Exelon Nuclear
200 Exelon Way
KSA3-N
Kennett Square, PA 19348

Telephone 610.765.5610
Fax 610.765.5755
www.exeloncorp.com

Exelon Nuclear

52.17

October 11, 2004

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

Subject: Response to Request for Additional Information (RAI) Letter No. 6 – Exelon Early Site Permit (ESP) Application for the Clinton ESP Site (TAC No. MC1122)

Re: Letter, U.S. Nuclear Regulatory Commission (N. V. Gilles) to Exelon Generation Company, LLC, (M. Kray), dated July 26, 2004, Request for Additional Information Letter No. 6 – Exelon Early Site Permit Application for the Clinton ESP Site (TAC No. MC1122)

Enclosed, as requested in the referenced letter, are responses to the requests for additional information (RAIs) associated with the hydrology portions of the Exelon Generation Company, LLC (EGC) ESP application. The attachments identified in the responses to specific RAIs are provided on the enclosed CD-ROM.

Please contact Eddie Grant of my staff at 610-765-5001 if you have any questions regarding this submittal.

Sincerely yours,

Marilyn C. Kray

Marilyn C. Kray
Vice President, Project Development

TPM/ERG

D073

cc: U.S. NRC Regional Office (w/ enclosures)
Ms. Nanette V. Gilles (w/ enclosures)

Enclosure: Response to RAI 2.4.1-1 through 2.4.1-5 (and associated attachments)
Response to RAI 2.4.2-1 through 2.4.2-5
Response to RAI 2.4.3-1 through 2.4.3-2
Response to RAI 2.4.7-1 through 2.4.7-8
Response to RAI 2.4.8-1 through 2.4.8-4
Response to RAI 2.4.9-1
Response to RAI 2.4.10-1
Response to RAI 2.4.12-1
Response to RAI 2.4.13-1
Response to RAI 3.2.2-1 through 3.2.2-2 (and associated attachments)

Attachments: (Note – These are provided on the enclosed CD-ROM.)
RAI 2.4.1-1 Attachment (Revised Figure 1.2-4)
RAI 3.2.2-1 Attachment (New Figure 3.2-1)
RAI 2.4.1-5 Attachment 1 (MRCC 2002a)
RAI 2.4.1-5 Attachment 2 (MRCC 2002b)

**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, 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 11th day of October, 2004.

My commission expires 10-6-07.

Vivia V. Gallimore

Notary Public

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

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.1-1**

Please provide survey coordinates (including elevations) for the bounding areas of all ESP safety-related structures including intake tunnels and piping corridors. Also provide the coordinates of existing aquifers in the bounding areas, particularly perched aquifers.

**EGC RAI ID: R9-1**

**EGC RESPONSE:**

SSAR Chapter 1, Figure 1.2-4, has been revised (see RAI 2.4.1-1 Attachment) to show the approximate location of safety-related structures, with a grid system provided on the figure, for the EGC ESP. The safety related structures are the intake structure, the essential service water cooling towers, and some of the structures that would be located within the power block area. The final size of the safety-related structures and locations will be determined after the selection of a reactor for the construction phase. No specific survey coordinates are established during the ESP process.

The location of the EGC ESP intake structure at approximately 65 feet south of the CPS intake structure was selected to provide a location where the ESP piping can be routed without disturbing the CPS shutdown cooling water piping to and from the CPS ultimate heat sink (UHS). The piping for CPS exits the intake structure on the side away from the lake (east side). The CPS nonsafety service water discharge and the fire protection discharge exit near the north end and turn north east at a 45º angle. The circulating water (CW) discharge piping is the next piping exiting the intake structure as three pipes and combining into a common pipe. The CPS CW pipe exits south of the service water pipe and north of the E-W centerline of the intake structure before turning north east at a 45º angle to the turbine building. South of the CPS CW piping is CW piping that was installed for the canceled CPS Unit 2 and also follows the northeast route of the CPS unit CW piping. The last piping exiting the intake structure and near the south end of the CPS intake structure is the shutdown service water piping which turns south east at 45º after leaving the intake structure and continues for approximately 250 ft before turning east and then north to the CPS diesel generator and HVAC building. Two trains of shutdown service water plus a fire protection line follow this path. The shutdown service water return lines follow the same routing as the supply lines and are located above the supply lines to a point approximately 175 ft east of where the supply lines turned east. The discharge lines turn 45º southwest at this point and slope downward to a discharge to the CPS UHS pond with the bottom of the discharge pipes at elevation 675 ft.

The piping from the EGC ESP facility intake structure will be routed similar to the CPS piping with an expected horizontal distance of about fifty feet maintained between the ESP facility piping and the CPS piping. The ESP facility piping will be south of the CPS piping and will be routed sufficiently south before turning east to provide adequate clearance and cover where it passes over the sloping CPS discharge piping to the CPS UHS pond. The ESP facility piping elevation will be selected to provide 3 ft – 9 in clearance (vertical distance) between the ESP and CPS pipes where they cross. After crossing over the CPS discharge piping, the ESP facility piping will continue generally in an east direction to reach the two cooling tower areas where it provides make-up. The physical location and elevation of the ESP facility piping will not be established until after the required diameters are determined based on the selection of a reactor type. The ESP facility piping exiting its intake structure will include the make-up supply to the normal heat sink tower, fire protection supply and two trains of make-up to the Ultimate Heat Sink cooling towers if the selected reactor type does not use passive systems for safety related cooling.

The discussion of the regional and local groundwater system is presented in SSAR 2.4.13. Groundwater beneath the ESP site occurs in the upper glacial deposits (Wisconsinan) and in the underlying Illinoian and Kansan tills. Because the Wisconsinan, Illinoian, and Kansan deposits are regional and not limited to any specific area within the ESP site, there are no specific coordinates for the aquifers. The depths to elevations of the different hydrogeologic units and the measured water levels based on the borings and piezometers recently installed within the footprint of the ESP are summarized below.

| Hydrogeologic Unit | Top of Unit | | Water Surface | |
|---|---|---|---|---|
| | Depth (ft) | Elevation (ft) | Depth (ft) | Elevation (ft) |
| Wisconsinan | 8 to 13 | 724.2 to 726.1 | 3.7 to 6.5 | 733.5 to 727.5 |
| Illinoian | 58 | 679.8 | 27.8 to 27.3 | 710.8 to 711.3 |
| Kansan | 189 | 548.2 | Not measured | Not measured |

Additional geological cross sections through the EGC ESP site are provided in SSAR Appendix A-Geotechnical Report (see Figures 2-1 and 5-2).

Section 3.2.2.3 of the SSAR will be revised to provide additional information on the location of structures.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

Revise SSAR, Chapter 3, Section 3.2.2.3, to include the following new paragraph as the second paragraph in Section 3.2.2.3:.

The location of the EGC ESP intake structure at approximately 65 feet south of the CPS intake structure was selected to provide a location where the ESP piping can be routed without disturbing the CPS shutdown cooling water piping to and from the CPS UHS.

Revise SSAR, Chapter 1, Figure 1.2-4 as shown in RAI 2.4.1-1 Attachment 1.

**ATTACHMENTS:**

RAI 2.4.1-1 Attachment (Revised Figure 1.2-4)

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.1-2**

Please identify any limits on plant operation due to either water supply or intake water temperature for the ESP unit (e.g., need to derate or shutdown reactors if the intake temperature exceeds a certain threshold). Estimate the frequency and duration of the applicability of these operating limits.

**EGC RAI ID: R9-2**

**EGC RESPONSE:**

Limits on plant operation due to water level and temperature are typically based on the volume and temperature of the ultimate heat sink (as assumed in the safe shutdown analyses). Since the design of the station has not yet been finalized and the safe shutdown analyses have not been performed, no such operating limits have been identified. These analyses would be expected to be performed as part of the design certification or combined license applications.

SSAR Section 2.4.11.5 indicates a plant shutdown would be initiated if the level in Clinton Lake drops to elevation 677 ft. However, this elevation is not based on any safety analysis or the ultimate heat sink volume. This is the highest minimum level for continued power generation, i.e., the normal cooling water source, and is based on a not yet finalized design of the intake structure (which could be designed to operate with lower water levels). Simulation of lake water levels over the 24 years of meteorological records since construction of the Clinton Lake Dam have shown water levels well within the minimum lake operating levels with both the existing CPS and proposed ESP facility in operation at 100 percent power. The lake drawdown analysis presented in SSAR section 2.4.11.3 demonstrates that elevation 677 ft is not reached during a 100-year drought (elevation 681.4 ft above msl).

Thermal modeling has indicated that essentially all of the water temperature increase due to plant operation for CPS is dissipated before the water is circulated to the plant intake (Edinger, 1989). Intake temperatures are more directly influenced by ambient weather conditions. The temperature of the water taken from Clinton Lake for make-up to the cooling towers is a small fraction of the total flow through the cooling towers and has minor impact on the cooling towers basin cold water temperature. The ESP facility will have the capability to add the cooling tower make-up water to the inlet side of the cooling towers and therefore it can be cooled to the design temperature. Therefore, no unit derating or shutdown will occur due to make-up (intake) water temperatures. Also, as with the volume/level, no safety analysis for safe shutdown has been performed, and therefore, no assumptions of maximum water temperature have been made for the safety analysis.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

None

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.1-3**

The application states that no dams exist upstream of Clinton Lake that could affect the availability of water to the ESP site. Please provide references that confirm this assertion and that no future dams upstream of the site are currently proposed.

**EGC RAI ID: R9-3**

**EGC RESPONSE:**

SSAR, Chapter 2, Section 2.4.1.2 will be revised to add information regarding dams upstream and downstream of Clinton Lake that supports the statement that the dams could not affect the availability of water at the ESP site.

With regard to future dams, a representative of the Illinois Department of Natural Resources, Office of Water, Division of Water Resources Management, Dam Safety Section advised that there are no recent or pending permits for recreational or water supply dams upstream of Clinton Lake.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

Revise SSAR, Chapter 2, Section 2.4.1.2 from:

There are currently no existing reservoirs or dams upstream or downstream from Clinton Lake that could affect the availability of water to Clinton Lake (CPS, 1982).

To read:

There are currently no existing reservoirs or dams upstream or downstream from Clinton Lake that could affect the availability of water to Clinton Lake (CPS, 1982). Four recreational dams were identified, two on the North Fork of Salt Creek upstream of Clinton Lake and two downstream of Clinton Lake (USACOE, 2004). The information on these four dams is provided in Table 2.4-1A. Because these dams were constructed for the recreational purposes and have limited storage capacities, water is not withdrawn from the watershed.

Salt Creek (downstream of Clinton Lake) is not a likely candidate for changes that would result in additional demand since the flow of the creek is often low for long periods of time.

Revise SSAR, Chapter 2, Section 2.4, to add new Table 2.4-1a:

**TABLE 2.4-1A**

Dams Upstream and Downstream of Clinton Lake

| Dam Name | Location | Owner/ Purpose | Date Built | Dam Height | Storage and Drainage Area |
|---|---|---|---|---|---|
| Moraine View Dam (or Dawson Lake) | Near the city of Leroy in McLean County (about 25 miles upstream of Clinton Lake) | Illinois DNR/ Recreation | 1963 | 42 ft | Storage (acre-feet): Maximum = 4,133 Normal = 1,620 Drainage area: 4.5 acres |
| Vance Lake Dam (or Clyde Vance Lake) | DeWitt County (about 15 miles upstream of Clinton Lake) | John M. Clark/ Recreation | 1955 | 20 ft | Storage (acre-feet): Maximum = 313 Normal = 134 Drainage area: not provided |
| Weldon Springs State Park Lake Dam | DeWitt County (about 2.5 miles downstream of Clinton Lake) | Illinois DNR/ Recreation | 1900 | 30 | Storage (acre-feet): Maximum = 532 Normal = 303 Drainage area: 1.4 acres |
| Little Galilee Lake Dam | DeWitt County (about 10 miles down stream of Clinton Lake) | Little Galilee Christian | 1954 | 35 | Storage (acre-feet): Maximum = 60 Normal = 41 Drainage area: not provided |

Source: USACOE, 2004

Revise SSAR, Chapter 2, Section 2.4 References to add the following new reference:

U.S. Army Corps of Engineers (USACOE). National Inventory of Dams (NIOD). Available at: http://crunch.tec.army.mil/nid/webpages/nid.cfm. September 2004.

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.1-4**

Please provide any information regarding proposed land use changes that might result in increased bed load in the tributaries upstream of Clinton Lake or sediment deposition in the ultimate heat sink (UHS).

**EGC RAI ID: R9-4**

**EGC RESPONSE:**

EGC has no information regarding proposed land use changes upstream of Clinton Lake. Current land use upstream of Clinton Lake and the CPS ultimate heat sink is mainly agricultural. The agricultural use, especially in early spring when the soils are exposed from farming and the fields have not yet been planted results in the maximum expected sediment load to the tributaries. Future development will tend to create a more impervious watershed and decrease the amount of soil erosion and sediment carried to the tributaries.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

None

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.1-5**

Table 2.4-2 shows the percentage of rainfall as runoff and mean lake evaporation. Please provide copies of the references for these estimates.

**EGC RAI ID: R9-5**

**EGC RESPONSE:**

SSAR Chapter 2, Table 2.4-2, shows the percentages of rainfall and mean lake evaporation. A copy of each of the following references is included as an attachment to this RAI response:

Midwest Regional Climate Center (MRCC). Database File of Evaporation Data 1963-2002. August 12, 2002a.

Midwest Regional Climate Center (MRCC). Database File of Rainfall Data 1910-2002. August 12, 2002b.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

None

**ATTACHMENTS:**

RAI 2.4.1-5 Attachment 1 (MRCC 2002a)

RAI 2.4.1-5 Attachment 2 (MRCC 2002b)

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.2-1**

The Probable Maximum Precipitation (PMP) for Clinton Dam was obtained using Hydrometeorological Report No. 33 (HMR 33); however, the current standards are American National Standards Institute/American Nuclear Society (ANSI/ANS)-2.8-1992, HMR 51, and HMR 52. Please explain why the current standards were not used. Also, please explain why an estimate based on HMR 33 is conservative relative to an estimate based on HMR 51 and HMR 52.

**EGC RAI ID: R9-6**

**EGC RESPONSE:**

The 48-hour probable maximum precipitation (PMP) referred to in SSAR, Chapter 2, Section 2.4.2.3, "Effects of Local Intense Precipitation," and Section 2.4.3.1, "Probable Maximum Precipitation," was taken directly from the CPS USAR (CPS, 2002). The PMP information in the CPS USAR was originally obtained or derived from U.S. Weather Bureau Hydrometeorological Report No. 33 (HMR-33). As indicated in the RAI, more recent procedures than those provided in HMR-33 for determining maximum precipitation (PMP) are available. In order to update the PMP information presented in the SSAR, four reports were reviewed which relate directly to estimating PMP at a given location. A brief description of each report and their purpose and objectives is provided below:

***HMR-33***: Hydrometeorological Report No. 33 "Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1000 Square Miles and Durations of 6, 12, 24, and 48 Hours" (Reidel, Appleby, and Schloemer, April 1956). This document provides a generalized set of charts indicating monthly and seasonal variations of the 24-hour PMP for a 200 square mile area. The report also provides a method for estimating the PMP for areas ranging from 10 to 1000 square miles, and for durations of 6 to 48 hours.

***HMR-51***: Hydrometeorological Report No. 51 "Probable Maximum Precipitation Estimates, United States East of the 105th Meridian" (Schreiner and Reidel, June 1978.) This report provides an update to HMR-33; with all-season PMP's for 6, 12, 24, 48, and 72 hours and for 10, 200, 1000, 5000, 10,000, and 20,000 square miles.

***HMR-52***: Hydrometeorological Report No. 52 "Application of Probable Maximum Precipitation Estimates - United States East of the 105th Meridian" (National Weather Service, August 1982.) This report provides a methodology to determine the temporal and spatial distribution of PMP estimates derived from HMR-51 for situations where this information is needed for a specific drainage.

***HMR-53:*** Hydrometeorological Report No. 53 "Seasonal Variation of 10-Square-Mile Probable Maximum Precipitation Estimates, United States East of the 105th Meridian". (National Weather Service, April 1980.) This report provides seasonal variations of PMP estimates for 10 square mile areas for duration's of 6, 24, and 72 hours. All-season estimates of PMP in HMR-51 were assumed to represent upper bounds of PMP for the results presented in this report. Because the all-season values of HMR-51 were found to differ from those of HMR-33, the seasonal results in this report were intended to supersede the seasonal results in HMR-33.

The 48-hour all-season PMP referenced in the SSAR is 25.2 inches (SSAR Table 2.4-8) and is assumed to be uniformly distributed over the entire 296 $mi^2$ drainage area. The corresponding 24-hour all-season PMP for the same area (SSAR Table 2.4-8) is 22.6 inches, and the 24-hour all-season PMP for a 200 $mi^2$ area is 24.0 inches (SSAR Table 2.4-5). The PMP for the 296 $mi^2$ area was based on the use of a scaling factor "F" of 0.94 obtained from HMR-33 (i.e., $PMP_{296} = PMP_{200} \times F$). A review of the more recent HMR-51, -52, and -53 publications indicates that the 24-hour PMP for a 200 $mi^2$ area is 25.0 inches (HMR-51) and the 48-hour PMP for a 200 $mi^2$ area is 28.0 inches (HMR-51). Using the HMR-33 scaling factor of 0.94 to convert from 200 to 296 $mi^2$, the 24- and 48-hour PMP estimates for the 296 $mi^2$ Salt Creek Drainage Basin would be approximately 23.5 and 26.3 inches, respectively.

A summary of this information is as follows:

| Period (hr) | Area ($mi^2$) | Source | PMP (in.) | Factor "F"[1] |
|---|---|---|---|---|
| 24 | 200 | HMR-33 (Figure 1)<br>USAR Table 2.4-5 | 24.0 | |
| 24 | 296 | HMR-33 PMP x F<br>USAR Table 2.4-8 | 22.6 | 0.94 |
| 24 | 200 | HMR-51 (Figure 25) | 25.0 | |
| 24 | 296 | HMR-51 PMP x F | 23.5 | 0.94 |
| 48 | 296 | HMR-33 (Figure 2)<br>USAR Table 2.4-8 | 25.2 | |
| 48 | 200 | HMR-51 (Figure 26) | 28.0 | |
| 48 | 296 | HMR-51 PMP x F | 26.3 | 0.94 |

[1] Factor "F" (obtained from USAR and HMR-33, Figure 2) is used to determine PMP for 296 $mi^2$ area (i.e., $PMP_{296} = PMP_{200} \times F$)

Based on the information provided and discussed above, the 24- and 48-hour PMP estimates derived from the information contained in the more recent HMR publications are approximately 4 percent greater than those predicted by the previous HMR-33 report and summarized in the CPS USAR. The increase in the 48-hour PMP from 25.2 to 26.3 was evaluated to estimate the associated increase in the PMF and potential hazard to the plant site. A mass balance approach was used by estimating the increased volume of rainfall over the lake watershed and associated runoff. The runoff is added to the lake at previously calculated PMF levels (Elevation 809.9) to determine changes in lake discharge and lake level.

Assuming a 1.1-inch increase in the 48-hour PMP and an estimated 29.8 percent runoff to rainfall ratio (measured value from measured rainfall and runoff at the USGS Rowell Gauging Station, Table 2.3-2 of the EGC ESP Environmental Report) there is an estimated 0.1-inch increase in the lake water surface elevation. This increase includes consideration for a nominal increased discharge (1,300 cfs) at the dam due to the higher water surface elevation over the 48-hour period of the PMP. The change in lake level is not considered a hazard to the plant site because there is still 20 plus feet of elevation difference between the high lake level and the plant site.

Table 1.4-1, Item 1.2.2 and Sections 2.4.3.1 and 2.4.2.2 of the SSAR will be revised to provide additional information on the use of procedures HMR-51, HMR-52 and HMR-53 on the calculated PMP and PMF values.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

Revise SSAR, Chapter 2, Section 2.4.3.1, third paragraph, from:

The maximum potential snow accumulation was studied and estimated to correspond to a weight of 35 psf, which would be attributable to the 100 yr snowpack of 22 psf (ASCE, 2000) plus the snow accumulated from the...

To read (add new paragraph to section 2.4.3.1 & change third paragraph, first sentence (35 to 40))

The 48 hour PMP of 25.2 inches developed above was based on methods described in Hydrometeorological Report No. 33. More recent procedures for developing PMP values are presented in Hydrometeorological Report No. 51 (USDOC, 1978), Hydrometeorological Report No. 52 (USWB, 1982) and Hydrometeorological Report No. 53 (USNRC, 1980). The use of these later procedures results in a calculated PMP of 26.3 inches, which is an increase of 1.1 inches, or 4 percent, compared to the 25.2 inches using the previous method. Subsequent analyses of the potential effects of the PMP on other ESP site characteristics (including probable maximum flood (PMF)) have indicated that this increase is essentially insignificant.

The maximum potential snow accumulation was studied and estimated to correspond to a weight of 40 psf, which would be attributable to the 100 yr snowpack of 22 psf (ASCE, 2000) plus the snow accumulated from the...

Revise SSAR, Chapter 2, Section 2.4.2.2, from:

At the dam site, the PMF water surface elevation in the Clinton Lake is 708.8 ft above msl. The top of the dam is at an elevation of 711.8 ft above msl. A minimum freeboard of 3 ft from the PMF water level was provided in order to determine the elevation at the top of the dam. This provides for protection against overtopping of the dam by the PMF and wave action. The maximum wave run-up elevation at the dam, due to sustained 40 mph wind acting on the PMF water level, is 711 ft above msl.

To read:

At the dam site, the PMF water surface elevation in the Clinton Lake is 708.8 ft above msl using the 48-hr duration CPS PMP value of 25.2 inches. As noted in SSAR section 2.4.3.1 use of more recent procedures to estimate PMP results in an increase of 1.1 inches for the 48-hr ESP PMP (total of 26.3 inches). Use of this value would result in an increase of the PMF water surface elevation of Clinton Lake to 708.9 ft above msl, which represents a negligible increase compared to the previous estimate of 708.8 ft msl. The top of the dam is at an elevation of 711.8 ft above msl which provides a freeboard of approximately 3 ft from the PMF water level. This provides for protection against overtopping of the dam by the PMF and wave action. The wave run-up elevation due to sustained wind acting on the PMF water level is discussed in Sections 2.4.3.6 and 2.4.10.

Revise SSAR, Chapter 2, Section 2.4 References, to include the following two new references:

U. S. Department of Commerce (USDOC) and U.S Army Corp of Engineers (USACOE). L.C. Schreiner and J.T. Reidel. Probable Maximum Precipitation Estimates, United States East of the 105th Meridian. Hydrometeorological Report No. 51. June 1978.

U.S. Nuclear Regulatory Commission (USNRC). NUREG/CR-1486. Seasonal Variation of 10-Square-Mile Probable Maximum Precipitation Estimates, United States East of the 105th Meridian. Hydrometeorological Report No. 53. April 1980.

Revise SSAR, Chapter 1, Table 1.4-1, Item 1.2.2, from:

1.2.2 Snow Load 35 lb/ft2

To read:

1.2.2 Snow Load 40 lb/ft2

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.2-2**

Please provide a description of likely changes to both upstream land use and downstream water demand that would alter either the intensity or frequency of flood risk and low-flow conditions.

**EGC RAI ID: R9-7**

**EGC RESPONSE:**

A shift in upstream land use to a more impervious watershed (with development) will tend to deliver more precipitation as runoff to Clinton Lake. This will also tend to decrease the duration of low flows because more water will be routed through the lake. No change is expected in the 100-year flood levels because of the large flow attenuation capacity of the lake.

Salt Creek (downstream of Clinton Lake) is not a likely candidate for changes that would result in additional demand since the flow of the creek is often low for long periods of time.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

Revisions to SSAR, Chapter 2, Section 2.4.1.2, are provided in the response to RAI 2.4.1-3

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.2-3**

Please document any historical hill slope failures in the watershed. Also, please analyze the ability of a hypothetical hillslope failure to impact the plant. What would be the maximum terminal height of such a hypothetical wave?

**EGC RAI ID: R9-8**

**EGC RESPONSE:**

As discussed in SSAR, Appendix A, Section 5.1.3.5, there are no landslides documented for DeWitt County, and the landslide potential on the ISGS map is low. Although SSAR, Appendix A, Section 5.1.3.5 also indicates that the slopes near the EGC ESP Site associated with Clinton Lake have been very stable for the past 30 years, and do not pose a landslide hazard, the effects of a hypothetical hill slope failure and the maximum generated wave height have been postulated and estimated at 0.4 ft. SSAR Section 2.4.6 will be revised to provide this additional information.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

Revise SSAR, Chapter 2, Section 2.4.6, from:

The site will not be subjected to the effects of tsunami flooding because the site is not adjacent to a coastal area (CPS, 2002).

To read:

The site will not be subjected to the effects of tsunami flooding because the site is not adjacent to a coastal area (CPS, 2002). However, the impacts to the plant were determined for a lake tsunami generated from hypothetical hillside slope failures. The tsunami analysis was performed using very conservative assumptions that yielded a maximum tsunami wave height estimated to be 0.4-foot. The relatively small landslide velocity, slope angle, and thickness of the landslide contribute to the minimal creation of waves in Clinton Lake. Based on this analysis, it is concluded that landslide-induced tsunamis do not pose a risk to the EGC ESP site.

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.2-4**

Please document any seismically-induced seiches in Clinton Lake.

**EGC RAI ID: R9-9**

**EGC RESPONSE:**

A search of existing literature was performed to determine if any seismically induced seiches have occurred in Clinton Lake or any other lake in the area. The occurrence of seiches and other seismic wave activity are extremely rare in the non-coastal Midwest; subsequently no seismically-induced seiche information was identified. Additionally, CPS personnel did not report any seiches in Clinton Lake during the June 2004, magnitude 4.5 earthquake.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

None

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.2-5**

Please demonstrate that the drainage capacity at the existing grade is sufficient to accommodate local intense precipitation. If the capacity is not sufficient, please describe any active safety-related drainage systems that will be installed for the new units.

**EGC RAI ID: R9-10**

**EGC RESPONSE:**

The proposed plant site generally drains to the southeast with no significant internally drained areas for storm water to accumulate during local intense precipitation. The proposed ESP plant buildings and site drainage components will generally direct drainage in the same direction and will be designed so that no building or critical plant facility will be inundated by local intense precipitation. Examples of drainage features that may be incorporated, as necessary, include raised building entrance points, surface drains, subsurface drainage pipes, and surface drainage channels to Clinton Lake.

The site drainage for the ESP facility is not designed at this time since portions of the system will be dependent upon the reactor selected. The nominal grade elevation of 735 ft provides over 20 ft of elevation difference for drainage based on the maximum flood elevation for Clinton Lake. This is a large enough elevation difference to allow designing a drainage system to handle maximum site precipitation without requiring any active components.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

None

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.3-1**

Please describe the status of the U.S. Army Corps of Engineers SPRAT computer program referenced in Section 2.4.3.3 and any software quality assurance measures that were used to augment use of this software in support of the ESP application.

**EGC RAI ID: R9-11**

**EGC RESPONSE:**

A significant portion of the CPS Dam design included preparation of a discharge rating curve. Discharge rates at various lake levels are established based on dam, lake and watershed hydrologic characteristics. The dam designer used the SPRAT model as the design tool and to prepare the current discharge rating curve for the dam. The ESP facility does not require that the discharge rating curve for the dam be revised, and therefore does not require use of the SPRAT model.

SSAR Section 2.4.3 will be revised to indicate that the hydraulic modeling, i.e., SPRAT and Water Surface Profiles were performed as part of the dam design and not part of the ESP Application.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

Revise SSAR, Chapter 2, Section 2.4.3, paragraphs 2 and 3, from:

The floodwater surface elevations in the lake were determined by routing the floods through the lake using the Spillway Rating and Flood Routing (SPRAT) computer program (USACOE, 1966a). The 100 yr flood level in the lake at the dam site is at an elevation of 697 ft. The routed peak outflow through the service spillway is 11,610 cfs. Based on the flood frequency analysis, the 100 yr flood flow at the dam site, based on records before the dam was built (that is, before November 1977), was estimated to be 26,400 cfs. As shown by the analysis of the post-dam, however, the attenuation effect of the lake will reduce the expected magnitude of the flood flows downstream from the dam. The PMF level with an antecedent standard project flood is at an elevation of 708.8 ft above msl at the dam and 708.9 ft above msl at the plant sites.

The flooding effects on the headwater area of the cooling lake were determined by backwater computations using the computer program, "Water Surface Profiles" (USACOE, 1968). Figure 2.4-7 and Figure 2.4-8 depict the water surface profiles of the 100 yr flood and the PMF under natural conditions for Salt Creek and the North Fork of Salt Creek, respectively. The Illinois Central Railroad depicted on Figure 2.4-8 was procured by the Canadian National Railroad.

To read:

The floodwater surface elevations in the lake were determined during the design of the dam for CPS by routing the floods through the lake using the USACOE's Spillway Rating and Flood Routing (SPRAT) computer program (CPS, 2002). The results of the CPS modeling indicated that the 100 yr flood level in the lake at the dam site is at an elevation of 697 ft. The routed peak outflow through the service spillway is 11,610 cfs. Based on the flood frequency analysis, the 100 yr flood flow at the dam site (based on records before the dam was built, i.e., before November 1977), was estimated to be 26,400 cfs. As shown by the analysis of the post-dam, however, the attenuation effect of the lake will reduce the expected magnitude of the flood flows downstream from the dam. The PMF level with an antecedent standard project flood is at an elevation of 708.8 ft above msl at the dam and 708.9 ft above msl at the plant sites (CPS, 2002).

The flooding effects on the headwater area of the cooling lake were also evaluated during the dam design and were determined by backwater computations using the USACOE's computer program, "Water Surface Profiles" (CPS, 2002). Figure 2.4-7 and Figure 2.4-8 depict the water surface profiles of the 100 yr flood and the PMF under natural conditions for Salt Creek and the North Fork of Salt Creek, respectively. The Illinois Central Railroad depicted on Figure 2.4-8 was procured by the Canadian National Railroad.

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.3-2**

Please explain how the wave runup calculations were bounded through the examination of the Combined Events Criteria indicated in the ANS 2.8 1992 Standard. Discuss coincident wave calculation and the basis for applying a 40 miles per hour (mph) design wind.

**EGC RAI ID: R9-12**

**EGC RESPONSE:**

The maximum wave run-up elevation at the dam and the CPS site, due to a sustained 40 mph overland wind speed acting on the PMF water level, was previously estimated to be 711 ft above mean sea level (CPS USAR Section 2.4.2.2, "Flood Design Considerations"). Additionally, CPS USAR Section 2.4.10, "Flooding Protection Requirements," considered a 48 mph overland wind speed coincident with the PMF pool in the design of the circulating water screen house at CPS. The use of these values in the USAR did not result in any safety related issues for the CPS station site since the site was determined to be 22.2 feet above the calculated wave run-up level and 27.1 feet above the calculated PMF level, with the conclusion that the CPS plant facility could not flood under any circumstances.

The ESP Facility Site is considered to be a "dry site", consistent with Condition 3 of Attachment 2, Section 2.4.3 of NRC's RS-002 Review Standard, and will not be susceptible to flooding under any circumstances. Furthermore, the operation of the ESP Facility will not impact the potential for flooding at the existing dam or the plant site. Therefore, the use of *any* wind speed for the purpose of calculating wave run-up effects on PMF levels should be inconsequential. The use of the 40 mph wind speed was retained in the ESP SSAR wave run-up analysis to be consistent with what was originally prepared for the CPS SAR and what is currently relied upon in the CPS USAR. A review of more recent information published by the American Nuclear Society (ANSI/ANS-2.8-1992, "Determining Design Basis Flooding at Power Reactor Sites") has in fact indicated that a wind speed of somewhat greater magnitude may be appropriate for design considerations when estimating the impact of wind speeds on flooding. Figure 1 from the 1992 ANS publication, "Isotach 0.50 Quantiles (in miles per hour): Annual Extreme-Mile, 30 ft Above Ground, 2-yr Mean Recurrence Interval," indicates that a wind speed of 52 mph may be more appropriate for calculating wave run-up height coincident with the PMF pool height.

Screening analyses to conservatively estimate the impact of a 52 mph wind speed on wave run-up calculations have been performed, primarily to determine the incremental impact on the PMF attributable to the increase in wind speed as compared to the original wind speed of 40 mph. New coincident wave heights have been established based on the 52 mph coincident wind speed as 3.81 feet (or 0.94 feet over 40 mph wind wave height) for the significant waves and 6.39 feet (or 1.58 feet over the 40 mph wind wave height) for maximum waves. Wave height increases are not considered significant in terms of the 20 plus feet of elevation between the PMF and the plant site.

SSAR Sections 2.4.3.6 and 2.4.10 were revised to provide additional information on wave run-up, including revisions identified in the response to RAI 2.4.10-1.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

Revise SSAR, Chapter 2, Section 2.4.3.6, from:

The maximum runup elevation at the dam for significant waves was calculated by superimposing the significant wave effects of a coincident 40 mph wind on the probable maximum flood water level at the dam site. The calculations are based on an effective fetch of 0.9 mi, a windtide fetch of 4 mi, a water depth of 58 ft, and an upstream slope of the dam of 3:1 (horizontal to vertical) with riprap. The wave runup obtained is 2.2 ft, *resulting in a significant wave runup elevation of 711.0 ft above msl at the dam site.* The top of dam is at elevation 711.8 ft above msl.

To read:

Using the same assumptions regarding fetch, water depth, and shore slope, and assuming non-breaking waves, the wave runup was recalculated with an increased wind velocity from 40 mph to 52 mph (ANSI, 1992). This coincident wind velocity increase showed an increase in the significant (33.3% probability) wave runup to 3.81 feet. Similarly for the maximum (1% probability) wave runup, the runup value increased to 6.39 feet. Superimposing the wave runup values on the probable maximum flood level at the plant (station) site resulted in a wave runup elevation of 712.8 feet for significant waves and elevation of 715.4 feet for the maximum (1%) waves. Both elevations are significantly below the approximate grade elevation of 735 feet above msl.

Revise SSAR, Chapter 2, Section 2.4.10, from:

The maximum (1 percent) wave runup elevation at the station site is 713.8 ft above msl, produced by a sustained 40 mph overland wind acting on the PMF still water elevation of 708.9 ft above msl. The approximate grade elevation for the EGC ESP Facility of 735 ft above msl is approximately 21 ft above the maximum wave runup level and 26 ft above the PMF water level. The safety-related facilities in the station area would not be affected by the PMF conditions in the lake. The only EGC ESP Facility structure that would be affected by the PMF is the intake structure, which will be designed for flood protection of the safety-related equipment located in the intake structure.

Wind-wave forces caused by a sustained 48 mph overland wind coincident with the PMF pool and 67 mph overland wind coincident with normal pool will be considered in the design of the EGC ESP Facility intake structure. Both breaking and non-breaking wave forces will be considered. The flooding effects of the local PMP are design related and will be addressed at the COL stage.

To read:

The maximum (1 percent) wave runup elevation at the station site is 715.4 ft above msl, produced by a sustained 52 mph overland wind acting on the PMF still water elevation of 708.9 ft above msl. The approximate grade elevation for the EGC ESP Facility of 735 ft above msl is approximately 20 ft above the maximum wave runup level and 26 ft above the PMF water level. The safety-related facilities in the station area would not be affected by the PMF conditions in the lake. The only EGC ESP Facility structure that would be affected by the PMF is the intake structure, which will be designed to consider flood protection of the safety-related equipment located in the intake structure.

The flooding effects of the local intense precipitation (i.e., the local PMP values) are design related (since the effects are dependent on site grading and drainage design) and will be addressed at the COL stage as indicated in Section 2.4.2.3.

Revise SSAR, Chapter 2, Section 2.4 Reference, to include the following new reference:

American National Standards Institute / American Nuclear Society (ANSI/ANS). ANSI/ANS-2.8-1983. "Determining Design Basis Flooding at Power Reactor Sites." American Nuclear Society. La Grange Park, IL. 1992.

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.7-1**

Please discuss the potential for ice sheet collision impacts on the intake structure and quantify the force of impact.

**EGC RAI ID: R9-13**

**EGC RESPONSE:**

There is potential for ice sheet effects on the intake structure. As such, the ice sheet effects will be considered at the COL stage.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

Revise SSAR, Chapter 2, Section 2.4.7, to add the following at the end of the section:

Since there is a potential for ice sheet effects on the ESP intake structure, the final intake structure design at the COL stage will include the effects of the applicable ice forces. The force resulting when a moving ice sheet and a structure interact is limited to the magnitude of force necessary to fail the ice sheet in crushing, bending, buckling, splitting, or a combination of these modes. The total force on the entire structure is important for designing foundations to resist sliding and overturning. Contact forces over small areas, or local contact pressures, are important for designing internal structural members and the external skin of a structure.

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.7-2**

Please explain how the ice sheet thickness identified in Section 2.4.7 was calculated and provide the input assumptions.

**EGC RAI ID: R9-14**

**EGC RESPONSE:**

The ice sheet thickness was calculated using the standard methodology described in USACOE, *Engineering and Design-Ice Engineering (EM1110-2-1612).*

General assumptions used include:

Ice formation occurs over a four month period from November through February.

Little snow accumulation is expected on the ice surface. Therefore, snow ice which can form on the lake ice surface is not included in the calculation.

Because there are no records of freeze up for Clinton Lake, an approximate date was determined using the *observed* freeze up dates for Lake Monona in Madison, Wisconsin, located approximately 180 miles north of Clinton Lake. The two lakes are of similar size and volume.

Clinton Lake began filling with water in October 1977. Winter seasons 1978 through 2003 were used in the analysis.

The input parameters include:

Temperature data from Decatur, Illinois (10 miles to the south) were used for computing freezing degree days.

A conservative approach was taken in which the coefficient of ice cover of 0.80 was used. This assumes a windy lake with no snow cover which will tend towards a greater estimation of ice thickness.

The results of the analysis indicate that a maximum ice thickness on Clinton Lake is estimated at 22.2 inches, with an average thickness of 14.2 inches, for years in which the lake freezes.

Section 2.4.7 of the SSAR will be revised to provide additional information on ice depth.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

Revise SSAR, Chapter 2, Section 2.4.7, second paragraph, from:

The average thickness of sheet-ice that could form in the lake area is estimated to be 10 in, without considering the increase in lake water temperature due to station operation. The calculation is based on the empirical method developed by Assur (Chow, 1964), using a coefficient of snow cover of 0.85 and a value of 115 for the accumulated degree-days since freeze-up obtained from the average temperature data of Decatur, Urbana, and Springfield (USWB, 1964).

To read:

Ice thickness calculations were completed for Clinton Lake for 26-years extending back from the 2003-2004 winter. The average thickness of sheet-ice calculated over that period is 14.2-inches. The maximum thickness calculated was in the 1978-1979 winter of 22.2-inches. The calculations did not consider the influence of heat discharge from the power plant. The thickness was estimated using the standard method from the U. S. Army Corps of Engineers (USACOE, 2002). The coefficient of ice cover condition used in the calculation was 0.80 with freezing degree days calculated for each year from temperature data from Decatur, Illinois (MRCC, 2004).

Revise SSAR, Chapter 2, Section 2.4.7, first portion of third paragraph, from:

The inlet to the CPS screen house is at elevation 670 ft above msl, 5 ft below the design water level of the ultimate heat sink, giving a water depth of 12.3 ft for station operation during lake low water level conditions. The occurrence of an estimated ice thickness of 10 in in the intake area when the water level is at elevation 675 ft above msl would not block the flow into the CPS screen house. The availability of CPS station cooling water will not be affected by ice formation in the screen house area.

To read:

The inlet to a screen house at elevation 670 ft above msl is 5 ft below the design water level of the ultimate heat sink, giving a water depth of 12.3 ft for station operation during lake low water level conditions. The occurrence of a maximum ice thickness of 22.2 inches in the intake area when the water level is at elevation 675 ft above msl would not block the flow into the screen house. Thus, the availability of EGC ESP facility cooling water will not be affected by ice formation in the screen house area.

Revise SSAR, Chapter 2, Section 2.4 References, to include the following new reference:

Midwestern Regional Climate Center (MRCC). Champaign, IL. Daily Freezing Degree Days from 1978-2004 for Decatur, Illinois. 2004.

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.7-3**

Please describe the relationship (layout and depth) of the ESP intake relative to the current Clinton Power Station (CPS) intake.

**EGC RAI ID: R9-15**

**EGC RESPONSE:**

The ESP plant intake will be located approximately 65 ft west of the existing CPS plant intake. The bottom concrete slab of the CPS intake structure is at elevation 657 ft 6 in and the inlet extends from elevation 670 ft up to elevation 697 ft. The lake bottom is at elevation 668 ft 6 in. The layout of the ESP facility intake will be similar to the CPS intake. The bottom of the inlet will be at elevation 670 ft and the inlet opening will extend upwards to at least the normal water level in Clinton Lake of 690 ft. The base mat of the ESP facility intake will be located at approximately elevation 657 ft 6 in with the final elevation dependent on the submergence required for the pumps when they are purchased. The pumps will be mounted at approximately elevation 699 ft, the same as CPS.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

None

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.7-4**

Please describe the site characteristics of frazil and anchor ice formation.

**EGC RAI ID: R9-16**

**EGC RESPONSE:**

The site characteristics for frazil ice and anchor ice are addressed in a new Section 2.4.7.1 added to the SSAR, Chapter 2.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

Revise SSAR, Chapter 2, to add new Section 2.4.7.1, Frazil Ice and Anchor Ice:

2.4.7.1 Frazil Ice and Anchor Ice

At power plants, accumulations of frazil ice or anchor ice can cause blockages of the intakes of water systems by accumulating on any trash racks or screens in the intake path. Frazil ice is fine, small, needle-like structures or thin, flat circular plates of ice suspended in water. In supercooled water, frazil ice particles can adhere to each other forming clusters or flocs that accumulate. Frazil ice on the surface of supercooled water can form floating ice pans, or on the bottom of solid ice cover can form hanging ice dams. Anchor ice is submerged ice attached or anchored to a streambed. Generally anchor ice forms in shallow turbulent water. These conditions could occur in streams that empty into Clinton Lake but these conditions are not expected in the intake structure area. When the anchor ice breaks loose from the streambed it would flow into Clinton Lake and form or join with the cover ice on the lake. However, this anchor ice would not interfere with the operation of the ESP intake structure.

The current CPS facility water intake is designed to avoid obstruction from surface ice and accumulations of frazil ice. Protection against any probable ice blockage in the intake area is provided by recirculating waste heat through a warming line back to the inlet to the screen house. The warming line is designed to maintain a minimum water temperature of 40 degrees F at the intake during winter operation. The CPS plant has not experienced operational problems with frazil ice accumulation on intake facilities.

The ESP facility intake will be located in the vicinity of the existing CPS intake. A means will be provided in the design of the ESP intake, e.g., a warming line from the hot side of the cooling towers, to prevent the formation of frazil ice at the intake for the essential service water cooling tower make-up to protect against the effects of ice blockage. These features will be designed for operation of the EGC ESP facility independent of the CPS facility.

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.7-5**

Please discuss the impacts to ice formation if the existing unit was no longer operating.

**EGC RAI ID: R9-17**

**EGC RESPONSE:**

The impact of ice formation if the existing CPS unit is no longer operating is discussed in two new paragraphs of text added to the end of SSAR, Chapter 2, Section 2.4.7 and in new Section 2.4.7.1 provided in response to RAI 2.4.7-1.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

Revise SSAR, Chapter 2, Section 2.4.7, to add the following to the end of Section 2.4.7 (and following the additions included with the response to RAI 2.4.7-1):

No ice formation currently occurs in the discharge channel with the CPS operating. No change is expected to occur with the addition of the proposed ESP facility. The channel capacity is roughly 1,372,000 gpm at 1.5 fps. The CPS discharges about 445,000 gpm of warm cooling water during winter months. Adding the proposed ESP facility warm blowdown water discharge of approximately 12,000 gpm would increase the discharge rate to 457,000 gpm. The combined capacity is well within the capacity of the channel.

There is some potential for ice formation on portions of the discharge channel if the ESP facility is operated alone, without the CPS online. The warm water discharge volume would be significantly reduced to only the ESP warm water blowdown discharge rate of approximately 12,000 gpm. This would result in a lower heat output and flow velocity roughly proportional to the reduction in the flow rate. Under these conditions there is an increased potential for surface ice accumulation particularly at locations away from the point of discharge. The accumulation would be much thinner than the predicted normal lake accumulation because of the heat and velocity components of the ESP facility discharge. If ice does form it will tend to be thin and remain in place on the water surface allowing unrestricted flow below the water surface. Therefore, ice movement (and associated jamming or clogging of the discharge channel) is not expected.

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.7-6**

Please discuss whether or not ice sheet formation is likely to constrain the intake depth.

**EGC RAI ID: R9-18**

**EGC RESPONSE:**

Ice sheet formation on Clinton Lake will not constrain the ESP intake depth. The thickness of ice cover is a small percentage of the intake height, and the warming water used to prevent Frazil ice will retard the formation of an ice cover in the immediate area of the intake trash racks or screens for the essential service water cooling tower make-up.

Section 2.4.7 of the SSAR will be revised to provide additional information on ice effects related to intake depth.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

Revise SSAR, Chapter 2, Section 2.4.7, first portion of the fourth paragraph, from:

The only EGC ESP Facility structure exposed to the effect of ice on Clinton Lake is the new intake structure. The new intake structure will be similar to the existing CPS intake structure except it will be considerably smaller. It is planned to draw water from the same bottom elevation as the CPS intake structure.

To read:

The only EGC ESP Facility structure exposed to the effect of ice on Clinton Lake is the new intake structure. The new intake structure will be similar to the existing CPS intake structure except it will be smaller. The intake opening(s) to the ESP intake structure will extend vertically from elevation 690 feet, or higher, down to approximately elevation 669 feet. The formation of ice on Clinton Lake would potentially block only a small portion of the intake opening since the separation distance between the surface ice and the bottom of the intake is significant.

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.7-8**

Please describe the reduction of UHS capacity caused by a loss of Clinton Dam during periods when an ice sheet is covering the lake.

**EGC RAI ID: R9-19**

**EGC RESPONSE:**

The ultimate heat sink for the EGC ESP facility will be safety related cooling towers if the selected reactor type does not use passive cooling methods. Clinton Lake is used as a make-up water source for the ESP cooling towers, not as a heat sink. If Clinton Dam is lost, the ice would be expected to be lost also since it would float on the surface. If it is postulated that the ice drops to the CPS ultimate heat sink surface following the loss of Clinton Dam there would be a small decrease in the water mass available as a heat sink for CPS which is more than offset by the additional heat removal capacity gained by having the latent heat of fusion of the ice available for heat removal. Adequate water volume for make-up to the ESP cooling towers would be available since the required shutdown of CPS after a dam failure would supply heat to convert the ice back into water.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

None

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.8-1**

Please explain how the cooling needs for the CPS and ESP facilities were calculated as discussed in Section 2.4.8.1.5.

**EGC RAI ID: R9-20**

**EGC RESPONSE:**

The 30-day cooling needs for emergency shutdown of the CPS were calculated using the LAKET model, a one dimensional lake temperature prediction program. The LAKET modeling was conducted as part of the design of the CPS Ultimate Heat Sink (UHS) assuming dual 992 MWe power facilities. The model results for cooling volume along with volume estimates for physical processes of sedimentation from a 100-year flood, sedimentation introduced by liquefaction caused by a seismic event, and fire protection were used to established the minimum UHS volume. The minimum volume calculated for the CPS UHS is 849 ac-ft (CPS, 2002, USAR page A2.5-2).

The 30-day cooling needs for emergency shutdown of the EGC ESP are proposed to be satisfied with new cooling towers for an ultimate heat sink. The cooling towers provide the necessary heat dissipation but require make-up water that is proposed to be drawn from the CPS UHS. The estimated 30-day volume of make-up water required for emergency shutdown is 87 ac-ft. This volume was calculated based on the PPE 30-day make-up water volume, plus a 33 percent factor for blowdown, plus an overall 20 percent margin.

The volume of the CPS UHS is periodically measured and was recently measured to be 1,022 ac-ft. If the CPS UHS minimum volume of 849 ac-ft is subtracted from the recently measured UHS volume of 1,022 ac-ft the resulting available volume is 173 ac-ft. This available volume is significantly greater than the needed EGC ESP make-up water volume of 87 ac-ft by 86 ac-ft. Therefore the current CPS UHS has sufficient volume for both the CPS and ESP facilities.

Surface area was also checked, as it is the single most important factor for CPS heat dissipation to the atmosphere. The design surface area of the UHS at elevation 675 ft above msl is about 150 acres. The as-built area (at elevation 675 ft above msl) is about 158 acres, slightly grater than the design area. Drawing 87 ac-ft of water from the UHS to accommodate the EGC ESP make-up water volume reduces the UHS depth by about 0.5 feet. The surface area is also reduced but it remains higher than the design surface area of 150 acres. Therefore the design heat dissipation capacity associated with surface area is maintained.

Additional detail on the modeling review and volumetric and heat dissipation analysis is provided below.

Review of the Original CPS Modeling. The original analysis of the UHS was performed using the LAKET computer program (transient one-dimensional lake temperature prediction program). The modeling was performed to determine the maximum possible starting temperature of the UHS and not exceed the 95°F UHS outlet temperature during a two-unit LOCA and LOOP. The model was updated in 1985 and a sensitivity test was performed in 1986. The sensitivity analysis calculated maximum temperatures for the UHS with various depths to determine if dredging was necessary to remove silt. In addition, the maximum UHS temperature which will allow one of the dual units to shut down from 100 percent power and not exceed the 95°F UHS outlet temperature was also examined. The results of the modeling indicate that the maximum outlet temperature of 95° will not be exceeded with an initial volume of 590 acre-feet and initial UHS temperatures ranging from 84 to 95°F.

Review of the model documentation indicates that the inputs to the original 1995 LAKET model, and additional modeling performed in 1985 and 1986, were based on worst-case (most conservative) environmental parameters. Salt Creek temperature (downstream from Clinton Lake) and wind speed data were examined for the period of time prior to 1975 and recent time periods and no significant changes in these parameters were noted between the two periods of time (USGS, 2002). The original model results remain applicable and acceptable.

EGC notes that the previous modeling was based on a one-dimensional vertically and laterally averaged approach. Such a model does not account for thermal stratification. Stratification would result in higher surface temperatures than the depth-averaged value. This would enhance heat transfer to the atmosphere, making model predictions more conservative (lower than expected heat transfer rates and faster cooling of the UHS). The existing intake structure is located so that it is taking in water from the vertical depth of the lake. The new intake structure will also be designed to take water from the vertical depth of the lake. Therefore, in the existing and anticipated designs, the initial model approach and results remain valid and appropriate.

Volumetric Analysis for Exelon ESP. The UHS for the CPS is designed to provide sufficient water volume and cooling capacity to safely shut down two 992 MWe BWR units and maintain the plant in a shutdown condition for 30 days with no make up water. The minimum UHS volume of 849 acre-feet accounts for the minimum cooling capacity requirement to meet 95º F shutdown service water inlet temperature (590 acre-feet), fire protection (3 acre-feet), sedimentation from a 100-year flood (35 acre-feet), and sediment inflow from liquefaction (221 acre-feet) (CPS USAR, page A2.5-2, 2002). The minimum CPS UHS volume of 849 acre-feet of water, based on the 30-day emergency shut down of the two 992 MWe units, is considered more than sufficient for the existing single 1138.5 MWe CPS Facility.

Annual surveys have been conducted as part of the UHS sedimentation-monitoring program. The Ultimate Heat Sink Monitoring Program reports #20-23 (1998-2002) indicate that immediately following the dredging in 1991, the volume of the UHS was 1,054 acre-feet, and in 2001 the volume was reduced by sedimentation to 1,022 acre-feet.

The EGC ESP Facility is expected to require ≤ 87 acre-feet of cooling water from the UHS for the required 30-day emergency shut down supply. This water volume provides approximately 20% margin compared to the makeup water quantity for 30 days based on PPE data. Assuming no return flow to the UHS (i.e., the 87 acre-feet of water is unavailable for use), 935 acre-feet of the total of 1,022 acre-feet capacity of the UHS will be available for shut down and allocations for sedimentation and fire suppression for CPS. The withdrawal of the 87 acre-feet for the Exelon ESP plant and the minimum volume requirement of 849 acre-feet for CPS will allow a reserve volume of 86 acre-feet for accumulated sedimentation (based on the 2001 measured UHS volume).

Adequate UHS volume will be maintained for CPS and the Exelon ESP Facility if the total UHS volume is maintained to account for the initial required volume of 849 acre-feet plus the 87 acre-feet required by the Exelon ESP Facility. The current practice calling for dredging the UHS when sedimentation decreases the total UHS volume to less than the 849 acre-feet will be carried out at a schedule so that UHS volume does not decrease to below 936 acre-feet. The estimated annual sedimentation amount is about 5 acre-feet. While dredging should occur based on observed volume measurements, the new dredging trigger volume of 936 acre-feet is expected to result in dredging at least once every 23 years.

Heat Load Analysis. The relationship between UHS surface area and volume based on the design and as-built data found in the September 1975 and April 1985 modeling documents indicates that the immediate reduction of the existing volume by 87 acre-feet would result in a decrease of the water level by approximately 0.5 feet. The change in the UHS water level will not significantly impact the surface area, and in fact the surface area remains the same or greater than the original design. This indicates that the capacity of the UHS to reject heat to the atmosphere is maintained. In addition, the CPS USAR Section 9.2.5.3 identifies that the total heat rejection to the UHS for an emergency shutdown, over 30 days, for the Clinton Power Station Facility is less than that assumed in the original design basis modeling (CPS, 2002). Therefore, the original modeling of UHS is still applicable for the new proposed conditions, and the heat capacity of the UHS is adequate.

Section 2.4.8.1.5 of the SSAR will be revised to provide additional information on the calculation of cooling requirements.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

Revise SSAR Chapter 2, Section 2.4.8.1.5 from:

The EGC ESP Facility will use the existing UHS submerged pond as the supply source for makeup water to any required safety-related cooling tower(s) if Clinton Lake is not available. The makeup water will be supplied from the new intake structure located next to the existing screen house. The UHS pond capacity has been evaluated as sufficient volume to provide shutdown cooling for the existing CPS and makeup water to the EGC ESP Facility safety-related cooling tower(s) for 30 days.

To read:

The EGC ESP Facility will use the existing UHS submerged pond as the supply source of makeup water to any required safety-related cooling tower(s) if Clinton Lake is not available. The makeup water will be supplied from the new ESP intake structure located next to the existing CPS screen house. The UHS pond capacity has been evaluated and found to have sufficient volume to provide 30-day emergency shutdown cooling for the existing CPS and makeup water to the EGC ESP Facility safety-related cooling tower(s). The CPS safety-related cooling water volume is conservatively based upon the volume established for the original dual 992 MWe plants. The EGC ESP safety related volume for cooling tower make-up water was calculated based on the PPE evaporation rates for the UHS cooling towers plus a 33% margin for blowdown plus an overall 20% margin above the value obtained using the PPE values. With the combined CPS and ESP emergency cooling volumes there is enough excess UHS volume to provide for a dredging interval in excess of 20 years.

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.8-2**

Please discuss how the flow velocities were computed over the crest and toe of the submerged UHS dam discussed in Section 2.4.8.1.5. Please provide figures indicating where the toe of the UHS dam is relative to the fill shown in Figures 2.4-14 and 2.4-15.

**EGC RAI ID: R9-21**

**EGC RESPONSE:**

The SSAR, Chapter 2, Section 2.4.8.1.5, discussion of flow velocities over the crest and toe of the submerged UHS dam is unnecessary detail for an ESP review and the section will be revised by removing the discussion of velocities over the crest.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

Revise SSAR, Chapter 2, Section 2.4.8.1.5, from:

The area of the ultimate heat sink at the design water surface elevation of 675 ft above msl is 158 ac with a total volume of 1,067 ac-ft. The velocities over the submerged dam were analyzed for flow conditions resulting from a sudden breach in the main dam. The breach was conservatively assumed to occur at the time of the PMF with the lake water level at elevation 708.8 ft above msl. An instantaneous breach 100 ft wide and extending down to the Salt Creek bed was postulated. The ultimate heat sink and the lake area downstream of the submerged dam were analyzed to evaluate the flow conditions due to the breach. The conventional level pool reservoir routing method was used. This method is based on the premise that the inflow volume minus the outflow volume equals the change in storage. The inflow volume is the flow through a control section, which is the constriction due to a railroad bridge upstream of the ultimate heat sink. The water surface elevations upstream and downstream of the submerged dam were determined from the flood routing calculations. Based on the water surface elevations and the corresponding flow over the submerged dam, the maximum velocities at the crest and at the toe of the dam were calculated. The maximum velocities obtained are 3.8 and 11.8 fps at the crest and at the toe of the submerged dam, respectively, occurring 43 hours after the main dam breach. Correspondingly, a maximum velocity of 1.2 fps on the face of the baffle dike is obtained. The maximum velocity on the baffle dike is lower than the maximum velocity at the crest of the submerged dam because the induced flow is primarily parallel to the baffle dike.

The velocities over the submerged dam and baffle dike were also analyzed with the occurrence of a PMF on the North Fork when the lake level is at the 100 yr drought water surface elevation of 682.3 ft above msl. The maximum velocities obtained over the submerged dam and baffle dike are 2.1 and 2.6 fps, respectively.

The compacted soil-cement provided over the surface of submerged dam and baffle dike will protect these structures against the erosive effect of the velocities and flow conditions due to the postulated dam breach and the occurrence of a probable maximum flood on North Fork coincident with the 100 yr drought lake water level of elevation 682.3 ft above msl.

To read:

The area of the ultimate heat sink at the design water surface elevation of 675 ft above msl is 158 ac with a total volume of 1,067 ac-ft. The UHS for the CPS is designed to provide sufficient water volume and cooling capacity to safely shut down two 992 MWe BWR units and maintain the plant in a shutdown condition for 30 days with no make up water. The minimum UHS volume of 849 acre-feet accounts for the minimum cooling capacity requirement to meet 95º F shutdown service water inlet temperature (590 acre-feet), fire protection (3 acre-feet), sedimentation from a 100-year flood (35 acre-feet), and sediment inflow from liquefaction (221 acre-feet) (CPS, 2002, USAR page A2.5-2). The minimum UHS volume of 849 acre-feet of water, based on the 30-day emergency shut down of the two 992 MWe units is more than sufficient for the existing single uprated 1138.5 MWe CPS Facility.

Analysis conducted during the design of the submerged UHS dam and the baffle dike included evaluating flow conditions and velocities resulting from a sudden breach in the main dam that was conservatively assumed to occur at the time of the PMF. The flow conditions resulting from an occurrence of a PMF on the North Fork when the lake is at the 100 yr drought were also analyzed as part of the UHS design. As a result of the analysis, a compacted soil-cement was provided over the surface of the submerged dam and baffle dike to protect these structures against the erosive effect of the velocities and flow conditions due to the postulated dam breach and the occurrence of a probable maximum flood on North Fork coincident with the 100 yr drought lake water level of elevation 682.3 ft above msl (CPS, 2002).

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.8-3**

Please describe lake drawdown calculations.

**EGC RAI ID: R9-22**

**EGC RESPONSE:**

SSAR section 2.4.11.1 discusses the Clinton Lake drawdown evaluation. SSAR Section 2.4.11.1 will be updated to provide additional description of the evaluation.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

Revise SSAR, *Chapter 2, Section 2.4.11.1 from:*

A design drought with a recurrence interval of 100 yrs was used in the determination of the minimum water level in the cooling lake for the CPS. Factors considered in the evaluation include runoff, evaporation, and forced evaporation.

A drawdown analysis of Clinton Lake, for the original Clinton Power Station, was made for two 991 MWe units operating at a 70% load factor, starting at a normal pool elevation of 690 ft above msl, using a minimum reservoir release of 5 cfs and assuming a seepage loss of 0.5% of the lake capacity per month. The original Clinton Power Station drawdown analysis was used to evaluate the capability of Clinton Lake to provide cooling tower makeup water for the EGC ESP Facility and the cooling water requirements for CPS. The forced evaporation rate (evaporation loss due to heat rejection from CPS) was corrected as follows for use in the EGC ESP evaluation:

- Divided by 2 since only one of the two units originally planned was constructed.
- Divided by 0.7 to conservatively adjust the evaporation for a 100 % load factor.
- Multiplied by 1.20 to conservatively adjust for the additional heat load due to power uprate of CPS.

The drawdown evaluation performed for the EGC ESP Facility determined that the quantity of water available for cooling tower makeup based on a 50 yr drought is 15,808 gpm and the quantity available with a 100 yr drought is 10,222 gpm. The available water quantities maintain the lake level at or above the CPS minimum lake elevation of 677 ft above msl with both the CPS and the EGC ESP Facility in operation.

To read:

Two design droughts were established having a 5-year duration at 50-year and 100-year recurrence intervals. Factors considered in the evaluation include runoff, evaporation, and forced evaporation. Low flow runoff data for both design droughts were obtained from the CPS USAR, which cited the source Low Flows of Illinois Stream for Impounding Reservoir Design published as Bulletin 51 by the Illinois State Water Authority (Stall, 1964).

A normal lake elevation level of 690 ft above msl was used as the starting water surface level. Lake stage storage relationships were obtained from CPS ER (OLS) based on the original lake volume of 74,200 ac-ft at normal lake level (CPS, 1982). Inflow to the lake (in acre-feet) was computed on a monthly basis by multiplying the rainfall runoff (in feet) by the watershed area (in acres). Outflow from the lake was assumed to be comprised of downstream discharge; net lake evaporation minus lake precipitation; forced evaporation due to existing plant operations; seepage; and the cooling water consumed by the new facility. Rainfall runoff flows for both drought events were obtained from the CPS USAR. Runoff values were multiplied by the watershed area of 296 square miles to establish a runoff volume. Downstream discharge through the dam was assumed to be a minimum discharge of 5 cubic feet per second (cfs); or 298 acre-feet/month, when lake levels are at or below the 690-foot spill elevation. For the purpose of drought analysis calculations, the lake elevation was not allowed to exceed 690 ft above msl. The discharge was allowed to be greater than 5 cfs if inflows would increase the lake level to a level above the spillway elevation of 690 ft above msl (CPS, 2002).

Net lake evaporation minus precipitation data was obtained from CPS USAR for both the 50-year and 100-year recurrence interval droughts.

Existing plant forced evaporation data used in this analysis was developed from data given in the CPS USAR, which was based upon two originally planned 992 MWe BWR plants at a 70 percent load factor (CPS, 2002). Forced evaporation is defined as the additional evaporation produced due to an increase in lake water temperature caused by the discharge of cooling water to the lake under the open-cycle lake cooling process for the two original plants. This factor accounts for the total evaporative loss that results from dissipation of the heat rejected to the lake. The evaporative loss will occur through the cooling loop. The term forced evaporation is used because the rejected heat and associated increase in lake temperature will "force" an increase in the rate of evaporation over ambient levels to dissipate the rejected heat.

Forced evaporation rate for the two proposed plants was revised to reflect the rate for the existing single uprated plant. Only one of the two original plants was constructed at 992 MWe but was uprated in 2002 to an 1138 MWe plant. The forced evaporation rates from the CPS USAR were divided by 0.7 to obtain the evaporation rate for a 100 percent load factor. The forced evaporation rates were then divided by two to account for the fact that only one plant is present. To account for the power uprate, the forced evaporation rates were then multiplied by 1.147 (1138/992). The combination of these three factors is equal to multiplying the original forced evaporation rates by a factor of 0.82.

The forced evaporation values for the original 992 MWe plant operating at 100 percent were recently checked using an independent thermal analysis. The forced evaporation rates determined by that exercise closely matched the CPS USAR forced evaporation rates, but were slightly smaller, so the more conservative CPS USAR forced evaporation rates were used. The method used to check the forced evaporation rates is described below.

Forced and natural evaporation occur simultaneously as the circulating water flows through the cooling loop. In order to differentiate between the amounts of natural and forced evaporation, the equilibrium temperature for the lake was determined on a monthly basis using monthly climactic data over the period of record. The equilibrium temperature is the temperature of the lake water (about 1 foot below the surface) where the heat input to the lake water is exactly balanced by the heat output from the lake water. This equilibrium temperature is determined by performing a heat balance for solar heat gain, heat loss by convection, evaporative cooling and radiant heat transfer from the water to the surroundings. The amount of natural evaporation (per unit area of lake) is determined based on this equilibrium temperature.

To determine the amount of forced evaporation, a model that follows the method of Langhaar (Langhaar, 1953) was developed, and was validated by good agreement with results of an earlier study (Edinger, 1989). The model was then applied to simulate the cooling lake for each month, using monthly average climactic conditions over the period of record. The simulation quantifies the aforementioned modes of heat transfer per unit area of lake. The evaporative cooling that is determined by the model is a "total" value (forced plus natural evaporation). The amount of forced evaporation is simply the difference between the total and natural evaporation determined from the equilibrium temperature.

Existing and proposed plants assume a 100 percent load factor in their operation. It was assumed that each drought event would begin during January of the first year of the drought. As in the CPS USAR, seepage was assumed to be equal to 0.5 percent of the lake volume.

By definition, a 100-year recurrence interval event has a 1 percent exceedance probability to occur in any given year. Similarly, a 50-year recurrence interval event has a 2 percent exceedance probability to occur in any given year. Calculations were carried out to determine the likelihood of 50-year and 100-year recurrence interval events during the 40-year life of the proposed plant. It was determined that there is a 56 percent exceedance probability that at least one 50-year recurrence interval drought will occur during the 40-year life of the plant. There is a 33 percent exceedance probability that at least one, 100-year recurrence interval drought will occur during the same 40 year period.

Calculations were carried out for each month; a net volume gain or loss was calculated by subtracting lake volume losses and adding lake volume gains (both in acre-feet). This net change was then added to the initial volume for that month to obtain the initial volume for the next month. The lake elevation-area capacity and -volume capacity relationships found in the CPS ER (OLS) were then used to estimate the lake elevation level and lake area for the following month (CPS, 1982). These calculations were carried out separately for 60 months (the 5-year duration period) of the 50-year and 100-year recurrence interval droughts.

A determination of the amount of water available for cooling water use during drought periods was also conducted. The amount of water consumed on an average annual basis by the existing CPS plant at 100 percent of its rated capacity is 1,100 acre-feet/month (12.0 MGD or 8,300 gpm). The total amount of water available for consumption for the 100-year drought event is equal to 2,400 acre-feet/month (25.6 MGD or 17,800 gpm). Thus, the amount of water available for use in addition to the amount already used by the existing plant is 1,300 acre-feet/month (13.7 MGD or 9,500 gpm).

A similar analysis was performed for the 50-year drought event. The amount of water consumed on an annual basis by the existing plant was calculated out to a rate of 1,100 acre-feet/month (12.0 MGD or 8,300 gpm). The total amount of water available for consumption is equal to 3,100 acre-feet/month (33.7 MGD or 23,400 gpm). Thus, the amount of water available for use in addition to the amount already used by the existing plant is 2,000 acre-feet/month (21.7 MGD or 15,100 gpm).

The available water quantities maintain the lake level at or above the CPS minimum lake elevation of 677 ft above msl with both the CPS and the EGC ESP Facility in operation.

Revise SSAR, Chapter 2, Section 2.4 References to add the following new references:

J.E. Edinger & Associates, Inc. Probabilistic Hydrothermal Modeling Study of Clinton Lake. Document 89-15-R. February 1989.

Langhaar, J. W. Cooling Pond May Answer Your Water Cooling Problem. Chemical Engineering. 60(8), 194,1953.

Stall, J.B. Low Flows of Illinois Stream for Impounding Reservoir Design. Illinois State Water Authority. Bulletin 51. 1964.

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.8-4**

Please describe how UHS capacity loss due to sediment or debris loads during extreme events was estimated.

**EGC RAI ID: R9-23**

**EGC RESPONSE:**

The ESP facility will use safety-related cooling towers as the ultimate heat sink, if one is required, and will only use the CPS ultimate heat sink pond as a source of make-up. Therefore, the ESP facility ultimate heat sink is not directly affected by sediment or debris.

The basis for the CPS ultimate heat sink is discussed as follows. According to "Soil Survey of DeWitt County, Illinois" (Roger D. Windhorn, Illinois Experiment Station Soil Report No. 137, issued September 1991), early spring rains in areas where soils are exposed by farming can cause extensive erosion when the soils are partially frozen and more water runs off the surface. ESP SSAR Table 2.4-5-Monthly Probable Maximum Precipitation for 24-Hour Duration for Zone 7 indicates that the highest 24-hour PMP occurs in the summer and fall (June through October with a PMP range of 24.4 to 31.2 inches) and not during the early spring. Thus, the occurrence of the PMP would not be coincident with the conditions for maximum runoff (i.e., when the fields are not planted).

According to Attachment A2.5-"Ultimate Heat Sink Liquefaction Analysis" provided in the CPS USAR (CPS, 2002), the design of the UHS considered four failure modes including:

- Loss of cooling water inventory due to its displacement by alluvial flow slides into the UHS;
- Loss of the service water system due to blockage of the service water pump intakes from unstable soil flow blocking or entering the intake structure;
- Loss of the UHS circulation pattern due to local slides producing dikes or dams across the circulation channel; and
- Loss of UHS water because the UHS dam or its flanks are breached by the combination of seismic loadings, liquefaction, and wash out.

In addition to the storage requirements for cooling purposes and fire water supply, the storage capacity was provided to account for sedimentation. The design bases used in determining the minimum UHS volume included the following (CPS, 2002, USAR page A2.5-2):

Sediment inflow from liquefaction - 221 acre-feet

Required fire water storage capacity - 3 acre-feet

Minimum cooling capacity requirement to meet 95º F shutdown service water inlet temperature 590 acre-feet

Maximum sedimentation due to a 100-year flood - 35 acre-feet

As indicated in the ESP SSAR, Section 2.4.11.6, the CPS UHS is monitored for sediment accumulation periodically and after a major flood passes through the cooling lake (CPS, 2002). Dredging will be performed as necessary to prevent the accumulation from exceeding the capacity provided for sediment storage. The procedures used in the CPS UHS Sedimentation Monitoring Program are described in Attachment B of the CPS USAR (page 2.4-37; 2002).

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

None

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.9-1**

Please provide references to studies related to geological features or other characteristics that preclude any likelihood of channel diversion upstream of the site.

**EGC RAI ID: R9-24**

**EGC RESPONSE:**

The studies of the geological features and other characteristics related to potential channel diversion upstream of the site were performed specifically for the EGC ESP Application. This project specific examination did not rely upon previously existing studies or references (other than the topographic maps), and thus, there are no references to studies to provide. Examination of the topographic maps of the Salt Creek and North Fork of Salt Creek did not find evidence for natural channel diversions (e.g., oxbow lakes or broad well-developed floodplains). The creeks and streams in the watershed generally occur in well-defined valleys. Diversions of water out of these valleys into an adjacent drainage basin would require the energy to overcome the topography to cut a new drainage channel. Based on the physical characteristics of the drainage area and creek system, it is unlikely that a potential naturally-occurring channel diversion will shift water out of the Clinton Lake watershed. The text in SSAR, Chapter 2, Section 2.4.9, will be revised to add clarification.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

Revise SSAR, Chapter 2, Section 2.4.9 from:

There is no historical evidence of channel diversion of Salt Creek and North Fork of Salt Creek upstream of the dam site. The dam site is located on the upper reaches of Salt Creek, 28 mi from its source. The topographic characteristics and geological features of the drainage basin indicate that there is no possibility for the occurrence of a landslide that will cut off the streamflow into the lake. The history of ice jam formation discussed in Section 2.4.7, Ice Effects, did not show evidence of flow diversion during winter months.

To read:

There is no historical evidence of channel diversion of Salt Creek and North Fork of Salt Creek upstream of the dam site. The dam site is located on the upper reaches of Salt Creek, 28 mi from its source. Examination of the topographic maps of the Salt Creek and North Fork of Salt Creek did not find evidence for natural channel diversions (e.g., oxbow lakes or broad well-developed floodplains). The creeks and streams in the watershed generally occur in well-defined valleys. Diversions of water out of these valleys into an adjacent drainage basin would require the energy to overcome the topography to cut a new drainage channel. Based on the physical characteristics of the drainage area and creek system, it is unlikely that a potential naturally-occurring channel diversion will shift water out of the Clinton Lake watershed. The topographic characteristics and geological features of the drainage basin indicate that there is no possibility for the occurrence of a landslide that will cut off the streamflow into the lake.

The history of ice jam formation discussed in Section 2.4.7, Ice Effects, did not show evidence of flow diversion during winter months.

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.10-1**

A design wind of 40 mph was mentioned in the second paragraph of Section 2.4.10 and earlier in Section 2.4.3.6. In the third paragraph of Section 2.4.10, 48 and 67 mph winds are mentioned for wave run up consideration at the intake facility. Please discuss the differences in these design winds and the methods for determining both these design winds.

**EGC RAI ID: R9-25**

**EGC RESPONSE:**

The maximum wave run-up elevation at the dam and the CPS site, due to a sustained 40 mph overland wind speed acting on the PMF water level, was previously estimated to be 711 ft above mean sea level (CPS USAR Section 2.4.2.2, "Flood Design Considerations"). Additionally, CPS USAR Section 2.4.10, "Flooding Protection Requirements," considered a 48 mph overland wind speed coincident with the PMF pool in the design of the circulating water screen house at CPS. The use of these values in the CPS USAR did not result in any safety related issues for the CPS station site since the site was determined to be 22.2 feet above the calculated wave run-up level and 27.1 feet above the calculated PMF level, with the conclusion that the CPS plant facility could not flood under any circumstances. The ESP Facility Site is considered to be a "dry site", consistent with Condition 3 of Attachment 2, Section 2.4.3, "Probable Maximum Flood (PMF) on Streams and Rivers," of NRC's RS-002 Review Standard, and will not be susceptible to flooding under any circumstances. Furthermore, the operation of the ESP Facility will not impact the potential for flooding at the existing dam or the plant site and, therefore, the calculation of wave run-up effects on PMF levels is inconsequential. The use of the 40 mph wind speed was retained in the ESP SSAR wave run-up analysis to be consistent with what was originally prepared for the CPS USAR and what is currently relied upon in the CPS USAR. A review of more recent information published by the American Nuclear Society (ANSI/ANS-2.8-1992 "Determining Design Basis Flooding at Power Reactor Sites") has in fact indicated that a wind speed of somewhat greater magnitude may be appropriate for design considerations when estimating the impact of wind speeds on flooding. Figure 1 from the 1992 ANS publication entitled "Isotach 0.50 Quantiles (in miles per hour): Annual Extreme-Mile, 30 ft Above Ground, 2-yr Mean Recurrence Interval" indicates that a wind speed of 52 mph is more appropriate for calculating wave run-up height coincident with the PMF pool height.

Sections 2.4.3.6 and 2.4.10 of the SSAR will be revised to use a wind speed of 52 mph.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

Revise SSAR, Chapter 2, Section 2.4.3.6, Section 2.4.10, and Section 2.4 References, as provided with the response to RAI 2.4.3-2.

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.12-1**

Please provide additional information regarding the likelihood for liquid effluents to reach a surface water body.

**EGC RAI ID: R9-26**

**EGC RESPONSE:**

The design basis for the ESP facility regarding the potential for release of radioactive liquid effluents to reach a surface body of water following a postulated failure of a tank is that the liquid will be retained inside the structure due to the hydrostatic forces of the groundwater outside the structure. The discussion of the regional and local groundwater system is presented in SSAR 2.4.13 and the potential for accidental releases is discussed in SSAR Section 2.4.13.3. As discussed in SSAR Section 2.4.13.3, accidental releases to subsurface and surface water are unlikely since the level of radioactive liquids in the building would have to exceed the groundwater level before seepage could occur. The water levels measured in the recently installed piezometers (July 2002), within the ESP footprint, indicate that the uppermost groundwater naturally occurs at a shallow depth of about 5 feet below ground surface (see the table below). Based on the maximum seasonal variation in the groundwater level of 12 ft, the lowest water levels were at about elevation 718 ft above msl or about 17 ft below the ESP Facility grade elevation of 735 ft above msl.

| Hydrogeologic Unit | Top of Unit | | Water Surface | |
|---|---|---|---|---|
| | Depth (ft) | Elevation (ft) | Depth (ft) | Elevation (ft) |
| Wisconsinan | 8 to 13 | 724.2 to 726.1 | 3.7 to 6.5 | 733.5 to 727.5 |
| Illinoian | 58 | 679.8 | 27.8 to 27.3 | 710.8 to 711.3 |

Recent water levels are consistent with those reported in previous site investigations, indicating that the construction and operation of the CPS has not caused significant changes to the depth to the uppermost groundwater. The construction of the EGC ESP Facility is also not anticipated to cause changes to the groundwater system. Groundwater levels will be measured as part the Pre-Application, Construction, Pre-operational, and Operational Hydrologic Monitoring Programs in order to detect impacts to the groundwater system. This issue will be reviewed at the COL stage when an NSSS vendor is selected and the final plant layout of the structures and components is determined to assure that the inward gradient is maintained relative to final plant elevations and layout.

Sections 2.4.12 of the SSAR will be revised to provide additional discussion.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

Revise SSAR, Chapter 2, Section 2.4.12 from:

As discussed in Section 2.4.13.3, it is extremely unlikely that the effluents can move out of the buildings containing radioactive liquids due to high groundwater elevation. In addition, tanks located outside of structures potentially containing radioactive fluids will have positive means to collect and prevent uncontrolled releases such as dikes and collection basins. Therefore, it is extremely unlikely for the effluents to reach a surface water body.

To read:

As discussed in Section 2.4.13.3, it is extremely unlikely that the effluents can move out of the buildings containing radioactive liquids due to high groundwater elevation. Recent water level measurements, from within the ESP footprint, indicate that the uppermost groundwater naturally occurs at a shallow depth of about 5 feet below ground surface. Based on the maximum seasonal variation in the groundwater level of 12 ft, the lowest water levels were at about elevation 718 ft above msl or about 17 ft below the ESP Facility grade elevation of 735 ft above msl. Thus, the level of radioactive effluents in the building would have to exceed the groundwater level before seepage out of the building could occur. In addition, tanks located outside of structures potentially containing radioactive fluids will have positive means to collect and prevent uncontrolled releases such as dikes and collection basins. Therefore, it is extremely unlikely for the effluents to reach a surface water body.

*Groundwater levels will be measured as part the Pre-Application, Construction, Pre-operational, and Operational Hydrologic Monitoring Programs in order to detect impacts to the groundwater system. This issue will be reviewed at the COL stage when an NSSS vendor is selected and the final plant layout of the structures and components is determined to verify that the inward gradient is maintained relative to final plant elevations and layout.*

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 2.4.13-1**

Please provide a description of the local subsurface environment adequate to understand groundwater pathways from the plant including subsurface disturbances of local strata from structures and perched aquifers.

**EGC RAI ID: R9-27**

**EGC RESPONSE:**

The discussion of the regional and local subsurface environment is presented in SSAR 2.4.13. The following provides a synopsis of the information:

Groundwater beneath the ESP site occurs in unconfined conditions in the upper glacial deposits (Wisconsinan) and confined conditions in the underlying Illinoian and Kansan tills. The shallow groundwater moves along short flow paths and discharges to local surface water bodies (e.g., North Fork of Salt Creek or Clinton Lake). The remainder circulates to the deeper sand and gravel that fills the Mahomet Valley or to bedrock aquifers. The water levels measured in the recently installed piezometers (July 2002), within the ESP footprint, indicate that the uppermost groundwater naturally occurs at a shallow depth of about 5 feet below ground surface. Recent water levels are consistent with those reported in previous site investigations, indicating that the construction and operation of the CPS has not caused significant changes to the depth to the uppermost groundwater. The construction of the EGC ESP Facility is also not anticipated to cause changes to the groundwater system.

The water level measurements collected during the CPS site investigations and the description of impacts to water levels in response to filling the impoundment, indicate that lake filling did not cause a substantial readjustment of groundwater levels at the plant site. The lack of response in the uppermost water levels was anticipated because the base of the overlying Wisconsinan deposits in onsite borings (averaging 698 feet msl) is above the normal pool elevation of 690 ft msl (CPS USAR). Based on the results of the CPS investigations, changes in the lake levels are not anticipated to result in major changes in gradients across the site. In addition, the low permeability of the shallow glacial material will tend to minimize impacts from sudden changes in site conditions.

Groundwater levels will be measured as part the Pre-Application, Construction, Pre-operational, and Operational Hydrologic Monitoring Programs in order to detect impacts to the groundwater system (see SSAR Section 2.4.13.4). If construction of the plant causes the hydrologic system to change, the impact of these changes will be evaluated at the COL stage.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

None

**ATTACHMENTS:**

None

**NRC Letter Dated: 07/26/2004**

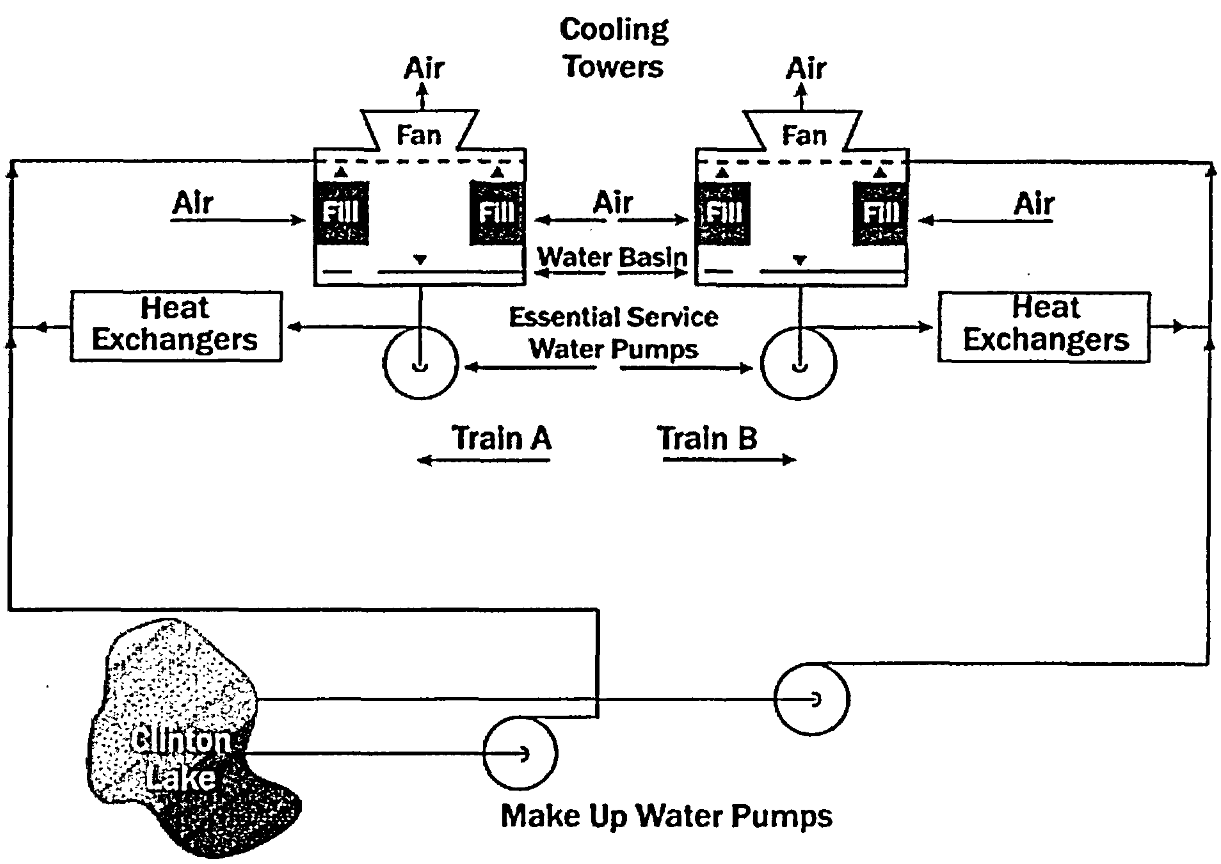
**NRC RAI No. 3.2.2-1**

Please provide a schematic that describes water circulation in the UHS.

**EGC RAI ID: R9-28**

**EGC RESPONSE:**

A schematic that describes typical water circulation in the EGC ESP UHS (should one be required) will be included in Section 3.2.2 as shown below:




**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

Revise SSAR, Chapter 3, Section 3.2.2, to include the following additional sentence at the end of the first paragraph:

Figure 3.2-1 shows a schematic diagram that describes typical water circulation in the UHS system for the EGC ESP Facility (should one be required).

Revise SSAR, Chapter 3, Section 3.2, to include new Figure 3.2-1 as shown in the attachment to this RAI response.

**NRC Letter Dated: 07/26/2004**

**NRC RAI No. 3.2.2-2**

Please describe the consequences of a failure of the baffle in the UHS.

**EGC RAI ID: R9-29**

**EGC RESPONSE:**

There is no baffle in the ESP facility UHS. The failure of the baffle in the CPS ultimate heat sink has no effect on the ESP facility since the ESP facility will use cooling towers as the UHS, if one is required, and only uses the CPS UHS pond as a source of make-up to the cooling towers. The volume of water available for make-up to the ESP facility is not impacted by the failure of the CPS UHS baffle.

**ASSOCIATED EGC ESP APPLICATION REVISIONS:**

None

**ATTACHMENTS:**

None

**RAI ATTACHMENT**

**RAI 2.4.1-1 Attachment (Revised Figure 1.2-4)**

(Note – This attachment provided on the enclosed CD-ROM.)

See file: RAI 2.4.1-1 Attachment (Revised Figure 1.2-4).pdf

**RAI ATTACHMENT**

**RAI 2.4.1-5 Attachment 1 (MRCC 2002a)**

(Note – This attachment provided on the enclosed CD-ROM.)

See file: RAI 2.4.1-5 Attachment 1 (MRCC 2002a).pdf

**RAI ATTACHMENT**

**RAI 2.4.1-5 Attachment 2 (MRCC 2002b)**

(Note – This attachment provided on the enclosed CD-ROM.)

See file: RAI 2.4.1-5 Attachment 2 (MRCC 2002b).pdf

**RAI ATTACHMENT**

**RAI 3.2.2-1 Attachment (New Figure 3.2-1)**

(Note – This attachment provided on the enclosed CD-ROM.)

See file: RAI 3.2.2-1 Attachment (New Figure 3.2-1).pdf