, 100 percent (461 ac) has been graded or otherwise developed for operation of the existing nuclear power plant. The EGC ESP Facility will reuse 93 ac of this previously disturbed or developed land.

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E4.3-2

E4.3-2 **Section 4.3.1 (Impacts to Terrestrial Ecosystems from Construction)** - The additional transmission lines that could be required for the EGC ESP facility apparently would use existing rights-of-way (ROWS) (ER Section 3.7.2 and 4.3.1.2). The current ROWS are both 250 feet wide (ER Section 2.2.2). The new lines would require ROWs 250 feet wide (ER Section 3.7.2). However, evidently there would be a need to widen the ROWs into forest habitat (ER Section 4.3.1.2) and construction would occur "along" existing ROWs (ER Section 4.3.1.4.2.4). The amount of disturbance would depend on the construction practices used (ER Section 4.3.1.4.2.4). Provide greater detail on transmission line impacts that would result from construction of the EGC ESP facility, i.e., where along the existing lines disturbance due to ROW widening would occur and how many acres of what habitats would be affected, etc. (See ESRP Section 4.3.1).

EGC RAI ID: R3-20

EGC RESPONSE:
The existing transmission and distribution system is owned and operated by Illinois Power and any construction or modification to existing ROWs will be the responsibility of Illinois Power. Impacts to habitats resulting from transmission line construction can be minimized by the use of approved erosion and sediment control measures to prevent transport of silts and sediments from the area of disturbance, topsoil stripping to avoid mixing and compaction of soils, special construction techniques in wetlands or other sensitive areas, and post-construction restoration measures approved by applicable local, state, and federal agencies. Additionally, impacts to natural resources can be avoided and/or minimized as a result of the proposed corridor being co-located within or adjacent to existing rights-of-way that are approximately 88% agricultural lands.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
Revise ER Chapter 4, Section 4.3.1.2 to add the following as a new third paragraph:

Impacts to habitats resulting from transmission line construction can be minimized by the use of approved erosion and sediment control measures to prevent transport of silts and sediments from the area of disturbance, topsoil stripping to avoid mixing and compaction of soils, special construction techniques in wetlands or other sensitive areas, and post-construction restoration measures approved by applicable local, state, and federal agencies. Additionally, impacts to natural resources can be avoided and/or minimized as a result of the proposed corridor being co-located within or adjacent to existing rights-of-way that are approximately 88% agricultural lands.

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E4.4-1

E4.4-1 **Section 2.5.2.7 (Public Services and Facilities), Section 4.4.2.7 (Public Services and Facilities), and Section 5.8.2.7 (Public Services and Facilities)** - The ER indicates there was a survey completed of "...water and water facilities in the region, and the facilities have excess capacity to accommodate a potential increase in the population in the region" – p. 2.5-9. Later in Chapters 4.0 and 5.0, the survey is referenced again (pages 4.4-4 and 5.8-5). The survey is not cited in the reference section. Provide a copy of the survey or the source of the data.

EGC RAI ID: R3-21

EGC RESPONSE:
The survey source data and a summary of the data compilation are provided as Attachments to this response on the enclosed CD-ROM. The reference is not cited since this was a survey done specifically for the EGC ESP Application. The survey was performed using publicly available information.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
E4.4-1 Att A - Waste Water Available
E4.4-1 Att B - Capacity Waste Water Supply

NRC Letter Dated: 05/11/2004

NRC RAI No. E4.4-2

E4.4-2 **Section 4.4.2 (Social and Economic Impacts)** - The ER states that EGC is planning to hire 3150 construction personnel to build what appears to be multiple units. Dominion's ESP ER for North Anna indicates they plan to hire 5000 construction workers to build two units. EGC also states, "Experience from the construction of the CPS indicates that a significant number of the construction workforce came from other areas; however, the construction workforce was at least three times larger than what is anticipated for the EGC ESP Facility (p. 4.4-2)." Provide further information on how EGC arrived at the 3150 construction workforce.

EGC RAI ID: R3-22

EGC RESPONSE:
The number of construction workers was obtained from the SSAR (Table 1.4-1 Plant Parameters Envelope). The number represents the maximum projected number of construction workers. It is based on input received from various vendors to perform the construction work. The specific value of 3150 is derived from vendor provided information for the construction of a single ABWR, not for multiple units.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E4.5-1

E4.5-1 In Section 4.5.3.2 of the EGC ESP application, Exelon states that "area TLD measurements during the third quarter of 2002 at the CPS protected area fenceline varied between 0.005 and 0.050 mrem/hr with an average fenceline dose rate of approximately 0.021 mrem/hr." Exelon used this value of 0.021 mrem/hr to derive the annual estimated dose per individual construction worker of less than 0.045 rem. As a result of discussions during the March 2004 site audit, Exelon stated that they were going to revise the method used to calculate the estimated annual construction worker dose. Exelon proposed to base this revised dose on the average of all of the fenceline TLD data for the time period between the second quarter 2001 through the first quarter 2003 (eight quarters of data). The data from all 16 fenceline TLDs would be included in this data.

When modifying Section 4.5 of the ESP application to include this revised data, Exelon should provide the following:

a. A table listing the quarterly TLD readings (net dose in mrem) for each of the 16 protected area fenceline TLDs for each of the calender quarters between the second quarter 2001 through the first quarter 2003 (eight quarters of data). This table should provide the average plant capacity factor for each of these eight quarters.

b. A figure of the plant and protected area indicating the locations of the 16 fenceline TLD locations.

c. The revised (based on the eight quarters of dose data) estimated annual dose to an individual construction worker of approximately 0.025 rem.

d. A discussion of why the eight quarters of TLD data used is considered to be bounding data for calculating the estimated annual dose to a construction worker.

EGC RAI ID: R3-23

EGC RESPONSE:
Section 4.5.3.2 will be revised and the requested information included (see response to RAI No. E1.0-1 [4]). Note, however, there are only 11 protected area fence line TLDs for the CPS plant area.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
See response to RAI No. E1.0-1 [4].

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E5.2-1

E5.2-1 **Section 5.2.1.2.2 (Droughts)** - Provide model (with documentation and inputs) that was used to perform the drawdown analysis discussed in ER Section 5.2.1.2.2.

EGC RAI ID: R3-24

EGC RESPONSE:
The model (documentation and inputs) for the drawdown analysis during drought conditions are provided as Attachments to this response on the enclosed CD-ROM. The documentation includes two memorandums and the spreadsheet model. The first memorandum (NRC RAI E5.2-1&2 Att A – Lake Drought Model Description) describes the model in general terms. It has recently been revised to describe in greater detail the forced evaporation values used for the existing CPS. The second memorandum (NRC RAI E5.2-1&2 Att B – Lake Drought Analysis Description) is a column by column description of the model elements. The drought model (NRC RAI E5.2–1&2 Att C – Lake Drought Analysis Model) is a spreadsheet model of the Clinton Lake drought scenarios described in the USAR. Model runs for both the 50-year and 100-year droughts with the following plant configurations are provided in separate worksheets within the file:

1) Two 992 MW Plants (the original planned plant configuration)

2) Existing Plant Uprated (One 992 MW Plant Uprated to 1138 MW, i.e., the current operating CPS plant)

3) Max Additional Loss (The current CPS Plant plus a hypothetical plant that will draw the lake down to the minimum lake operating level of 677.0 feet or minimum volume of 23,700 ac-ft)

Also included in the spreadsheet model file (NRC RAI E5.2–1&2 Att C – Lake Drought Analysis Model) is a worksheet describing the lake stage storage and stage area relationships that are referred to in each of the drought analysis worksheets.

Table 5.2-3, Lake Water Available for Use During Drought Events, will be revised based on the refinements to the drought analysis.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
Revise ER Chapter 5, Section 5.2.1.1.1 to add the following after the last paragraph:

A 24-year Period of Record model was developed to determine any change in the duration of stream low flows with addition of the ESP facility. The Period of Record model was run for the 24-year period of local hydrologic record from June 1, 1978 to April 31, 2002 for three scenarios; 1) with the current 1138.5 MW CPS plant operating at 100 percent power, 2) with the current CPS and new ESP with wet/dry cooling, and 3) with the current CPS and new ESP with wet cooling. The hydrologic conditions reflect monitored average daily values from recording stations near the plant. Plant operating conditions for the three scenarios were imposed over the total 24-year period of record.

Note that the simulated number of days at low flow do not represent actual watershed conditions. The model simply imposed the described operating conditions over a known period of

meteorological record. There are certain CPS plant operating factors and hydrologic factors that are not considered in the model such as variability in plant operation power, and lag time associated with delivery of water from the watershed to the point of discharge. The model assumes that the plant is operating at 100 percent power and that water as precipitation is immediately delivered to the lake. In real terms the plant output varies below 100 percent and runoff delivery would be delayed by seasonal and watershed conditions such as infiltration and inter-flow or precipitation as snow and runoff as snowmelt. For these reasons the model is expected to overestimate the number of days at minimum lake discharge. When compared to the base case, the increase in the number of days at minimum discharge are expected to be more representative of actual conditions.

The results of the model simulation are presented in Table 5.2-5. The yearly average number of days at low flow for the CPS plant only, is estimated to be 76 days per year. With a new ESP facility and wet/dry cooling the average number of days at low flow increases by 35 days per year. With a new ESP and wet cooling the average number of days at low flow increases by 114 days per year. The monthly distribution of days at low flow range from 0 days in April to 27 days in October for wet/dry cooling and 2 days in April to 31 days in October for wet cooling. The average number of days at low flow for the CPS plant only, is estimated to be 76 days per year. With a new ESP facility and wet/dry cooling the average number of days at low flow increases by 35 days per year. With a new ESP and wet cooling the average number of days at low flow increases by 114 days per year. The monthly distribution of days at low flow range from 0.5 days in April to 26.8 days in October for wet/dry cooling and 2.1 days in April to 31 days in October for wet cooling.

Add new Section 5.2.1.2.4, Lake Levels:

5.2.1.2.4 Lake Levels

A 24-year Period of Record model was developed to determine any change in lake levels with addition of the ESP facility. The Period of Record model was run for athe 24 year period of local hydrologic record from June 1, 1978 to April 31, 2002 for three scenarios; 1.) with the current 1138.5 MW CPS plant operating at 100 percent power, 2.) with the current CPS and new ESP with wet/dry cooling, and 3.) with the current CPS and new ESP with wet cooling. The hydrologic conditions for this period of record reflected monitored average daily values from recording stations near the plant. Plant operating conditions for the three scenarios were imposed over the total 24-year period of record.

Note that there are certain model limitations noted in Section 5.2.1.1.1 that limit the use of the daily values simulated. The comparison of changes over the modeled base case are however considered representative of actual conditions.

The results of the model simulation are presented in Table 5.2-6. The average water surface elevation of Clinton Lake with the CPS plant only, is estimated to be 690.4-feet. With a new ESP facility and wet/dry cooling the average annual lake level is reduced by 0.2-feet to 690.2-feet. With a new ESP and wet cooling the average lake level is reduced by 0.7-feet to 689.7-feet. The monthly distribution of reduced lake levels range from 0.0-feet in March, April, May and June to 0.4-feet in October and November for the Wet/dry cooling and from 0.1-feet in April and May to 1.9-feet in November for wet cooling.

Revise Table 5.2-3 to read as follows:

TABLE 5.2-3, Lake Water Available for Use During Drought Events

Water Use	50-year Drought Event	100-year Drought Event
Total Water Available for Withdrawal	23,400 gpm	17,800 gpm
Water Consumed by Existing Uprated Plant	8,300 gpm	8,300 gpm
Water Available for ESP Use	15,100 gpm	9,500 gpm

Add new Table 5.2-5:

Table 5.2-5, Average Number of Days at Low Flow Discharge (5 cfs) from Clinton Lake During 24-year Period of Record

Month	CPS Plant	CPS with ESP and Wet/Dry Cooling	CPS with ESP and Wet Cooling
January	2	6	21
February	2	4	12
March	0	1	3
April	0	1	2
May	1	2	5
June	3	4	9
July	7	10	15
August	8	11	18
September	18	22	27
October	23	27	31
November	9	17	27
December	2	6	19
Annual Average	76	111	190

Note: Values are established based on a 24-year period of local hydrologic record from June of 1978 to April of 2002. The Period of Record model does not simulate actual operating conditions but rather continuous operation of the designated plants over the total period of record. This allows determination of relative differences or expected change in the duration of low flow discharge.

Add new Table 5.2-6:

Table 5.2-6, Average Water Surface Elevation of Clinton Lake During 24-year Period of Record

Month	CPS Plant (Elev. in feet)	CPS with ESP and Wet/Dry Cooling (Elev. in feet)	CPS with ESP and Wet/Dry Cooling (Change in Elev. in feet)	CPS with ESP and Wet Cooling (Elev. in feet)	CPS with ESP and Wet Cooling (Change in Elev. in feet)
January	690.3	690.2	-0.1	689.4	-0.9
February	690.5	690.5	-0.1	690.0	-0.5
March	690.9	690.8	0.0	690.7	-0.2
April	690.8	690.7	0.0	690.7	-0.1
May	690.7	690.7	0.0	690.6	-0.1
June	690.5	690.5	0.0	690.3	-0.2
July	690.3	690.2	-0.1	690.0	-0.3
August	690.2	690.1	-0.1	689.8	-0.5
September	689.9	689.7	-0.2	689.1	-0.8
October	689.8	689.4	-0.4	688.2	-1.6
November	690.1	689.8	-0.4	688.3	-1.9
December	690.4	690.3	-0.2	689.1	-1.3
Annual Average	690.4	690.2	-0.1	689.7	-0.7

Note: Values are established based on a 24-year period of local hydrologic record from June of 1978 to April of 2002. The Period of Record model does not simulate actual operating conditions but rather continuous operation of the designated plants over the total period of record. This allows determination of relative differences or expected change.

ATTACHMENTS:
E5.2-1&-2 Att A – Lake Drought Model Description
E5.2-1&-2 Att B – Lake Drought Analysis Description
E5.2-1&-2 Att C – Lake Drought Analysis Model

NRC Letter Dated: 05/11/2004

NRC RAI No. E5.2-2

E5.2-2 **General** - Quantify seasonal variability, if any, in consumptive losses of water from the wet cooling tower.

EGC RAI ID: R3-25

EGC RESPONSE:
The cooling tower water consumption is determined by the amount of water that is evaporated to remove the heat rejected by the plant. The water consumption values used for the ESP cooling process conservatively assume that evaporation is the only heat removal mechanism involved. There are other small non-evaporative and non-consumptive heat removal processes that are influenced by seasonal conditions such as the heating of outside air as it passes through the cooling tower. These other processes combined represent a small fraction of the total heat removed. Therefore, seasonal variations in consumptive loss are conservatively assumed to be zero for this analysis.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E5.2-3

E5.2-3 **Section 5.2.1.2.3 (Temperature and Water Quality)** - Provide model (with documentation and inputs) that was used to perform the lake temperatures analysis described in ER Section 5.2.1.2.3.

EGC RAI ID: R3-26

EGC RESPONSE:
The model documentation and inputs are provided as Attachment to this response on the enclosed CD-ROM. Section 5.2.1.2.3, Temperature and Water Quality, has been rewritten to reflect a "Period of Record" lake level model that was used to predict lake level reduction due to operation of the new ESP facility with various cooling options. Note that new Table 5.2-6 is provided in the response to RAI No. E5.2-1.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
Replace ER Chapter 5, Section 5.2.1.2.3, Temperature and Water Quality, with the following:

The CPS NPDES permit allows a cooling water discharge of 670,000 gpm at a temperature that does not exceed 99 degrees F during 90 days in a fixed calendar year and 110.7 degrees F for any given day. The CPS discharges a summer volume of 566,000 gpm and a winter volume of 445,000 gpm, both at 99 degrees F, leaving considerable discharge capacity (104,000 gpm in summer and 225,000 gpm in winter) under the permit for the CPS. The estimates of discharge requirements for the EGC ESP Facility using the wet and wet/dry cooling tower methods and dry cooling methods are presented in Table 5.2-4. The wet cooling tower method has a maximum water discharge value of 49,000 gpm and normal discharge value of 12,000 gpm.

The wet/dry cooling towers have a reduced discharge flow of up to 70 percent of the wet cooling method or in the range of 14,700 to 3,600 gpm. There is no discharge required from the dry cooling method. The added ESP water discharge values for any of the cooling methods combined with the CPS discharge is well within the available capacity of 670,000 gpm established under the CPS NPDES permit.

If the dry cooling option is selected for the new EGC ESP facility there would be no change in lake temperature with continued operation of the current CPS along with a new EGC ESP Facility. Lake temperature increases are expected with wet/dry or wet cooling options for the new EGC ESP facility. The increases will result from new consumptive loss of water in the cooling process. A maximum of 16.000 gpm and 31,500 gpm of cooling lake water are expected to be consumed (evaporated) by the wet/dry and dry cooling processes respectively. This water is withdrawn and not returned to the cooling lake. The result is lower average lake levels.

A Period of Record Model was completed to determine the extent of lake level changes. The results are described in Table 5.2-6. Average lake level reductions range from a low of 0.03-feet in March and April to a high of 0.35-feet in October for the wet/dry cooling process and 0.12-feet in April and 1.68-feet in November for wet cooling process. These lower lake levels will result in reduced lake surface area and lake volume. Both factors can contribute to increased lake

temperatures. Surface area and volume reductions associated with proposed ESP plant operations with wet/dry and wet cooling are shown on Tables 5.2-7 and 5.2-8.

In 1989, J.E. Edinger Associates Inc., studied lake temperature changes in Clinton Lake with changing lake levels. A three dimensional hydrothermal model of the lake was developed and calibrated with lake temperatures measured during the summer of 1988. The model considered lake surface area and volume as well as many other hydrologic and meteorological conditions to predict temperatures throughout the lake. The calibrated model established excess temperatures for two lake levels, the normal lake level at Elevation 690.0 and a low lake level at elevation 686.5. A sensitivity analysis was performed to establish temperature changes that result from small changes in the plant load, the open lake cooling pumping rate, and lake water surface elevations. These sensitivity values are presented in Section 6.0 of the Edinger Report. The current CPS plant load and cooling pumping rate are not expected to change with the new ESP facility. The lake water surface elevation is expected to decrease with the new ESP facility. Temperature changes associated with this decrease can be calculated using the Edinger values established in the sensitivity analysis. Changes in mixing zone temperatures (point of discharge into model Segment 16) associated with changes in lake water surface elevation are presented in Table 5.2-9. The mixing zone is the point of discharge where temperature changes will be the most significant. Average lake temperature increases range from a low of 0.0 degrees F to a high of 0.2 degrees F in October and November for the wet/dry cooling process and 0.0 degrees F in April and May to 0.8 degrees F in November for wet cooling process. Temperature changes at other locations downstream in the cooling loop will be progressively less and approach zero at the plant intake (model Segment 5).

There will be a minor discharge of water from the wet/dry or wet cooling process for tower blowdown. Tower blowdown discharge rates range from 3,600 gpm for wet/dry cooling to 12,000 gpm for the wet cooling. Blowdown water temperatures are variable depending on ambient conditions but will be significantly less than the allowable 99 degrees F permitted limit. Because the blowdown discharge rates are relatively small (1 to 3 percent of existing CPS discharge) and the blowdown water temperatures are low, the lake temperature increases due to boiler blowdown are expected to be negligible.

Review of lake water quality monitoring data between 1987 and 1991 indicates that, with the exception of the temperature and dissolved oxygen, the quality of lake water near the CPS intake structure is similar to water near the discharge flume. A comparison of intake and discharge water quality is presented in Table 2.3-19. The comparison is made by reviewing data recorded at lake monitoring Site 4 (see Figure 2.3-25), near the plant intake and lake monitoring Site 2, near the plant discharge flume. Both sites are representative of the intake and discharge water, but are also influenced by other lake conditions and flow patterns in the vicinity. These locations were used because direct monitoring data of the plant intake and discharge water is not available.

Review of the temperature data indicates that average lake temperatures increase from upstream (19.3 degrees C or 66.7 degrees F) to downstream (24.6 degrees C or 76.3 degrees F) of the CPS. Dissolved oxygen decreased from 9.3 mg/L to 8.1 mg/L, as would be expected with an increase in temperature. There appears to be only slight changes in other constituents presented including turbidity, hardness, TDS, magnesium, chloride, orthophosphate, and sulfate.

Other constituents such as hardness and TDS may increase as a result of evaporation if the wet or wet/dry cooling method is selected. For example, the TDS intake water concentration at Site 4 measured in the range of 275 mg/L. Discharge concentrations of TDS from the EGC ESP Facility (see SSAR Table 1.4-2) are estimated to be 17,000 mg/L. The combined discharge will be in the range of 380 mg/L (based on 3,600 gpm) to 620 mg/L (based on 12,000 gpm) of TDS. The

discharge will be diluted by lower dissolved solids in the lake and in the base flows from Salt Creek and North Fork of Salt Creek. Dissolved solids will also be passed downstream through the dam. Over time, a rise in ambient lake dissolved solids concentration is expected to a level of equilibrium higher than the ambient level. Further discussion of dissolved solids concentration is included in Section 5.3.

Add new Tables 5.2-7, 5.2-8, and 5.2-9:

Table 5.2-7, Water Elevation - Surface Area Relationship for Clinton Lake

Water Surface Elevation	Surface Area (Acres)
670	1,600
672	1,900
674	2,100
676	2,400
678	2,700
680	3,100
682	3,550
684	3,930
686	4,250
688	4,520
690 (Normal Pool Elevation)	4,895

Source: Illinois Power. Clinton Power Station Updated Safety Analysis Report. Revision 9. January 2001.

Table 5.2-8, Water Elevation - Volume Relationship for Clinton Lake

Water Surface Elevation	Volume (Acre-feet)
670	10,500
672	14,500
674	18,000
676	23,000
678	28,000
680	33,900
682	40,600
684	48,000
686	56,000
688	64,800
690 (Normal Pool Elevation)	74,200

Source: Illinois Power. Clinton Power Station Updated Safety Analysis Report. Revision 9. January 2001.

Table 5.2-9, Projected Temperature Changes Due to the Proposed ESP

			Edinger Temp Change per Foot of Lake Level			
			0.24	Deg C/ft	0.43	Deg F/ft
Month	Lake Level Change (ft)		Temperature Change (Deg C)		Temperature Change (Deg F)	
	Wet/dry	Wet	Wet/dry	Wet	Wet/dry	Wet
January	-0.1	-0.9	0.0	-0.2	0.0	-0.4
February	-0.1	-0.5	0.0	-0.1	0.0	-0.2
March	0.0	-0.2	0.0	0.0	0.0	-0.1
April	0.0	-0.1	0.0	0.0	0.0	0.0
May	0.0	-0.1	0.0	0.0	0.0	0.0
June	0.0	-0.2	0.0	0.0	0.0	-0.1
July	-0.1	-0.3	0.0	-0.1	0.0	-0.1
August	-0.1	-0.5	0.0	-0.1	0.0	-0.2
September	-0.2	-0.8	0.0	-0.2	-0.1	-0.3
October	-0.4	-1.6	-0.1	-0.4	-0.2	-0.7
November	-0.4	-1.9	-0.1	-0.5	-0.2	-0.8
December	-0.2	-1.3	0.0	-0.3	-0.1	-0.6
Annual Average	-0.1	-0.7	0.0	-0.2	-0.1	-0.3

Source: J. E. Edinger Associates Inc. Probabilistic Hydrothermal Modeling Study of Clinton Lake, February 1989, Document No 89-15-R

ATTACHMENTS:
E5.2-3 Att D Lake Period of Record Analysis
E5.2-3 Att E1 - Existing_Plant-USAR_PeriodofRecordAnalysis
E5.2-3 Att E2 - Existing_Plant-USAR-New_Plant-Wet-Dry-PeriodofRecordAnalysis
E5.2-3 Att E3 - Existing_Plant-USAR-New_Plant-Wet-PeriodofRecordAnalysis
E5.2-3 Att E4 - Source-info-PeriodofRecordAnalysis-DAILY

NRC Letter Dated: 05/11/2004

NRC RAI No. E5.2-4

E5.2-4 **Section 5.2.1.2.3 (Temperature and Water Quality)** - Explain why the reduction in lake volume due to the wet cooling tower does not make the conclusion stated in ER Section 5.2.1.2.3 ('the increase in lake temperature would be 8% or less') nonconservative.

EGC RAI ID: R3-27

EGC RESPONSE:
Section 5.2.1.2.3, Temperature and Water Quality, will be revised to reflect a "Period of Record" lake level model that was used to predict lake level reduction due to operation of the new ESP facility with various cooling options. The quoted text is no longer in the referenced document.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
This section will be deleted and replaced with text shown in the response to RAI No. E5.2-3.

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E5.2-5

E5.2-5 **General** - Provide wetlands delineations and jurisdictional determinations from the US Corps of Engineers for all lands that may be impacted directly or indirectly by the plant construction or operation.

EGC RAI ID: R3-28

EGC RESPONSE:
Based on reviews of USGS Maps, NWI Maps, Aerial Photography, and GIS Databases, in addition to the site assessment for natural resources discussed in the ER, no USCOE jurisdictional wetlands are anticipated to be impacted directly or indirectly by plant construction. Coordination with the USCOE will occur, if required, prior to commencement of construction activities to confirm the absence of USCOE jurisdictional wetlands in the project area.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E5.3-1

E5.3-1 **Section 5.3.4.1, p. 5.3-11 (Thermophilic Organisms)** - Provide the basis on which the following statement was made - "The increase in heat rejected to the lake due to the uprate would be greater than the increase due to the EGC ESP Facility; therefore, the EGC ESP Facility logically would not increase the risk significantly."

EGC RAI ID: R3-29

EGC RESPONSE:
The potential increases in temperature within the mixing zone due to the EGC ESP Facility are discussed in the newly revised Section 5.2.1.2.3 (see the response to RAI No. E5.2-3). The increase in the average annual lake temperature within the mixing zone for wet cooling process was estimated to be 0.3 degrees F. This relatively small change in temperature would not increase the risk significantly.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
Revise ER, Chapter 5, Section 5.3.4.1, page 5.3-11 from:

The EGC Facility will maintain discharges to the lake below the NPDS permit maximum 90-day average limit of 99 degrees F.

to read:

The potential increases in temperature within the mixing zone due to the EGC ESP Facility are discussed in Section 5.2.1.2.3. The increase in the average annual lake temperature within the mixing zone for wet cooling process was estimated to be 0.3 degrees F. This relatively small change in temperature would not increase the risk significantly.

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E5.4-1

E5.4-1 **Section 5.4.2, p. 5.4-3 (Radiation Doses to Members of the Public)** – ESRP Section 5.4.2 identifies the need for information on occupational radiation dose estimates. Provide occupational dose estimates for the plant parameter envelope reactor designs.

EGC RAI ID: R3-30

EGC RESPONSE:
A new Section 5.4.5, Occupational Radiation Exposure, is added to Section 5.4 to address exposures to occupational workers from EGC facility operations.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
Revise ER, Chapter5, to add new Section 5.4.5, Occupational Radiation Exposures, as follows:

This section provides a discussion of the anticipated occupational radiation exposure to EGC ESP Facility operating personnel. Estimates of these radiation doses are intended to provide a quantitative basis for the regulatory assessment of the potential risks and health impact to operating personnel.

Similar to current plant designs, occupational exposure from the operation of advanced reactor designs will continue to result from exposure to direct radiation from contained sources of radioactivity and from the small amounts of airborne sources typically resulting from equipment leakages. Past experience demonstrates that for commercial nuclear power reactors the dose to operating personnel from airborne activity is not a significant contributor to the total occupational dose. This experience is expected to continue to apply to the EGC ESP Facility.

As indicated in NUREG-1437 (USNRC, 1996) for the purpose of assessing radiological impacts to workers, the Commission has concluded that impacts are of small significance if doses and releases do not exceed permissible levels in the Commission's regulations. The standards for acceptable dose limits are given in 10 CFR Part 20. For any reactor concept selected for deployment at the ESP site, the radiation exposures to operating personnel will be maintained within the limits of 10 CFR 20 and will also satisfy the as low as reasonably achievable (ALARA) guidance contained in Standard Review Plan Chapter 12.1 (USNRC, 1996a) and Regulatory Guide 8.8 (USNRC, 1978a).

Administrative programs and procedures governing Radiation Protection and Health Physics in conjunction with the radiation protection design features of the EGC ESP Facility will be developed with the intent to maintain occupational radiation exposures ALARA. The advanced light water reactor designs being considered have or will incorporate radiation protection features that go beyond the designs provided for plants currently in operation. In addition, gas-cooled reactor design basis source terms and expected operating characteristics exhibit lower radiation levels during normal operation and for abnormal operating occurrences. Consequently for environmental impact assessment purposes, it is reasonable to expect and conclude that the annual operator exposures for the EGC ESP Facility will be bounded by the operating experience exhibited by

existing operating light water reactors (LWR).

The average annual collective occupational dose information for LWR plants operating in the United States between 1973 and 2002 is given in Table 5.4-21 based on data provided in NUREG-0713 (USNRC, 2003). The more recent dose data presented in this report is based on 35 operating BWRs and 69 PWRs. The data shows that historically (since 1974) the average collective dose and average number of workers per BWR type plant have been higher than those for PWRs and that the values for both parameters, in general, continued to rise until 1983. Thereafter (data through 2002) the average collective dose per LWR dropped by 84%. The overall decreasing trend in average reactor collective doses since 1983 is indicative of successful implementation of ALARA dose reduction measures at commercial power reactor facilities.

The variation in annual collective dose at operating reactors results from a number of factors such as the amount of required maintenance, the amount of reactor operations and required in-plant surveillances. These factors have varied in the past but are expected to improve with the advance designs concepts under consideration for the EGC ESP Facility.

The 3-year average collective dose per reactor is one of the metrics that the NRC uses in the Reactor Oversight Program to evaluate the effectiveness of a licensee's ALARA program. Tables 5.4-22 and 5.4-23 show the BWR and PWR commercial reactor sites in operation for at least 3 years as of December 31, 2002 and detail the occupational exposure statistics. As shown in Table 5.4-22 the BWR average annual collective total effective dose equivalent (TEDE) per reactor, average measurable TEDE per worker, and average collective TEDE per MW-yr are 162 person-rem, 0.19 rem, and 0.20 person-rem per MW-yr, respectively. Similarly as presented in Table 5.4-23, the PWR average annual collective TEDE per reactor, average measurable TEDE per worker, and average collective TEDE per MW-yr are 91 person-rem, 0.15 rem, and 0.11 person-rem per MW-yr, respectively.

Using this metric and the distribution of occupational exposures, a conservative estimate for the EGC ESP Facility is expected to be less than the recent BWR average collective TEDE dose per reactor of 162 person-rem but could average during any particular 3 year averaging period as much as 2 to 3 times this value over the life of the facility. The average annual dose of about 0.2 rem per nuclear plant worker at operating BWRs and PWRs is well within the limits of 10 CFR 20. These exposures are considered to be of small significance and pose a risk that is comparable to the risks associated with other industrial occupations.

Add the following new references to the Section 5.4 Reference List

U.S. Nuclear Regulatory Commission (USNRC). *Generic Environmental Impact Statement for License Renewal of Nuclear Plants.* NUREG-1437. Vol. 1. Office of Nuclear Regulatory Research. May 1996.

U.S. Nuclear Regulatory Commission (USNRC). *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants.* Chapter 12.1 Assuring that Occupational Radiation Exposures are ALARA. NUREG-0800. Office of Nuclear Reactor Regulation. Draft Revision 3. April 1996a.

U.S. Nuclear Regulatory Commission (USNRC). Regulatory Guide 8.8. *Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable.* ML003739549. Revision 3. June 1978

U.S. Nuclear Regulatory Commission (USNRC). *Occupational Radiation Exposure at Commercial Nuclear Power Reactors and other Facilities 2002.* NUREG-0713. Vol. 24. Thirty-Fifth Annual Report. Office of Nuclear Regulatory Research. October 2003.

Add new Table 5.4-21:

Table 5.4-21, Summary of Information Reported by Commercial Light Water Reactors (1973 – 2002)

Year	Number of Reactors Included*	Annual Collective Dose (person-rem)	No. of Workers With Measurable Dose**	Electricity Generated (MW-yrs)	Average Measurable Dose Per Worker (rem)	Average Collective Dose Per Reactor (person – rem)	Average No. Personnel With Measurable Doses Per Reactor**
1973	24	13,962	14,780	7,164.1	0.95	582	616
1974	33	13,650	18,139	10,590.9	0.75	414	550
1975	44	20,901	28,234	17,768.9	0.74	475	642
1976	52	26,105	34,515	21,462.9	0.76	502	664
1977	57	32,521	42,393	26,448.3	0.77	571	744
1978	64	31,785	46,081	31,696.5	0.69	497	720
1979	67	39,908	64,253	29,926.0	0.62	596	959
1980	68	53,739	80,457	29,157.5	0.67	790	1,183
1981	70	54,163	82,224	31,452.9	0.66	774	1,175
1982	74	52,201	84,467	32,755.2	0.62	705	1,141
1983	75	56,484	85,751	32,925.6	0.66	753	1,143
1984	78	55,251	98,309	36,497.6	0.56	708	1,260
1985	82	43,048	92,968	41,754.7	0.46	525	1,134
1986	90	42,386	100,997	45,695.1	0.42	471	1,122
1987	96	40,406	104,403	52,116.3	0.39	421	1,088
1988	102	40,772	103,294	59,595.1	0.40	400	1,013
1989	107	35,931	108,278	62,223.0	0.33	336	1,012
1990	110	36,602	108,667	68,291.7	0.34	333	988
1991	111	28,519	98,782	73,448.4	0.29	257	890
1992	110	29,297	103,155	74,012.0	0.28	266	938
1993	106	25,597	93,749	70,704.9	0.27	241	884
1994	107	21,672	83,454	74,536.6	0.26	203	780
1995	107	21,233	85,671	78,875.2	0.25	198	801
1996	109	18,883	84,644	79,660.0	0.22	173	777
1997	109	17,149	84,711	71,851.4	0.20	157	777
1998	105	13,187	71,485	77,069.9	0.18	126	681
1999	104	13,666	75,420	83,197.6	0.18	131	725
2000	104	12,652	74,108	86,006.8	0.17	122	713

Table 5.4-21, Summary of Information Reported by Commercial Light Water Reactors (1973 – 2002)

Year	Number of Reactors Included*	Annual Collective Dose (person-rem)	No. of Workers With Measurable Dose**	Electricity Generated (MW-yrs)	Average Measurable Dose Per Worker (rem)	Average Collective Dose Per Reactor (person – rem)	Average No. Personnel With Measurable Doses Per Reactor**
2001	104	11,109	67,570	87,552.8	0.16	107	650
2002	104	12,126	73,242	88,829.7	0.17	117	704

* Includes only those reactors that had been in commercial operation for at least one full year as of December 31 of each of the indicated years.
** Figures are not adjusted for the multiple reporting of transient individuals.
*** Electricity Generated reflects the gross electricity generated for the years 1973 – 1996. Beginning in 1997, it reflects the net.
Source: NUREG-0713, Vol. 24

Add new Table 5.4-22:

Table 5.4-22, Three Year Totals and Averages Listed in Ascending Order of Collective TEDE per BWR (2000-2002)

Site Name	Reactor Years	Collective TEDE per Reactor	Collective TEDE per Site	Number of Workers with Measurable TEDE	Average TEDE per Worker	Total MW-Years	Average TEDE per MW-Year
DUANE ARNOLD	3	72	217	1,534	0.14	1,468.3	0.15
PILGRIM	3	90	269	1,998	0.13	1,869.9	0.14
LIMERICK 1, 2	6	105	631	3,654	0.17	6,557.6	0.10
COLUMBIA GENERATING	3	109	326	2,868	0.11	2,941.4	0.11
BROWNS FERRY 1, 2, 3**	9	109	985	5,159	0.19	6,286.5	0.16
VERMONT YANKEE	3	110	331	2,007	0.17	1,443.8	0.23
FERMI	3	118	353	2,931	0.12	2,973.7	0.12
HOPE CREEK 1	3	123	370	2,988	0.12	2,752.7	0.13
PERRY	3	128	384	2,329	0.17	3,169.7	0.12
LASALLE 1, 2	6	132	793	4,378	0.18	6,402.8	0.12
GRAND GULF	3	132	396	2,458	0.16	3,492.5	0.11
COOPER STATION	3	136	407	2,634	0.15	1,851.2	0.22
HATCH 1, 2	6	141	847	4,619	0.18	4,717.5	0.18
SUSQUEHANNA 1, 2	6	147	880	5,509	0.16	5,995.4	0.15
BRUNSWICK 1, 2	6	150	900	5,014	0.18	4,715.5	0.19
RIVER BEND 1	3	153	459	2,726	0.17	2,690.9	0.17
MONTICELLO	3	159	477	2,025	0.24	1,495.5	0.32
CLINTON	3	165	495	2,995	0.17	2,552.8	0.19

PEACH BOTTOM 2, 3	6	168	1,008	5,089	0.20	6,199.9	0.16
DRESDEN 2, 3	6	170	1,017	7,929	0.13	4,480.7	0.23
NINE MILE POINT 1, 2	6	190	1,143	5,603	0.20	4,467.4	0.26
FITZPATRICK	3	198	595	3,166	0.19	2,243.9	0.27
OYSTER CREEK	3	309	926	3,954	0.23	1,612.7	0.57
QUAD CITIES 1, 2	6	471	2,824	7,394	0.38	4,285.0	0.66
Totals and Averages	105		17,033	90,961	0.19	86,667.3	0.20
Averages per Reactor-Yr		162		866		825.4	

* Sites where not all reactors had completed 3 full years of commercial operation as of 12/31/02 are not included.
** Browns Ferry 1 remains in the count of operating reactors, but was placed on Administrative Hold in June of 1985.
Source: NUREG-0713, Vol. 24

Add new Table 5.4-23:

Table 5.4-23, Three Year Totals and Averages Listed in Ascending Order of Collective TEDE per PWR (2000-2002)

Site Name	Reactor Years	Collective TEDE per Reactor	Collective TEDE per Site	Number of Workers with Measurable TEDE	Average TEDE per Worker	Total MW-Years	Average TEDE per MW-Year
INDIAN POINT 3	3	45	134	1,313	0.10	2,823.9	0.05
SEABROOK	3	48	145	2,676	0.05	2,949.4	0.05
PALO VERDE 1, 2, 3	9	53	480	3,983	0.12	10,252.2	0.05
GINNA	3	56	167	1,104	0.15	1,359.7	0.12
CRYSTAL RIVER 3	3	56	168	1,287	0.13	2,392.1	0.07
PRAIRIE ISLAND 1, 2	6	60	359	2,292	0.16	2,879.9	0.12
SAN ONOFRE 2, 3	6	64	383	3,513	0.11	5,850.3	0.07
CATAWBA 1, 2	6	64	384	3,029	0.13	6,387.7	0.06
BRAIDWOOD 1, 2	6	64	385	3,418	0.11	6,613.1	0.06
TURKEY POINT 3, 4	6	66	395	2,912	0.14	3,981.8	0.10
COMANCHE PEAK 1, 2	6	70	418	2,719	0.15	6,078.0	0.07
THREE MILE ISLAND 1	3	71	212	1,551	0.14	2,262.7	0.09
CALLAWAY 1	3	73	218	2,100	0.10	3,046.8	0.07
WATTS BAR 1	3	74	222	2,159	0.10	3,162.8	0.07
DIABLO CANYON 1, 2	6	75	447	3,147	0.14	5,867.3	0.08
BYRON 1, 2	6	75	448	2,965	0.15	6,703.0	0.07
MCGUIRE 1, 2	6	75	450	3,070	0.15	6,264.2	0.07
POINT BEACH 1, 2	6	75	451	2,450	0.18	2,696.4	0.17
ST. LUCIE 1, 2	6	80	483	3,357	0.14	4,790.5	0.10

Table 5.4-23, Three Year Totals and Averages Listed in Ascending Order of Collective TEDE per PWR (2000-2002)

Site Name	Reactor Years	Collective TEDE per Reactor	Collective TEDE per Site	Number of Workers with Measurable TEDE	Average TEDE per Worker	Total MW-Years	Average TEDE per MW-Year
ROBINSON 2	3	81	244	1,795	0.14	1,976.1	0.12
WATERFORD 3	3	82	246	1,727	0.14	3,058.4	0.08
VOGTLE 1, 2	6	82	495	2,921	0.17	6,397.3	0.08
WOLF CREEK 1	3	83	249	1,782	0.14	3,239.9	0.08
NORTH ANNA 1, 2	6	86	518	2,875	0.18	4,781.8	0.11
CALVERT CLIFFS 1, 2	6	91	547	3,389	0.16	4,510.8	0.12
SUMMER 1	3	99	296	2,104	0.14	2,333.3	0.13
MILLSTONE 2, 3	6	102	609	4,260	0.14	5,327.7	0.11
KEWAUNEE	3	102	305	1,606	0.19	1,335.4	0.23
SURRY 1, 2	6	102	610	3,239	0.19	4,488.1	0.14
SEQUOYAH 1, 2	6	102	611	4,588	0.13	6,173.9	0.10
BEAVER VALLEY 1, 2	6	102	613	3,980	0.15	4,427.1	0.14
ARKANSAS 1, 2	6	102	614	4,640	0.13	4,672.0	0.13
COOK 1, 2	6	107	643	4,553	0.14	4,110.8	0.16
SALEM 1, 2	6	107	644	4,925	0.13	5,868.6	0.11
OCONEE 1, 2, 3	9	120	1,077	5,411	0.20	6,843.3	0.16
HARRIS	3	120	360	2,619	0.14	2,286.2	0.16
FARLEY 1, 2	6	129	777	4,265	0.18	4,372.4	0.18
SOUTH TEXAS 1, 2	6	133	798	4,207	0.19	6,615.7	0.12
PALISADES	3	138	413	1,511	0.27	1,647.7	0.25
FORT CALHOUN	3	142	425	1,761	0.24	1,278.6	0.33
DAVIS-BESSE	3	192	576	3,211	0.18	1,752.2	0.33
INDIAN POINT 2	3	279	838	3,758	0.22	1,862.9	0.45
Totals and Averages	207		18,854	124,172	0.15	175,722.0	0.11
Averages per Reactor-Yr		91		600		848.9	

*** Sites where not all reactors had completed 3 full years of commercial operation as of 12/31/02 are not included.**

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E7.1-1

E7.1-1 **Section 7.1.2 of ER (Evaluation of Radiological Consequences)** - ER Section 7.1.2 states that the site 50th percentile χ/Qs from Table 2.3-52 of the Clinton SSAR were used for the radiological consequence evaluations. Identify χ/Q values used for the surrogate plants (e.g., AP1000, ABWR, ESBWR, and ACR-700) used in Chapter 7 tables for evaluating the radiological consequences in these tables. Westinghouse has revised its χ/Qs in the AP1000 design certification control document since submittal of the EGC ESP application. Using the certified χ/Qs in the Westinghouse AP1000 Design Control Document, revise the site-specific doses and fission product releases for all design basis accidents (DBAs) in ER Chapter 7 accordingly, or note where the AP1000 values used in the ER have been revised but Exelon has elected not to use the updated values in the accident analyses.

EGC RAI ID: R3-31

EGC RESPONSE:
EGC has elected not to use the updated AP1000 chi/Q values at this time. The chi /Q values used for the surrogate plants (e.g., AP1000, ABWR, ESBWR, and ACR-700) in the example calculations are provided below:

Accident Dispersion Factors Used in AP-1000 Generic Analyses

Post-accident chi/Qs- sec/m^3

Interval	EAB	LPZ
0 to 2 hours	6.00E-04	
0 to 8 hours		1.35E-04
8 to 24 hours		1.00E-04
24 to 96 hours		5.40E-05
96 to 720 hours		2.20E-05

Accident Dispersion Factors Used in the ABWR Generic Analysis

Post Accident chi/Qs- sec/m^3

Interval	EAB	LPZ
0 to 2 hour	1.85E-04	
0 to 8 hour		2.49E-05
8 to 24 hour		1.68E-05
24 to 96 hour		7.18E-06
96 to 720 hours		2.11E-06

Accident Dispersion Factors Used in ESBWR Generic LOCA Analysis

Post-accident chi/Qs- sec/m^3

Interval	EAB	LPZ
0 to 2 hours	2.87E-03	
0 to 8 hours		1.56E-04
8 to 24 hours		1.17E-04
24 to 96 hours		4.18E-05
96 to 720 hours		9.24E-06

Accident Dispersion Factors Used in the ACR 700 Generic Analysis

Post Accident chi/Qs- sec/m^3

Interval	EAB	LPZ
0 to 2 hour	1.85E-04	
0 to 8 hour		2.49E-05
8 to 24 hour		1.68E-05
24 to 96 hour		7.18E-06
96 to 720 hours		2.11E-06

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E7.1-2

E7.1-2 **Section 7.1.2 of ER** - ER Section 7.1.2 shows the time intervals used for the exclusion area boundary (EAB) and low population zone (LPZ). Clarify whether the 0- to 2-hour EAB time period is for the 2-hour period with the greatest EAB doses.

EGC RAI ID: R3-32

EGC RESPONSE:
The 2-hour period with the greatest EAB doses is used for analysis. For example, the 0 to 2 hour period is the time period used in the LOCA analyses for the ABWR and ACR-700, the 1 to 3 hour time period is used for the AP1000, and the 1.4 to 3.4 hour time period is used for the ESBWR.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
Revise ER Chapter 7, Table 7.1-22, column header labeled "2 - 3 hr" to read "1 - 3 hr."

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E7.1-3

E7.1-3 **Section 7.1.2 of ER** - ER Table 7.1-2 summarizes the resulting doses at the ESP site for postulated design basis accidents using the AP1000, the ABWR, and the ACR-700 as surrogate reactor designs. Update the table for each design basis accident to include (1) AP1000, ABWR, and ACR-700 doses used for the EAB and LPZ, and (2) the ratios of site-specific χ/Qs to design certification chi/Qs used.

EGC RAI ID: R3-33

EGC RESPONSE:
Table 7.1-2 summarizes the resulting EAB and LPZ doses at the ESP Site for the spectrum of postulated design basis accidents (DBA) that had offsite dose consequences as considered in the AP1000 and ABWR certification documents. In addition, projected EGC ESP Facility offsite doses were provided for the ESBWR and the ACR-700 for the limiting DBA (Loss of Coolant Accident) based on estimated radioactive releases to the environment provided by the vendors.

Table 7.1-2 will be modified to include the Vendor Certification EAB and LPZ doses along with the corresponding ratio of ESP Site chi/Q to Vendor specified chi/Qs as a function of post accident time periods. The doses provided for the ABWR are presented in the TEDE equivalent in lieu of thyroid and whole body doses (see response to E7.1-4). Certification doses and chi/Q ratios are not available for the ACR-700 or the ESBWR since these designs have not yet been certified.

Since in some cases vendors have utilized a number of chi/Q values in their certification package the following is the basis for the ratios presented in the attached tabulation.

Exelon ESP Site 50% Accident chi/Qs - sec/m^3

Interval	EAB	LPZ
0 to 2 hour	3.56E-05	
0 to 8 hour		3.40E-06
8 to 24 hour		2.85E-06
24 to 96 hour		1.85E-06
96 to 720 hours		1.00E-06

AP1000 Standard 5 % Accident chi/Qs - sec/m^3

Interval	EAB	LPZ
0 to 2 hour	6.00E-04	
0 to 8 hour		1.35E-04
8 to 24 hour		1.00E-04
24 to 96 hour		5.40E-05
96 to 720 hours		2.20E-05

ABWR 5 % Accident chi/Qs - sec/m^3

Interval	EAB	LPZ
0 to 2 hour	1.37E-03	
0 to 8 hour		1.56E-04
8 to 24 hour		9.61E-05
24 to 96 hour		3.36E-05
96 to 720 hours		7.42E-06

ASSOCIATED EGC ESP APPLICATION REVISIONS:
Revise ER Chapter 7, Table 7.1-2 to read as shown in Attachment identified below.

ATTACHMENTS:
E7.1-3 Att A – Revised Table 7.1-2

NRC Letter Dated: 05/11/2004

NRC RAI No. E7.1-4

E7.1-4 **Section 7.1.2 of ER** - Several tables in ER Chapter 7 present doses for ABWR design basis accidents in total effective dose equivalent (TEDE) units. The ABWR design was certified with thyroid and whole body doses, not TEDE. Provide tables to show doses in thyroid and whole body doses as well as TEDE.

EGC RAI ID: R3-34

EGC RESPONSE:
The Tables in Section 7.1 that present doses for the ABWR design basis accidents will be revised as presented below with the calculated thyroid, whole body and TEDE doses:

ASSOCIATED EGC ESP APPLICATION REVISIONS:
Revise ER Chapter 7 Tables 7.1-8, 7.1-9, 7.1-21, 7.1-25, and 7.1-33 to read:

Table 7.1-8 ABWR Main Steam Line Break Outside Containment Maximum Equilibrium Value for Full Power Operation

Dose Type	EAB (rem)	LPZ (rem)
Thyroid	6.64E-02	6.34E-03
Whole Body	1.46E-03	1.39E-04
TEDE	3.43E-03	3.28E-04

Table 7.1-9 ABWR Main Steam Line Break Outside Containment - Pre-existing Iodine Spike

Dose Type	EAB (rem)	LPZ (rem)
Thyroid	1.33E+00	1.27E-01
Whole Body	2.89E-02	2.76E-03
TEDE	6.85E-02	6.54E-03

Table 7.1-21 ABWR Small Line Break Outside Primary Containment

Dose Type	EAB (rem)	LPZ (rem)
Thyroid	6.10E-02	1.20E-02
Whole Body	1.14E-03	2.16E-04
TEDE	2.97E-03	5.75E-04

Table 7.1-25 ABWR Design Basis Loss of Coolant Accident

Dose Type	EAB (rem)	LPZ (rem)
Thyroid	4.96E+00	2.15E+01
Whole Body	1.02E-01	1.79E-01
TEDE	2.35E-01	7.63E-01

Table 7.1-33 ABWR Fuel Handling Accident

Dose Type	EAB (rem)	LPZ (rem)
Thyroid	1.97E+00	1.91E-01
Whole Body	2.82E-02	5.56E-03
TEDE	8.04E-02	9.78E-03

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E7.1-5

E7.1-5 **Section 7 of ER (Environmental Impacts of Postulated Accidents Involving Radioactive Materials)** - Several tables in ER Chapter 7 present the time-dependent activity releases for each design basis accident. Provide the references and the methodology used to determine the time-dependent activity release values in these tables. Note that the values in these tables should appropriately reflect the certified AP1000 design χ/Qs, as discussed in RAI E7.1-1.

EGC RAI ID: R3-35

EGC RESPONSE:
The approach used for the calculating time-dependent activity releases are as generally described in Section 7.1.3 of the Environmental Report. For the ABWR and AP1000 designs the specific methodology used to determine the time dependent activity release values are presented in their respective design certification documents as referenced in Section 7.1. Therefore, these values are considered to be reasonable values for use in determining the expected environmental impact for the EGC ESP facility.

For the other non-certified reactors, the vendors have not provided the specific details of the methodology but have directly provided the time-dependent activity release values which were presented in their respective tables in Section 7.1.

The final time-dependent activity release values for the facility will be design specific and thus are not yet available. Approval of the design specific values will appropriately include review and approval of the methodology at either the Design Certification stage or at the Combined License stage. However, at the ESP stage, the application provides substitute values for use in the evaluation of environmental impacts. These substitute values need not be reviewed by the NRC staff for correctness since it is the responsibility of the applicant to show, once a design is chosen, that the actual environmental impact from the final design specific time-dependent activity release values are bounded by the environmental impact identified in the ESP evaluation. The values in the EGC ESP ER are considered reasonable for the purpose of evaluating the expected environmental impacts of the EGC ESP facility since they are comparable to, or less than, the design certification values provided for the ABWR and AP1000.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E7.2-1

E7.2-1 **Section 7.2.2 (Evaluation of Potential Severe Accident Releases)** - Provide an up-to-date, site-specific assessment of the adverse health effects from fallout onto open bodies of water, considering the EGC ESP site characteristics (e.g., water flow rates and contaminant residence times). Justify that the generic conclusion with respect to such matters that was reached in NUREG-1437 is valid for a future reactor at the ESP site.

EGC RAI ID: R3-36

EGC RESPONSE:
Example evaluations of the severe accident consequences associated with two different reactor designs located at the EGC ESP site (i.e., ABWR and AP1000) are provided using an updated version of the MELCOR Accident Consequence Code System (i.e., MACCS2). MACCS is an industry-accepted tool for the calculation of the health and economic consequences of severe accident atmospheric radiological releases.

As indicated in the ER, NUREG-1437 describes the CPS site (i.e, the EGC ESP site) as a "small river site" for surface water pathway purposes. In Table 5.15 of NUREG-1437, the site is listed as one that may not be bounded by the Fermi 2 surface water analysis contained in NUREG-1437. The CPS, (and 12 other sites) are not bound by the Fermi analysis due to the following combined characteristics:

(1) low on-site average annual flow rates

(2) comparatively long residence times

(3) comparatively large surface-area-to-volume ratios.

NUREG-1437 notes that because combined residence time and surface-area-to-volume ratios for the 13 small river sites in Table 5.15 exceed values at Fermi by less than a factor of 3, and these sites have populations lower than Fermi by at least a factor of 2 (Clinton population is smaller by a factor of 7), the population dose at these sites is expected to remain a small fraction of the value estimated for the atmospheric pathway. Additionally, the CPS is considered to be at least as amenable to interdictive measures as Fermi, which would further reduce population dose. Therefore, the impact of fallout on open bodies of water is determined to be small. The relevant factors utilized in the NUREG-1437 study are:

- Low on-site average annual flow rate
- Comparatively long residence time
- Comparatively large surface-area-to-volume ratios

These factors are independent of plant type located at the site.

Site population projections for the EGC ESP plant show only a modest population increase over the projected license period and would not change the conclusions of NUREG-1437 for the CPS.

The plant design features associated with the ABWR or AP1000 are not expected to change the conclusion that population dose due to fallout on open bodies of water around the CPS would remain small compared to population dose due to the atmospheric release on a whole.

NUREG-1437 concluded that the consequence of atmospheric fallout onto open bodies of water due to severe accidents at the CPS site is characterized to be small. The example evaluations noted above demonstrate that the conclusions of NUREG-1437 remain valid for the purposes of evaluating environmental impacts of severe accidents at the EGC ESP site.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E7.2-2

E7.2-2 **Section 7.2.2 (Evaluation of Potential Severe Accident Releases)** - Provide an up-to-date, site-specific assessment of the adverse health effects from potential releases to groundwater, considering the ESP site characteristics. Justify that the generic conclusion with respect to such matters that was reached in NUREG-1437 is valid for a future reactor at the ESP site.

EGC RAI ID: R3-37

EGC RESPONSE:
Example evaluations of the severe accident consequences associated with two different reactor designs located at the EGC ESP site (i.e., ABWR and AP1000) are provided using an updated version of the MELCOR Accident Consequence Code System (i.e., MACCS2). MACCS is an industry-accepted tool for the calculation of the health and economic consequences of severe accident atmospheric radiological releases.

As indicated in the ER, groundwater contamination due to severe accidents has been evaluated generically in the Liquid Pathway Generic Study, NUREG-0440 and summarized in NUREG-1437.

NUREG-0400 defined and evaluates six "generic" sites using typical or comparative assumptions on geology, adsorption factors, etc. The six generic sites typify those adjacent to small rivers, large rivers, the Great Lakes, oceans, estuaries, and a "dry" site.

Twenty-seven sites (including the CPS site and in effect, the EGC ESP site) of the 74 nuclear power plant sites, which performed groundwater pathways analyses for their Final Environmental Statements, are compared with one another and the results of the generic site.

The NUREG-0440 results are believed to provide generally conservative uninterdicted population dose estimates in the six generic plant-site categories. According to NUREG-0440, the generic liquid pathway uninterdicted dose estimates are one or more orders of magnitude lower than those attributed to the atmospheric pathway and therefore represent a "small" impact. The 27 current site dose estimates are compared to these generic sites. If the individual sites do not significantly exceed those of the generic counter part, the liquid pathway may be considered an insignificant contributor to the population dose that could result from a severe accident for the plants.

The CPS site liquid pathway dose estimates are presented in Table 5.18 of NUREG-1437 as a dose ratio (i.e., CPS site dose divided by the "generic" small river site dose) as follows:

NUREG-1437 Dose Estimate Ratio CPS

Drinking water dose	0.3
Ingestion dose	1.3
Direct contact	(not given)

Based on other data present in NUREG-1437, the proportion of liquid pathway population dose for small river sites for each of the three categories above is approximately:

Proportion of Total Liquid Pathway

Drinking water dose	89%
Ingestion dose	7%
Direct contact	4%

With respect to the CPS site, it is noted that the ingestion dose is approximately 30% larger than the small river generic site dose (1.3 dose estimate ratio). This ingestion dose category, however, contributes only approximately 7% of the total liquid pathway dose. The majority of the dose (i.e., 89%) is due to drinking water, for which the CPS site liquid pathway dose is estimated to be nearly one third of the generic site (i.e., 0.3 dose ratio). Therefore, the CPS site is reasonably judged to be bounded or approximated by the small river generic site liquid pathway dose.

The relevant factors utilized in the liquid pathway NUREG-0440 study are:

- Ground water travel time
- Retention-adsorption coefficient
- Distance to surface water
- Soil, sediment, and rock characteristics

These factors are independent of plant type located at the site.

The plant design features associated with the ABWR or the AP1000 are not expected to change the conclusion that population dose due to liquid pathway would remain small compared to the atmospheric population dose.

NUREG-1437 and NUREG-0440 concluded that the consequence from liquid pathway releases due to severe accidents at the CPS site is characterized to be small. The example evaluations noted above demonstrate that the conclusions of NUREG-1437 remain valid for the purposes of evaluating environmental impacts of severe accidents at the EGC ESP site.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E7.2-3

E7.2-3 **Section 7.2 (Severe Accidents)** - Provide a site-specific analysis of the environmental consequences of a potential severe accident at a new reactor located on the EGC ESP site using a Level 3 probabilistic risk assessment (PRA) consequence code such as the MACCS2 code. This could involve characterizing the spectrum of credible releases from candidate future plant designs, in terms of representative source terms and their respective frequencies, and using these release characteristics in conjunction with site-specific population and meteorology to determine site-specific risk impacts for the potential design. Release characteristics could be developed through a survey of severe accident analyses for previously certified advanced LWRs and/or operating reactors. The following information should be provided as part of this analysis:

a. a description of the computer code used as the basis for the calculations,including any modifications to the officially released version of the code, and important deviations from recommended or default code input values,

b. a description of the site-specific meteorology data used in the calculation, including the treatment of rain/precipitation events, and the degree to which the data represents or bounds year-to-year variations in weather at the ESP site,

c. a description of the site-specific population data used in the calculation, and justification that this data is representative of the time period through which new unit operations could extend,

d. a description of the major input assumptions for modeling economic impacts, including farm and non-farm values, evacuation costs, value of crops and milk contaminated or condemned, costs of decontamination of property, and costs associated with loss of use of property as a result of the accident (including contamination and condemnation of property),

e. a description of the protective actions considered in the evaluation, including criteria for sheltering and evacuation, criteria for interdiction and condemnation of property and/or crops, and the assumed level of medical support to aid the exposed population,

f. a description of the source terms used to represent the reference or surrogate plant design(s), including the radionuclide inventory and the release frequency and characteristics for each release category. These characteristics include release fractions for the major radionuclide groups, release times and durations, and elevation and energy of release,

g. the results of the calculations in terms of probabilistically-weighted population dose, early and latent fatalities, economic costs, and contaminated and condemned land areas, for the reference or surrogate plant design(s). Sufficient information should be provided to enable results to be displayed in a manner similar to later final environmental statements (FESs, e.g., Tables 5.10 through 5.13 in NUREG-0921), and

h. a listing of the input file for the ESP site (including population and meteorology) for the MACCS2 code.

EGC RAI ID: R3-38

EGC RESPONSE:

a. Site specific example evaluations assessment of the environmental consequences are provided to evaluate the severe accident consequences associated with two different reactor plants located at the EGC ESP site (i.e., ABWR and AP1000) for the Exelon Early Site Permit (ESP) application. The analysis was performed using the Melcor Accident Consequence Code System (MACCS2) designated as Oak Ridge National Laboratory RSICC Computer Code Collection MACCS2 V.1.12, CCC-652 Code Package. MACCS2, Version 1.12 simulates the impact of severe accidents at nuclear power plants on the surrounding environment. The principle phenomena considered in MACCS2 are atmospheric transport, mitigating actions based on dose projections, dose accumulation by a number of pathways including food and water ingestion, early and latent health effects, and economic costs.

   The base model had no important deviations from the default code input values, except where site-specific values were required. The respective reactor vendors provided the Level 2 data for the ABWR and AP1000 designs. This data includes the radionuclide source term, power level, release fractions and corresponding frequencies, plume release start time, plume release height, and delay and duration.

b. Site-specific weather data obtained from the CPS on-site meteorological monitoring system was utilized in the development of the MACCS2 MET files. (See Section 2.3.3 of the ESP SSAR for details regarding the CPS on-site meteorological measurement program). The site-specific data was used to develop the MACCS2 file inputs of wind speed, wind direction, and atmospheric stability.

   Site-specific precipitation data was not available for the time periods evaluated (i.e., 2000-2003). Therefore, precipitation data was obtained from the National Weather Service Station located in Springfield, Illinois. Use of rain data from Springfield is consistent with the use of other regional weather data from the Springfield station in the SSAR. (See SSAR Section 2.3.1.1 for details regarding the Springfield Station).

   Four years of weather data (i.e., 2000, 2001, 2002, 2003) were evaluated in order to ensure that a "representative" year was used in the analyses. Year 2001 was selected as the base case year, consistent with the meteorological data discussions presented in the ESP ER.

   Reg. Guide 1.23 recognizes the potential for weather sensor failures and data losses and requires site data systems to have at least a 90% data recovery ability. MACCS2 input files require 100% data coverage for each hour (8760) of a site MET file. Therefore, to perform a MACCS2 evaluation, it is necessary to estimate weather data parameters for any hours for which data is missing.

   The goal of the data completion process was to replace missing data with a best estimate. The following data estimation methods were utilized in the MACCS2 MET files to achieve 100% data coverage, (in order of preference):

   - Site Backup Sensor Data – Sites generally have redundant (i.e., backup) sensors to preclude the loss of meteorological data. The redundant sensors may be positioned at a different location on the site. Due to lack of recorded site backup data at the Clinton site, this approach was not utilized in this analysis.

   - Interpolation – Short intervals (e.g., 1 to 7 hours) of missing data may be estimated by interpolating between the known data points.

- Profiling – When site tower data is available at a different elevation, a profile extrapolation may be performed. The probable error of the profiling estimate does not increase with the duration of the missing data, as is the case for interpolation. Consequently, profiling becomes a better estimator compared to interpolation as the length of the missing data period increases. Profiling based on a power-law is used for extrapolating wind speed with height. Profiling based on lapse rate is used for extrapolating temperature with height. Due to lack of usable data (i.e., typically all Clinton data was lost for a given time period), this approach was not utilized in this analysis.

- Duplication – Use of site-specific data from a similar time period (e.g., prior week, same time of day) may be used as a substitute, using appropriate judgement in the data selection. This is acceptable for longer periods of missing data (8 hours or more). This is judged preferred to using an average climatological value (e.g., monthly average).

The last data record in the site MET file contains a table of eight values representing the atmospheric mixing layer height. The eight values specify the mixing height for time of day (i.e., morning and afternoon) for each of the four seasons. Mixing layer heights representative of the EGC ESP site (i.e., Central Illinois) are currently specified in the ESP SSAR (Table 2.3-7). These SSAR values were used in the MACCS2 MET files.

c. The population distribution and land use information for the region surrounding the ESP site are specified in the SITE input data file. Contained in the SITE input file are the geometry data used for the site (spatial intervals and wind directions), population distribution, fraction of the area that is land, watershed data for the liquid pathways model, information on agricultural land use and growing seasons, and regional economic information.

The SITE data file contains the regional specific data for:

- population distribution
- fraction of the area that is land
- watershed data for the liquid pathways modeling
- agricultural land use and growing seasons
- economic information

The data was organized using a polar coordinate system. The area around the site was divided into 16 compass sectors and radial rings.

Whenever possible, site-specific data from the ESP SSAR or ESP ER was utilized. The SECPOP2000 code (Reference 1), documented in NUREG/CR-6525, is one means of calculating most input data required for a MACCS2 SITE file. The SECPOP2000 utilizes 1990 or 2000 census population data, and associated county economic data. SECPOP2000 was used to provide required MACCS2 input data not previously developed in the ESP SSAR or ER.

Section 7.2.2.1 of the ESP Environmental Report reviews the NUREG-1437 Exposure Index development for the Clinton site and notes that:

- Only modest population growth is expected around the CPS site (based on comparison of 10-mile and 50-mile population projections)
- The Clinton site is well within the EI spectrum of other plants

No calculations of the EI values were specifically performed for the Clinton site. These calculations were therefore performed for this site specific study. EI values were developed for year 2000 (for comparison to the NUREG-1437 values) and year 2060 as follows. The 10-mile EI population distribution is taken from the Environmental Report, Table 2.5-1 (Year 2000) and Table 2.5-2 (Year 2060). The 150-mile EI population distribution is estimated using the SECPOP2000 program since population data for 150-miles is not included in the ESP SSAR or ER. An annual growth rate of 0.40% was assumed based on the population growth of the 50-mile region as presented in the data tables of the ESP ER. The wind direction frequencies were developed from Table 2.7-37 of the ESP ER (joint frequency distribution table for all stability categories combined over the period of 01/01/2000 – 08/31/2002). The year 2000 EI values of 865 (10-mile) and 891,094 (150-mile) are in reasonable agreement with those calculated in NUREG-1437. The differences are attributed to using different inputs for the population and wind direction frequencies. (The sector specific data used in the NUREG-1437 analysis was not provided in NUREG-1437 such that detailed input comparisons could not be made.) The year 2060 EI values of 731 (10-mile) and 1,103,449 (150-mile) are in reasonable agreement with those calculated for the year 2050 in NUREG-1437. The calculated values show that the ESP site still falls well within the expected spectrum of all plants.

d. Land use statistics including farmland values, farm product values, dairy production, and growing seasons are considered on a countywide basis within 50 miles.

Much of the data was prepared by utilizing the SECPOP90 computer code. The SECPOP90 regional economic values were updated in 1999 using cost of living and other data from the Bureau of the Census and the Department of Agriculture. Agricultural data was taken from the 1997 Census of Agriculture (Reference 2). This was accomplished by replacing the SECPOP90 data for the counties within the 50-mile radius with the 1997 values. That is, the SECPOP90 county database was modified so that the results produced by the code were correctly assigned to the various economic regions.

A single base case CHRONC file was developed for the ESP evaluation. The base case CHRONC file was used for both the ABWR and AP1000 analysis. Table 1 summarizes pertinent file development choices and data sources for each data block of the CHRONC file. The CHRONC module simulates the events that occur following the emergency-phase time period modeled by the EARLY module. CHRONC performs all of the calculations pertaining to both the intermediate and long-term phases. Various long-term protective actions may be taken during this period to limit radiation doses to acceptable levels. Four long-term exposure pathways are modeled in MACCS2 CHRONC to predict the long-term radiation exposures from accidental radiological releases:

- groundshine
- resuspension inhalation
- ingestion of contaminated food
- ingestion of contaminated drinking water

The dose from each of the long-term pathways is evaluated for each spatial element surrounding the accident site. For the intermediate phase (i.e., 1 year), only the groundshine and re-suspension inhalation exposure pathways are considered. For the long-term phase (i.e., 30 years), all four exposure pathways are modeled. The models utilized in predicting the doses from these four pathways are described in detail in the MACCS2 User's Guide. CHRONC also calculates the economic costs of the long-term protective actions as well as the cost of the emergency response actions that were modeled in the EARLY module.

Table 1. CHRONC File Summary

Data Block	Description
Emergency Response Costs Data	Emergency phase (i.e., first week) daily costs for evacuees and relocates are based on NUREG/CR-4551 (Reference 3) and cover food, transportation, and housing. Intermediate phase (i.e., first year) daily costs are based on NUREG/CR-4551 and cover food, housing, and transportation.
Long Term Protective Actions Data	Values were selected to meet EPA-400 (Reference 4) protective action guides (PAGs) of: - 2 Rem TEDE in first year - 0.5 Rem/year TEDE in subsequent years - 5 Rem TEDE in 50 years
Decontamination Plan Data	Decontamination plan and cost data are consistent with those used in NUREG-1150 (NUREG/CR-4551), updated using a consumer price index (CPI) adjustment. Decontamination costs are in year 2000 dollars. Decontamination costs include: - Cost of farm decontamination (dollars/hectare) - Cost of nonfarm decontamination (dollars/person)
Interdiction Cost Data	Values used are consistent with those of NUREG-1150 (NUREG/CR-4551), updated using a CPI adjustment. Interdiction costs are in year 2000 dollars. Interdiction costs associated with population relocation include alternate housing, moving costs, and lost income for people in areas which require decontamination, interdiction, or condemnation.
Groundshine Weathering Data	Decay of groundshine contributors is performed consistent with NUREG-1150 (NUREG/CR-4551).
Resuspensing Weather Data	Decay of resuspensing contributors is performed consistent with NUREG-1150 (NUREG/CR-4551).
Regional Characteristics Data	Most parameters in this data section (e.g., farm production, dairy production) are calculated using the SITE file inputs. Average farm wealth and non-farm wealth are based on an area weighted average of economic values calculated by SECPOP2000. Data for fraction of farm wealth and non-farm wealth improvements to the region utilized the NUREG-1150 (NUREG/CR-4551) values.
Food Ingestion Model Data	The newer (i.e., post NUREG-1150) COMIDA-2 based food ingestion model is utilized, consistent with the MACCS2 User's Guide. Annual dose limits trigger crop or milk disposal, as appropriate. Values are chosen consistent with the MACCS2 User's Guide.

e. The EARLY module of the MACCS2 code models the time period immediately following radiological releases. This period is commonly referred to as the emergency phase. It may extend up to one week after arrival of the first plume at any downwind spatial interval. The CHRONC module of the code treats the subsequent intermediate and long-term periods. In the EARLY module the user may specify emergency response scenarios that include evacuation, sheltering, and dose-dependant relocation.

Evacuation parameters included in the file are based on the ESP Emergency Plan (Reference 9). Protective action parameters for the EARLY phase are based on the protective action guides (PAGs) specified in EPA-400.

Table 2 summarizes pertinent file development choices and data sources for each data block section of the EARLY file.

Table 2. EARLY File Summary

Data Block	Description
Evacuation Data	Evacuation Modeling is based on data contained in the EGC ESP Emergency Plan. 95% of population is assumed to evacuate the EPZ radially away from the site at an average speed of 3.29 mph (1.47 m/sec), starting 30 minutes after the declaration of a general emergency.
Shelter and Relocation Data	An emergency phase of one week is used, with relocation times consistent with NUREG-1150 (NUREG/CR-4551). Relocation dose criteria of 1 Rem is used, consistent with EPA-400.
Early Fatality Data	Fatality parameters are consistent with MACCS2 User's Guide (Reference 5) and NUREG/CR-4214. (Reference 6)
Early Injury Data	Injury parameters are consistent with MACCS2 User's Guide. Early injuries were included in the model for completeness, but these results are not utilized.
Dose Conversion Data	Dose conversion factors are from the DOSFAC generated file DOSDATA.inp supplied with MACCS2 (originally distributed with MACCS 1.5.11.1) and are those used in the NUREG-1150 (NUREG/CR-4551) studies.
Organ Data	Organs are defined for health effect calculations consistent with the MACCS2 User's Guide for the Dose Conversion file and the COMIDA-2 food-chain model.
Miscellaneous Data	Plume dispersion calculations utilize the shift rotation approach to generate 16 sets of results (i.e., one for each sector) for each weather trial, consistent with NUREG-1150 (NUREG/CR-4551).
Population Data	Site-specific population data is utilized via the SITE file.
Shielding and Exposure Data	Shielding and exposure factors are those used for Zion in NUREG-1150 (NUREG/CR-4551).
Latent Cancer Data	Latent cancer effects during the EARLY phase are calculated using the Piecewise Liner Dose-Response Function, as recommended by the MACCS2 User's Guide. (The Linear-Quadratic Model used in NUREG-1150 (NUREG/CR-4551) is no longer recommended.) Dose factors are from Sample Problem C supplied with MACCS2.

f. The ATMOS input data file calculates the dispersion and deposition of radiological material released (source terms) to the atmosphere as a function of downwind distance. Source term release fractions (RELFRC) for the ABWR and AP1000 are shown below, as are plume characterizations.

Two separate base case ATMOS files were developed for the ESP evaluation, one for the ABWR plant and one for the AP1000 plant. The two files are the same except for data related to:

- Core inventory
- Source term release

Table 3 summarizes pertinent file development choices and data sources for each data block section of ATMOS file. In most cases, file development utilized either the recommended data provided in the MACCS2 User's Guide (NUREG/CR-6613) or those utilized in the NUREG-1150 evaluations as documented in the NUREG/CR-4551 MACCS Input volume. It is noted that one of the five plants evaluated in NUREG/CR-4551 was the Zion Generating Station located in Illinois. Due to the regional proximity of Zion to the EGC ESP site, Zion parameters were generally utilized as the default NUREG-1150 parameters.

Table 3. ATMOS File Summary

Data Block	Description
Geometry Data	Nine radial spatial elements and 16 sectors out to 50 miles, consistent with the SITE file.
Nuclide Data	Sixty radioactive nuclides utilized in 9 groups, consistent with NUREG-1150.
Wet Deposition Data	Coefficients chosen consistent with MACCS2 User's Guide.
Dry Deposition Data	One particle size group, using NRC recommended deposition velocity of 0.01 meters/sec.
Dispersion Parameter Data	Power law model is utilized with Tadmor and Gur parameterization, consistent with NUREG-1150 and MACCS2 User's Guide.
Plume Meander Data	Expansion factors consistent with MACCS2 User's Guide.
Plume Rise Data	Scaling factors set to 1.0, consistent with MACCS2 User's Guide.
Wake Effects Data	Building dimensions taken from the ESP SSAR for the plant parameter envelope.
Release Description – Core Inventory	ABWR core inventory supplied by GE. No scaling is required. A single core (i.e., one unit) is used. AP1000 core inventory supplied by Westinghouse. A single core (i.e., one unit) is used. No scaling is required.
Release Descriptions – Source Terms	ABWR source term release fractions are based on modeling one plume and are presented in Table 4. A plume release height of 37.7m is used (the ABWR utilizes a rupture disc design) along with buoyant plume rise heat values developed by GE and are presented in Table 5. AP1000 source term release fractions are based on modeling two plumes and are presented in Table 6. A plume release height of 10m was assumed (see table 7), consistent with the EGC ESP SSAR, and buoyant plume rise was conservatively neglected.
Meteorological Sampling	Weather category bin sampling using 12 samples/bin (NUREG-1150 used only 4 samples/bin).

The reactor vendor supplied the Level 2 data. This data included the source term inventory, power level, release fractions, plume start time, plume release height, delay, and dilution.

The ABWR shows 10 different source term categories (STCs) [Table 4]. The release times and durations and elevation and energy of release for the ABWR were extracted form the GE ABWR licensing submittal document. Parameters are assigned to each source term according to an STC number. Each release plume is assumed to have one segment (Table 5).

The vendor provided the AP1000 radionuclide inventory, as well as the source term category release fractions and corresponding frequencies for the MACCS2 element groups. Four plume segments of release fraction data were originally reported, but were collapsed to two in order to satisfy the limitations of the MACCS2 code. Shown in the table below are the collapsed source term release fractions for the different STCs (Table 6).

Timing data indicated in Table 7 below was also revised to reflect two plume segments. A plume energy level of 3.0E+06 W was assigned to the first plume and 2.0E+06 W for the second plume except for the bypass sequence. The plume release height was selected to be 30 meters. The ALARM time was selected to be the same as the first plume delay time. The balance of the timing data of each plume are taken form the Westinghouse PRA study document.

The scaling factor (CORSCA) was used to adjust the ABWR core inventory for a power level of 4300 MWt. The core inventory was based on the discharge exposure burnup of 35,000 MWD/MT.

The scaling factor (CORSCA) used to adjust the AP1000 core inventory for power level was (3415/3412 = 1.00). This was determined due to the base 3412 MWt MACCS2 pressurized water reactor default inventory and the actual AP1000 thermal power rating on 3415 MWt.

Table 4. ABWR Source Term Release Fraction

STC	Xe/Kr	I-Br	Cs-Rb	Te-Sb	Sr	Co-Mo	La	Ce	Ba
ST1 – Case 0	4.4E-02	2.3E-05	2.3E-05	5.0E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ST2 – Case 1	1.0E+00	1.5E-07	1.3E-05	3.1E-04	6.3E-06	2.4E-11	7.9E-08	7.9E-08	6.3E-06
ST3 – Case 2	1.0E+00	5.0E-06	5.0E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ST4 – Case 3	1.0E+00	2.8E-04	2.2E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ST5 – Case 4	1.0E+00	1.6E-03	1.6E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ST6 – Case 5	1.0E+00	6.0E-03	5.3E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ST7 – Case 6	1.0E+00	3.1E-02	7.7E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ST8 – Case 7	1.0E+00	8.9E-02	9.9E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ST9 – Case 8	1.0E+00	1.9E-01	2.5E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
ST10 – Case 9	1.0E+00	3.7E-01	3.6E-01	1.1E-03	9.3E-03	9.2E-08	2.8E-03	2.8E-03	9.3E-03

Table 5. ABWR Plume Characterization Data

STC	OALARM (s)	NUMREL	MAXRIS	REFTIM (s)	PLHEAT (w)	PLHITE (m)	PLDUR (s)	PDELAY (s)
0	6120	1	1	0	1.38E+06	37.7	36000	9720
1	69120	1	1	0	1.38E+06	37.7	3600	72000
2	65520	1	1	0	1.38E+06	37.7	3600	68400
3	177120	1	1	0	1.38E+06	37.7	36000	180000
4	69120	1	1	0	1.38E+06	37.7	3600	72000
5	65520	1	1	0	1.38E+06	37.7	3600	68400
6	65520	1	1	0	1.38E+06	37.7	36000	68400
7	69120	1	1	0	1.38E+06	37.7	36000	72000
8	4320	1	1	0	1.38E+06	37.7	36000	7200
9	43920	1	1	0	1.38E+06	37.7	36000	84960

Table 6. AP1000 SOURCE TERM RELEASE FRACTIONS

STC	Plume	Xe/Kr	I-Br	Cs-Rb	Te-Sb	Sr	Ru	La	Ce	Ba
CFI	Plume 1	7.98E-01	3.33E-03	3.32E-03	4.35E-04	2.18E-02	9.28E-03	8.06E-03	4.32E-05	1.65E-02
	Plume 2	1.22E-01	0.00E+00	0.00E+00	6.04E-06	0.00E+00	0.00E+00	1.12E-02	4.06E-05	0.00E+00
CFE	Plume 1	8.21E-01	5.66E-02	5.49E-02	1.39E-03	3.48E-03	1.42E-02	6.54E-05	1.00E-06	5.28E-03
	Plume 2	1.42E-01	0.00E+00	0.00E+00	6.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
IC	Plume 1	1.48E-03	1.20E-05	1.15E-05	8.09E-07	1.07E-05	1.31E-05	1.36E-06	5.88E-09	1.20E-05
	Plume 2	1.17E-03	0.00E+00	0.00E+00	1.81E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BP	Plume 1	1.00E+00	2.15E-01	1.96E-01	9.84E-03	3.57E-03	4.48E-02	1.30E-04	3.19E-06	8.93E-03
	Plume 2	0.00E+00	2.34E-01	7.60E-02	6.89E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-06
CI	Plume 1	6.86E-01	4.56E-02	2.10E-02	1.65E-03	2.03E-02	4.04E-02	2.39E-04	2.97E-06	3.16E-02
	Plume 2	8.40E-02	0.00E+00	0.00E+00	9.37E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CFL	Plume 1	1.53E-03	1.21E-05	1.15E-05	1.02E-06	1.67E-05	1.71E-05	1.17E-05	4.79E-08	1.68E-05
	Plume 2	9.79E-01	2.13E-05	1.19E-05	3.67E-05	2.83E-03	1.42E-03	1.41E-01	5.34E-04	2.60E-03

Table 7. AP1000 Collapsed Plume Characterization Data

STC	OALARM (S)	NUMREL	MAXRIS	REFTIM (s)	PLHEAT (w)	PLHITE (m)	PLDUR (s)	PDELAY (s)
CFI	2924	2	1	0.0	3.0E+06	30	36000	2924
				0.5	2.0E+06	30	36000	32590
CFE	3004	2	1	0.0	3.0E+06	30	36000	3004
				0.5	2.0E+06	30	36000	19810
DIRECT	4378	2	1	0.5	3.0E+06	30	36000	4378
				0.0	2.0E+06	30	36000	84810
IC	4378	2	1	0.5	3.0E+06	30	36000	4378
				0.0	2.0E+06	30	36000	84810
BP	31890	2	1	0.5	3.0E+06	30	36000	31890
				0.0	3.0E+06	30	36000	46440
CI	100.8	2	1	0.5	3.0E+06	30	36000	100.8
				0.5	2.0E+06	30	36000	50020
CFL	2922	2	1	0.5	3.0E+06	30	36000	2922
				0.5	2.0E+06	30	36000	26360

g. The mean annual environmental dose risk from severe accidents for two new reactor designs (AP1000 and ABWR) at the EGC ESP site is presented in Table 8. For comparison purpose, this table also includes results from NUREG-1150 (NUREG/CR-4551) for three other sites (Zion, Grand Gulf, and Surry). These results are probabilistically weighted. The data in Table 8 show that the environmental dose risk of severe accidents for the two new reactor designs at the ESP site is significantly lower than for current design reactors.

Table 8. Mean Annual (Dose) Risk For Several Sites And Reactors

Plant	Population Dose Risk (50-mile) (person-rem/year)
ABWR	2.35E-03
AP1000	2.21E-02
Zion	5.47E+01
Grand Gulf	5.2E-01
Surry	5.8E+00

Other MACCS2 results of interest for the ABWR and AP1000 plants at the EGC ESP site such as economic risk, total fatalities (early fatalities, and latent cancer fatalities), affected land (i.e. farmland requiring decontamination and condemned farmland), dose (0-50 mile radius in person-rem/yr), and economic cost are provided in Table 9.

Risk is defined as the product of source term category frequency and the dose or cost associated with the STC. Although each STC reflects a different release scenario and only one at a time would normally be hypothesized, the total risk is conservatively assumed to be the sum of all scenarios. Also, since the AP1000 and the ABWR plant designs reflect different release/STCs, use of the total/summed risk provides a common reference point.

As can be seen from the results presented in Tables 8 and 9, consequences from severe accidents from the two advanced reactor designs are products of significantly lower risk factors when compared to existing plant inputs. This is consistent with the GEIS findings for existing plants where risk impacts from severe accidents would be small.

Table 9. Results Summary Comparison of Plant Designs

(0-50 Mile Radius from the ESP Site)

Plant Design	Dose Risk (Person-rem/year)	Dollar Risk (per year)	Contaminated Land (Hectares)	Condemned Land (Hectares)	Fatalities/Year	
					Early	Latent
ABWR	2.35E-03	$11.10	2.20E+05	3.02E+04	7.93E-10	1.04E-06
AP1000	2.21E-02	$194.00	2.52E+05	1.88E+04	1.35E-08	1.16E-05

h. The input file listings for the EGC ESP site MACCS2 code run are provided in Attachments A through F.

- E7.2-3 Att A - ATMOS Input Parameters (2 plumes)
- E7.2-3 Att B - ATMOS Input Parameters (1 plume)
- E7.2-3 Att C - CHRONC Input Parameters
- E7.2-3 Att D - EARLY Input Parameters
- E7.2-3 Att E - MET Input Parameters
- E7.2-3 Att F - SITE Input Parameters

References:

Reference 1 - N.E. Bixler, et al., SECPOP2000: Sector Population, Land Fraction, and Economic Estimation Program, NUREG/CR-6525, Rev. 1, August 2003.

Reference 2 – 1997 Census of Agriculture, "U.S. Department of Agriculture, National Agricultural Statistics service".

Reference 3 - E.D. Gorham, et al., Evaluation of Severe Accident Risks: Methodology for the Containment, Source Term, Consequence, and Risk Integration Analyses, Vol. 1, Rev. 1, NUREG/CR-4551 (SAND86-1309), December 1993.

Reference 4 - Environmental Protection Agency, Manual of Protective Action Guides and Protective Actions for Nuclear Incidents, EPA 400R92001, May 1992.

Reference 5 - D. Chanin and M.L. Young, Code Manual for MACCS2: User's Guide, NUREG/CR-6613, Vol. 1 (SAND97-0594), May 1998.

Reference 6 - J.S. Evans, et al., Health Effects Models for Nuclear Power Plant Accident Consequence Analysis, NUREG/CR-4214, Rev. 2, Part 1, October 1993.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:

E7.2-3 Att A - ATMOS Input Parameters (2 plumes)

E7.2-3 Att B - ATMOS Input Parameters (1 plume)

E7.2-3 Att C - CHRONC Input Parameters

E7.2-3 Att D - EARLY Input Parameters

E7.2-3 Att E - MET Input Parameters

E7.2-3 Att F - SITE Input Parameters

NRC Letter Dated: 05/11/2004

NRC RAI No. E7.2-4

E7.2-4 **Section 7.2 (Severe Accidents)** - Provide a comparison of the (probabilistically weighted) environmental risk of severe accidents for a future reactor at the EGC ESP site with:

a. the risks (doses) associated with normal and anticipated operational releases from a future reactor at the ESP site, and

b. the risk of severe accidents for the current generation of operating plants (at their respective sites), as characterized in such studies as NUREG-1150, *Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants*, and the plant-specific risk study for Clinton Power Station.

EGC RAI ID: R3-39

EGC RESPONSE:
The mean annual environmental dose risk from severe accidents for the two example reactor designs (i.e., AP1000 and ABWR) at the ESP site is presented in Table 1. For comparison purpose, this table also includes results from NUREG-1150 for three other sites with current generation light water reactors (Zion, Grand Gulf, and Surry). These results show that the environmental dose risk of severe accidents for the two new reactor designs at the ESP site is significantly lower than for these current design reactors.

Table 1 - Annual (Dose) Risk For Several Sites And Reactors

Plant	Site	Population Dose Risk (50-mile person-rem/year)
ABWR (ESP)	Clinton, IL	2.35E-03
AP1000 (ESP)	Clinton, IL	2.21E-02
Zion	Zion, IL	5.47E+01
Grand Gulf	Grand Gulf, MS	5.2E-01
Surry	Surry, VA	5.8E+00

Other MACCS2 results of interest for the ABWR and AP1000 plants at the EGC ESP site such as economic risk, total fatalities and affected land are provided in Table 2 and Table 3. Dose, economic cost, and fatalities results presented in Table 2 are developed as the sum of the products of each source term category frequency and the mean value associated with that source term category. Affected land results presented in Table 3 (i.e., farm land requiring decontamination and farm land condemned) are defined as the mean value for the worst-case source term category.

A variety of sensitivity cases were performed as part of the EGC ESP MACCS2 analysis to determine the impacts associated with various input choices and are discussed in the report.

Table 2 - Results Summary Comparison of Plant Designs (0-50 Mile Radius From the ESP Site)

Plant Design	50 Mile Dose Risk (Person-rem/year)	Dollar Risk (Per year)	Fatalities Per Year Early	Fatalities Per Year Latent
ABWR	2.35E-03	$11.1	7.93E-10	1.04E-06
AP1000	2.21E-02	$194	1.35E-08	1.16E-05

Table 3 - Affected Land (0-50 Mile Radius From the ESP Site)

Plant Design	Decontaminated Farm Land (Hectares	Condemned Farm Land (Hectares)
ABWR	2.20E+05	3.02E+04
AP1000	2.52E+05	1.88E+04

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E9.3-1

ESRP Sections 9.3 and 9.4.3 provide guidance to the staff to consider transmission corridors in its evaluation of alternative sites. Provide information in response to the following questions for each of the alternative sites.

E9.3-1 **General question** - Do the existing transmission lines that connect the site to the grid have the capacity to carry the bounding case power output for additional units at the site?

EGC RAI ID: R3-40

EGC RESPONSE:
The following response applies to each alternative site:

EGC did not conduct an extended analysis of existing transmission line capacity as part of the alternative site review because it was not relevant to the two-step comparison of other sites to the proposed EGC ESP Site.

The alternative site comparison process for the ESP is developed from several layers of information. This comparison process is based on the guidance outlined in NUREG-1555:

The review involves a two-part ***sequential*** test for obvious superiority. The first stage of the test determines whether there are environmentally preferred sites among the candidate sites. The second stage of the test considers economics, technology, and institutional factors among the environmentally preferred sites to see if any is obviously superior. If there is no environmentally preferred or obviously superior site, the proposed site prevails; if an obviously superior site is found, the reviewer must identify this site and consult with the Environmental Project Manager (EPM). (Emphasis added.)

Transmission capacity at potentially environmentally preferable sites would have been compared "to see if any is obviously superior." In its comparative analysis, EGC concluded that none of the alternative sites was environmentally preferable to the EGC ESP Site, and did not continue the review to include connection capacity at the sites. Therefore, no information about existing transmission lines that connect site to the grid is available.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E9.3-2

E9.3-2 General question - Do the existing transmission towers have room for additional circuits that could carry the bounding case power output?

EGC RAI ID: R3-41

EGC RESPONSE:
The following response applies to each alternative site.

EGC did not conduct a detailed review of existing transmission towers beyond the boundaries of the alternative sites as part of the alternative site review because it was not relevant to the overall two-step comparison of other sites to the proposed EGC ESP Site.

The alternative site comparison process for the ESP is developed from several layers of information. This comparison process is based on the guidance outlined in NUREG-1555:

The review involves a two-part ***sequential*** test for obvious superiority. The first stage of the test determines whether there are environmentally preferred sites among the candidate sites. The second stage of the test considers economics, technology, and institutional factors among the environmentally preferred sites to see if any is obviously superior. If there is no environmentally preferred or obviously superior site, the proposed site prevails; if an obviously superior site is found, the reviewer must identify this site and consult with the Environmental Project Manager (EPM). (Emphasis added.)

Transmission tower capacity at potentially environmentally preferable sites would have been reviewed as part of the effort "to see if any is obviously superior." In its comparative analysis, EGC concluded that none of the alternative sites was environmentally preferable to the EGC ESP Site, and did not continue the review to include tower capacity at the alternative sites as part of any review for an "obviously superior" site. Therefore, no information about existing tower capacity is available.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E9.3-3

E9.3-3 **General question** - Do the existing rights-of-way have room for all additional circuits that would be needed to carry the bounding case power output?

EGC RAI ID: R3-42

EGC RESPONSE:
The following response applies to each alternative site.

EGC did not evaluate whether existing rights of way had room for additional circuits beyond the boundaries of the alternative sites as part of the alternative site review because it was not relevant to the overall two-step comparison of other sites to the proposed EGC ESP Site.

The alternative site comparison process for the ESP is developed from several layers of information. This comparison process is based on the guidance outlined in NUREG-1555:

The review involves a two-part ***sequential*** test for obvious superiority. The first stage of the test determines whether there are environmentally preferred sites among the candidate sites. The second stage of the test considers economics, technology, and institutional factors among the environmentally preferred sites to see if any is obviously superior. If there is no environmentally preferred or obviously superior site, the proposed site prevails; if an obviously superior site is found, the reviewer must identify this site and consult with the Environmental Project Manager (EPM). (Emphasis added.)

The capacity of rights of way extending from potentially environmentally preferable sites would have been compared as part of EGC's review "too see if any is obviously superior." In its comparative analysis, however, EGC concluded that none of the alternative sites was environmentally preferable to the EGC ESP Site, and did not continue include a review of rights of way extending from the alternative sites as part of any review for an "obviously superior" site. Therefore, no information about existing the capacity of rights of way extending from the alternative sites is available.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

NRC Letter Dated: 05/11/2004

NRC RAI No. E9.3-4

E9.3-4 General - ESRP Sections 9.3 and 9.4.3 identify the need for information regarding presence of habitats, including wetlands, on each of the alternate sites and their transmission line corridors, and potential impacts to the same for each of the alternate sites. None of this information is currently provided in ER Section 9.3. Provide an estimate of the number of acres of each habitat type that would be disturbed at each alternate site.[2]

[2]Alternatively, provide electronic versions of aerial photos that display the habitats on each alternative site and a GIS layer of polygons representing EGC ESP facilities and laydown yards, etc., that can be superimposed on the aerial photos to derive the above estimates.

EGC RAI ID: R3-43

EGC RESPONSE:
The following response applies to each alternative site.

EGC did not conduct an extended analysis of habitats under NUREG-1555, Section 9.3 or 9.4.3 as part of the alternative site review, nor did EGC conduct a detailed review for the presence of habitats in transmission corridors beyond the boundaries of the alternative sites because the regulation does not require the development of this information for existing alternative sites. However, a "reconnaissance view" of the candidate site criteria in NUREG-1555, Section 9.3 is included in the EGC ESP ER.

Moreover, in determining environmental preferability, EGC reviewed the criteria for candidate sites, but determined that a more detailed examination of corridor habitats was not relevant to the two-part comparison of existing sites. The alternative site comparison process for the ESP is developed from several layers of information. This comparison process is based on the guidance outlined in NUREG-1555:

The review involves a two-part ***sequential*** test for obvious superiority. The first stage of the test determines whether there are environmentally preferred sites among the candidate sites. The second stage of the test considers economics, technology, and institutional factors among the environmentally preferred sites to see if any is obviously superior. If there is no environmentally preferred or obviously superior site, the proposed site prevails; if an obviously superior site is found, the reviewer must identify this site and consult with the Environmental Project Manager (EPM). (Emphasis added.)

Corridor habitats extending beyond the boundaries of environmentally preferable sites would have been compared as part of EGC's review "too see if any is obviously superior." In its comparative analysis, however, EGC concluded that none of the alternative sites was environmentally preferable to the EGC ESP Site, and did not review habitats within these extended corridors. Therefore, no information about habitats in of way extending from the alternative sites is available.

ASSOCIATED EGC ESP APPLICATION REVISIONS:
None

ATTACHMENTS:
None

U.S. Nuclear Regulatory Commission
July 23, 2003, Enclosure 2

CD-ROM

The enclosed CD-ROM contains the following files associated with the responses to the environmental request for additional information provided in Enclosure 1. These files are identified as Attachments in the associated response.

E4.4-1 Att A - Waste Water Available.pdf
E4.4-1 Att B - Capacity Waste Water Supply.pdf

E5.2-1&-2 Att A - Lake Drought Model Description.pdf
E5.2-1&-2 Att B - Lake Drought Analysis Description.pdf
E5.2-1&-2 Att C - Lake Drought Analysis Model.xls

E5.2-3 Att D - Lake Period of Record Analysis.pdf
E5.2-3 Att E1 - Existing_Plant-USAR_PeriodofRecordAnalysis.xls
E5.2-3 Att E2 - Existing_Plant-USAR-New_Plant-Wet-Dry-PeriodofRecordAnalysis.xls
E5.2-3 Att E3 - Existing_Plant-USAR-New_Plant-Wet-PeriodofRecordAnalysis.xls
E5.2-3 Att E4 - Source-info-PeriodofRecordAnalysis-DAILY.xls

E7.1-3 Att A – Revised Table 7.1-2

E7.2-3 Att A - ATMOS Input Parameters (2 plumes).pdf
E7.2-3 Att B - ATMOS Input Parameters (1 plume).pdf
E7.2-3 Att C - CRONC Input Parameters.pdf
E7.2-3 Att D - EARLY Input Parameters.pdf
E7.2-3 Att E - MET Input Parameters.pdf
E7.2-3 Att F - SITE Input Parameters.pdf