Nuclear Operating Company

South Texas Project Electric Generating Station 4000 Avenue F – Suite A Bay City, Texas 77414

January 22, 2009
U7-C-STP-NRC-090006

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

South Texas Project
Units 3 and 4
Docket Nos. 52-012 and 52-013
Response to Request for Additional Information

References: (1) Letter, Paul Kallan to Scott Head, "Request for Additional Information, Letter Number Two Related to the Environmental Report for the South Texas Combined License Application", dated November 18, 2008, ML083190269 (U7-C-NRC-STP-080110)

(2) Letter, Scott Head to U.S. Nuclear Regulatory Commission, "Response to Requests for Additional Information", dated December 18, 2008, (U7-C-STP-NRC-080073)

Reference Letter 1 identified thirty-five Requests for Additional Information (RAIs) related to the Environmental Report for the South Texas Project Units 3 & 4 Combined License Application (COLA). Reference Letter 2 transmitted STPNOC's responses to those RAIs including an initial response to RAI 02.03-06 that was based on preliminary modeling information which could not be verified and validated prior to the submittal date. This letter provides the RAI response based on the final verified and validated results from the modeling activities.

D091
NRO

STI: 32424289

There are no commitments in this letter.

If you have any questions, please feel free to contact me at (361) 972-7136, or Russell W. Kiesling at (361)-972-4716

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 1/22/09

Scott Head
Manager, Regulatory Affairs
South Texas Project, Units 3 & 4

rwk

Attachment:

Question 02.03-06

cc: w/o attachment except*
(paper copy)

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Question Number: 02.03-06:

QUESTION:

Provide details of MCR operation during existing two–unit and future four–unit operation to help staff independently estimate water–use and water–quality impacts.

FULL TEXT (Supporting Information) – ER RAI Letter No. 1, dated May 19, 2008:

Part 1: Provide details of operating policy for the MCR including details of water withdrawal conditions and limits defined by the Lower Colorado River Authority (LCRA) permit. Provide details on differences in the operating policy of the MCR for operation with all four units compared to the existing operation with two units.

Part 2: When was the maximum operating water level in the MCR increased from 45 to 47 ft mean sea level (MSL)? Why was this necessary? Discuss the impact of an increase in maximum water level of the MCR from 47 to 49 ft MSL on natural and forced evaporation and on seepage losses from the MCR.

Part 3: Why is a discharge of 1200 cfs in the Colorado River near the RMPF considered the threshold for "high flow?" How is the discharge in the Colorado River near the RMPF monitored?

Part 4: Provide water budget and water quality models of the MCR for two-unit and for four-unit operation taking into account the water withdrawal policy, LCRA permit limits, discharges to the MCR, seepage losses from the MCR, and blowdown from the MCR.

Part 5: Provide details of frequencies of operation of the RMPF for existing two-unit operation and for future four-unit operation.

Part 6: Provide details of existing water use for Units 1 and 2 as well as estimated water use for all four units, including (1) maximum annual makeup from Colorado River, (2) maximum monthly makeup from the Colorado River for each month, (3) maximum annual consumptive use, and (4) maximum monthly consumptive use for each month.

Part 7: Provide an explanation as to why there has been no release of water to the Colorado River from operation of Units 1 and 2.

Part 8: Describe the assessment performed or provide the analysis to support the conclusion that the impact on water quality in the Colorado River from the operation of the MCR blowdown would be SMALL. Include the description of chemical and thermal impacts.

Part 9: Describe the impact of a prolonged drought on water quality in the MCR and how this may affect the water quality impact on the Colorado River during a subsequent blowdown.

FULL TEXT (Supporting Information) – ER RAI Letter No. 2, dated November 18, 2008:

Provide an update on the modeling effort currently underway for the MCR water budget and water quality. Include details pertaining to the approach adopted in the development of these models. Also include details regarding input data requirements for these models, with particular emphasis on modeling/simulation time steps. Describe the anticipated approach adopted for using these models to predict impacts on water use in the Colorado River Basin and on water quality in the Colorado River.

RESPONSE:

A response to each part of ER RAI 02.03-06 provided in ER RAI Letter No. 1 was submitted to the NRC in STP letters ABR-AE-08000063, dated August 14, 2008 and U7-C-STP-NRC-080073, dated December 18, 2008. Additional information with respect to the four-unit operation, including response to ER RAI Letter No. 2, dated November 18, 2008, is provided in the following supplemental responses to Parts 4, 5 and 6 of RAI 02.03-06.

Restatement of Question Part 4:

Provide water budget and water quality models of the MCR for two-unit and for four-unit operation taking into account the water withdrawal policy, LCRA permit limits, discharges to the MCR, seepage losses from the MCR, and blowdown from the MCR.

Supplemental Response to Question Part 4:

A water budget and water quality model for four-unit operation has been developed for the MCR to predict the blowdown characteristics in response to the discharge limits specified in the TPDES Permit No. WQ0001908000, dated July 27, 2005 (Reference 1); the diversion rules from the Colorado River established in the Certificate of Adjudication 14-5437 (Reference 2); and the Water Delivery Plan, the contractual agreement between the LCRA and STPNOC (Reference 3). The simulation is conducted for the modeling period of May, 1948 to December, 2005, using a time step of one day. Input parameters of the model are listed below:

- Colorado River flow rates and conductivity levels. The time history of river flow rate was obtained from the USGS gaging station 'Colorado Rv nr Bay City, TX' (Site No. 08162500). The conductivity data were obtained from USGS (at the Bay City gage), TCEQ (near the FM521 bridge) and measurements taken at the Reservoir Makeup Pumping Facility (RMPF).
- Evaporative loss from the MCR due to plant operation. A one-dimensional multi-layer hydrothermal model was developed to simulate the thermal performance in the MCR and to estimate the evaporative loss as a result of the heat loading from the projected operation of four units. The model simulates the heat exchange across the open surface of a cooling pond based on a given set of meteorological conditions and plant operating parameters for the specified pond configuration. The thermal model was calibrated with historical plant operation data and meteorological data from 2002 to 2005.

- Consumptive use (i.e., evaporative loss from the MCR) is limited to 80,125 acre-ft/year, in accordance with the Certificate of Adjudication 14-5437 (Reference 2).
- Station load factor. A station load factor of 93% is used in the evaluation of water availability to sustain the four-unit operation and the expected blowdown quantity and quality on a long-term average basis. Full load operation (i.e., station load factor of 100%) is assumed in the evaluation of maximum monthly and maximum annual consumptive use and the corresponding makeup flow rate from the Colorado River.
- Water temperature at the blowdown location. It is the result of the hydrothermal model simulation.
- Rainfall data. National Climate Data Center (NCDC) daily rainfall data from two meteorological stations: Victoria (WBAN # 12922) and Victoria Regional Airport (WBAN # 12912) for the period 1948 to 2005 are used to estimate the natural inflow to the MCR.
- Seepage rate. The seepage loss rate used is 5700 acre-ft/year, in accordance with UFSAR 1 & 2 (Reference 4). The seepage rate was assessed in the validation of the water budget model using historical operational data from the existing units and found to be reasonable.
- Makeup rules. The makeup/diversion rules have been provided in the response to Question Part 1.
- Blowdown rules. The blowdown rules implemented in the model are discussed below.

<u>Blowdown Rules:</u>

1. Blowdown is permitted only when the MCR water level is between 40 ft MSL and 49 ft MSL.
2. Blowdown in conjunction with makeup water diversion is permitted only when the river water conductivity is less than 2100 μS/cm. Blowdown without makeup may occur during significant rainfall events to reduce MCR level when the MCR level is near or above 49 ft MSL.
3. Blowdown is permitted only when the river flow at the blowdown facility is greater than or equal to 2500 cfs. This value is estimated by subtracting the reservoir makeup flow from the measured flow rate at the Bay City gage.
4. If Rules #1, 2 and 3 are met, and the conductivity level in MCR is greater than or equal to 3000 μS/cm, commence blowdown.
5. Stop blowdown when any of Rules 1, 2 or 3 are not met or when the MCR conductivity is less than or equal to 2100 μS/cm.
6. Spillway Gate operation is required when MCR level reaches 49.5 ft MSL during abnormal or emergency situations.
7. Blowdown (designed leakage through the relief well system) is 3,850 acre-ft/year, which constitutes a portion of the total seepage loss of 5,700 acre-ft/year from the MCR (Reference 4).

In terms of the flow rates for makeup and blowdown, the following rules have been implemented in the model:

Flow Rate Rules:

8. Allowable diversion rate (makeup) = $0.55\ (Q_{BC} - 300\ \text{cfs})$
9. Maximum diversion rate (makeup) = 1200 cfs
10. Maximum annual diversion is 102,000 acre-ft
11. Maximum blowdown rate = 308 cfs, Average daily blowdown rate = 222 cfs
12. Blowdown flow rate, $Q_{BD} = \alpha\ (Q_{BC} - Q_M)$

$\alpha = 0.125$, Q_{BC} = River flow rate at Bay City gage, Q_M = makeup flow

Also the following rule was specified on the MCR water temperature during blowdown.

Temperature Rule:

13. Blowdown is permitted only when the MCR water temperature is below or equal to 95°F.

Finally the river water diversion rules when blowdown is not permitted as described below were incorporated in the model (these rules are similar to those described in the Water Delivery Plan and given in response to Question Part 1):

River Water Diversion (Makeup) Rules – (when blowdown is not permitted):

14. If the MCR water level is between 36 ft MSL and 40 ft MSL and the river water conductivity is less than or equal to the MCR water conductivity, divert river water to the MCR to provide makeup. Flow rate rules # 8, 9, and 10 apply.
15. If the MCR water level is between 32 ft MSL and 36 ft MSL, and the river water conductivity is less than or equal to 10,000 μS/cm, divert river water to the MCR to provide makeup. Flow rate rules # 8, 9 and 10 apply.
16. When the MCR level is below 35 ft MSL, LCRA begins staged deliveries of firm water at the rate of 40,000 acre-ft per year (rolling 5 year average) to ensure that MCR level does not drop below 27 ft MSL. Rules # 8 and 10 do not apply to the staged firm water deliveries.

In accordance with the makeup and blowdown rules described above, the inventory (i.e., volume of water) in the MCR at the end of each day is calculated in the model as follows:

(volume of water at the beginning of the day) + (makeup water, if available/allowed) + (precipitation) + (firm supply of makeup, if necessary) – (evaporation) – (seepage) – (blowdown, if necessary/allowed) = (volume of water at the end of the day)

For every time step in the model, available amount of makeup water under the river permit will be diverted to the MCR to compensate for the net daily water losses (precipitation minus evaporation, seepage and blowdown) as necessary to restore the MCR to the target pool level of 49 ft MSL. After the change in volume for each day is determined, the conductivity level of the MCR is calculated based on the assumption that the MCR would be fully mixed.

Initially, the model was validated using the following historical operational data of Units 1 & 2 from 01/01/2004 to 12/31/2005 including:

- Daily diversion flows from the Colorado River
- Heat load from Units 1 & 2 to MCR.
- Water level and conductivity measurements at the MCR.

The predicted water surface elevations and the observed water levels in the MCR from 01/2004 to 12/2005 are shown on Figure 1.

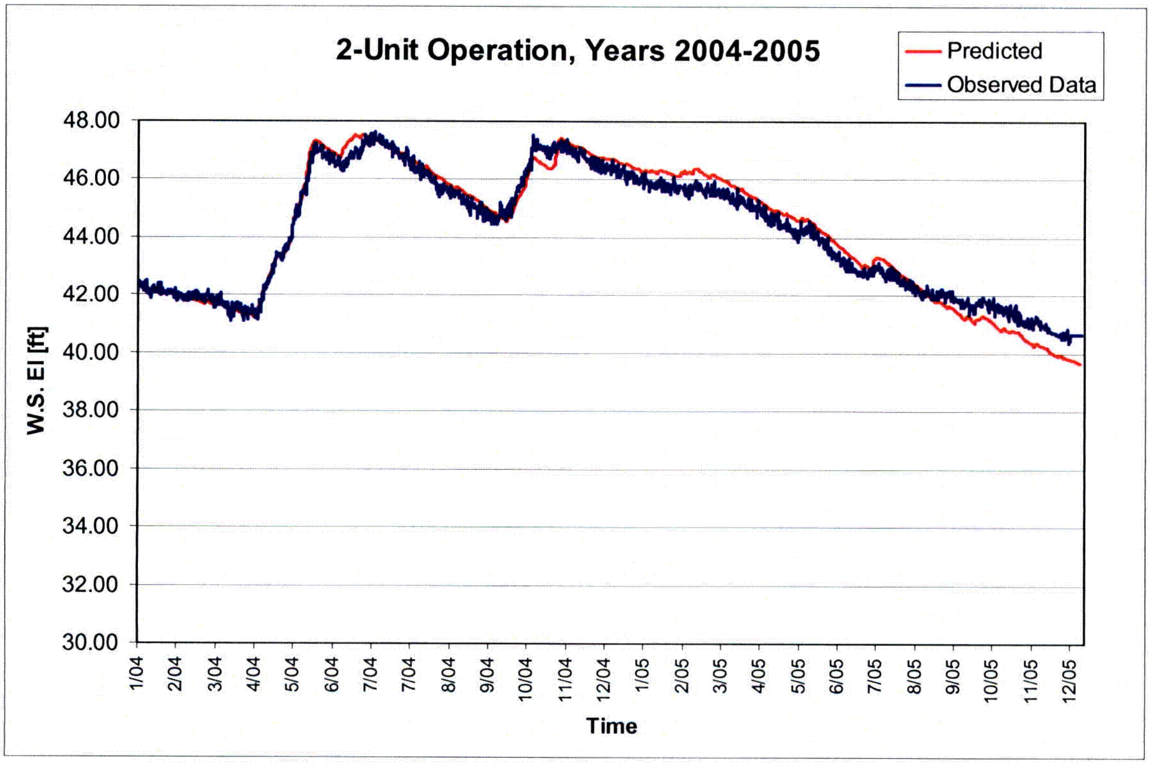

Figure 1: Comparison of Predicted and Observed Water Levels in the MCR for 2-Unit Operation from 1/2004 to 12/2005

The model also predicts the MCR conductivity levels for two-unit operation, which is shown in Figure 2, together with the measured conductivity levels. It should be noted that no blowdown was reported during the period 2004 to 2005. From the two figures it can be seen that there is a reasonable comparison between the results as predicted by the model and the actual operational data for two-unit operation; thus, it can be concluded that the model is suitable for predicting four-unit operation.

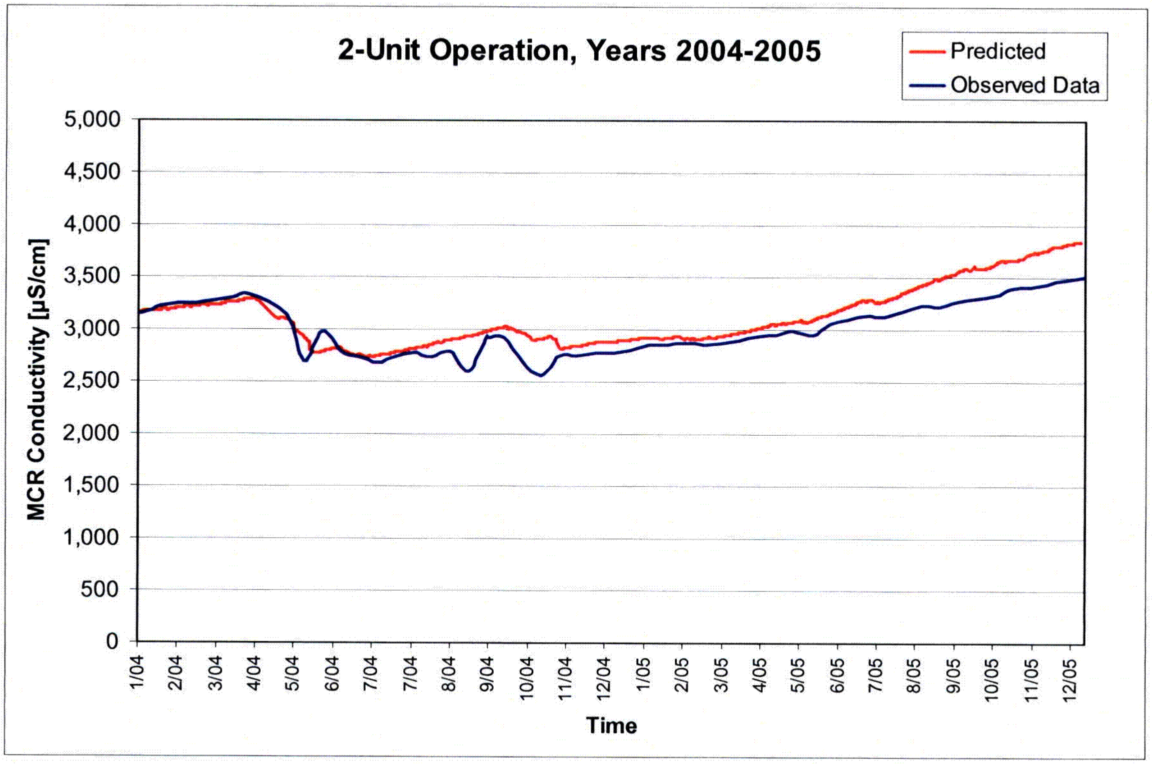

Figure 2: Comparison of Predicted and Measured Conductivity Levels in the MCR for 2-Unit Operation from 1/2004 to 12/2005

The simulation for the four-unit operation covers the period from 05/01/1948 to 12/31/2005. The model predicts the water surface elevation, the conductivity level, the daily diversion of makeup water (if available/allowed) and the daily blowdown (if necessary/allowed) with a starting value of 2,400 µS/cm for the conductivity level. A sensitivity analysis was performed to assess the impact of this assumption, using a range of initial conductivity levels varying from 1,200 µS/cm to 3,600 µS/cm. The differences in the maximum predicted reservoir conductivity levels vary from -5% to 11%, while the predicted frequency of blowdown changes by less than 1%. It is therefore concluded that the model results are not sensitive to the initial conductivity level in the simulation runs. Figures 3 and 4 present the frequency distribution of the predicted water surface elevation and conductivity level of the MCR. The figures show that the water surface elevation is below 40.0 ft MSL for about 10% of the time of the simulation period and the conductivity level is below 7,218 µS/cm for about 90% of the time of the simulation period.

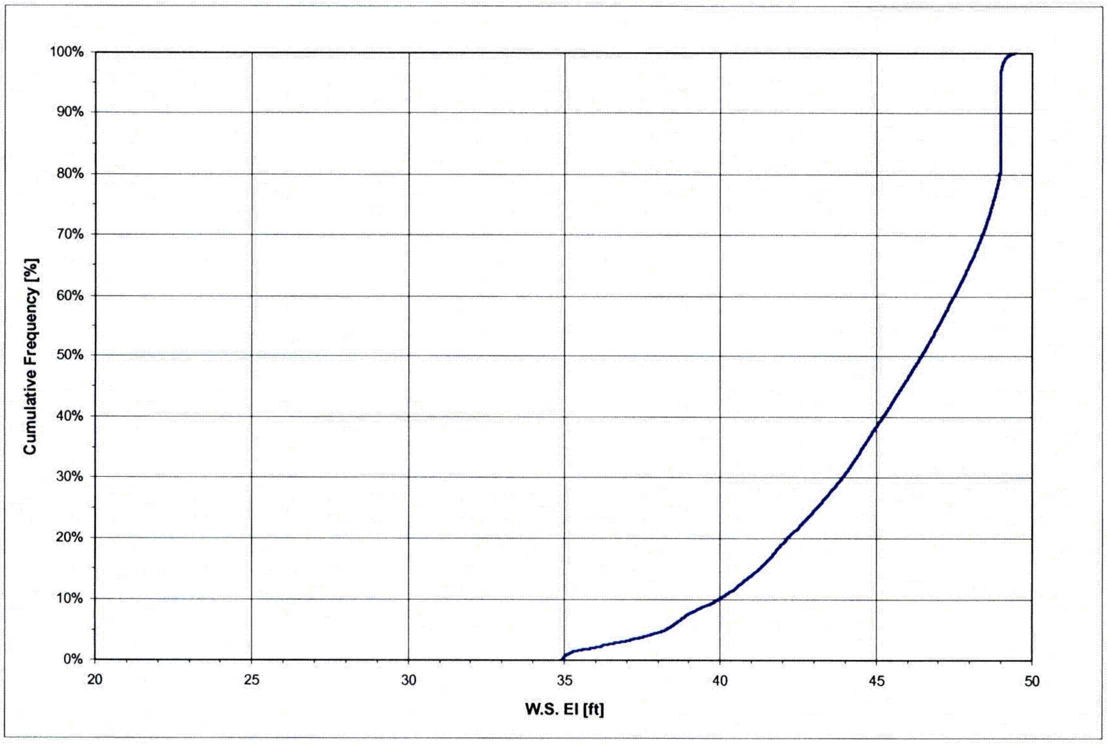

Figure 3: Frequency Distribution of Predicted MCR Water Levels for 4-Unit Operation

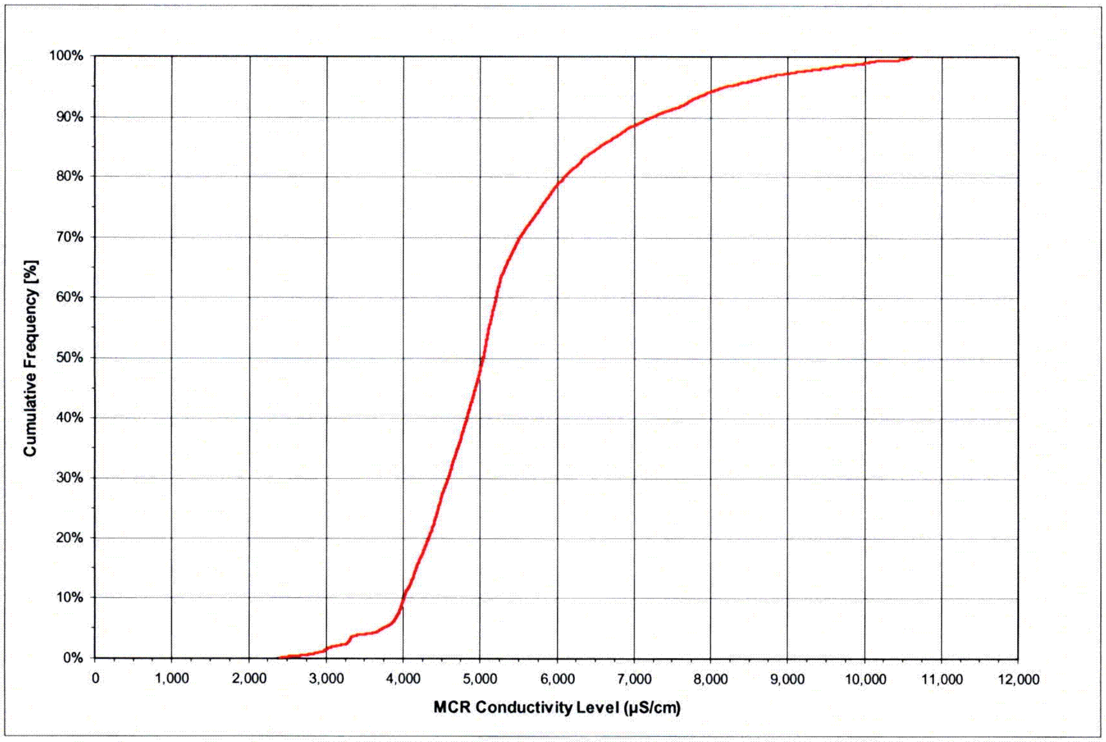

Figure 4: Frequency Distribution of Predicted MCR Conductivity Levels for 4-Unit Operation

The model results are summarized further in Figures 5, 6 and 7:

- Figure 5 indicates that the MCR conductivity level is highest during periods of drought (1950s and 1960s). Also, it demonstrates that the provisions in the existing water permit are adequate for keeping the water level of the MCR above 35.0 ft MSL, provided that the firm supply of water is available when needed. This figure presents similar data as in Figure 3.4-16 of the Environmental Report – Construction Phase (ER-CP) for Units 1&2 (Reference 5).
- Figure 6 shows the predicted monthly blowdown volume (similar data are presented in Figure 3.4-17 of the ER-CP for Units 1&2, Reference 5).
- Figure 7 shows the predicted occurrences of blowdown by month, defined as the number of years in which blowdown occurs at least one day in the month (similar data are presented in Figure 3.4-14 of the ER-CP for Units 1&2 operation, Reference 5). The figure indicates that most of the blowdown will take place during the first six months of any year, with blowdown taking place in January and February in 34 years out of the 57.5 years of simulations.

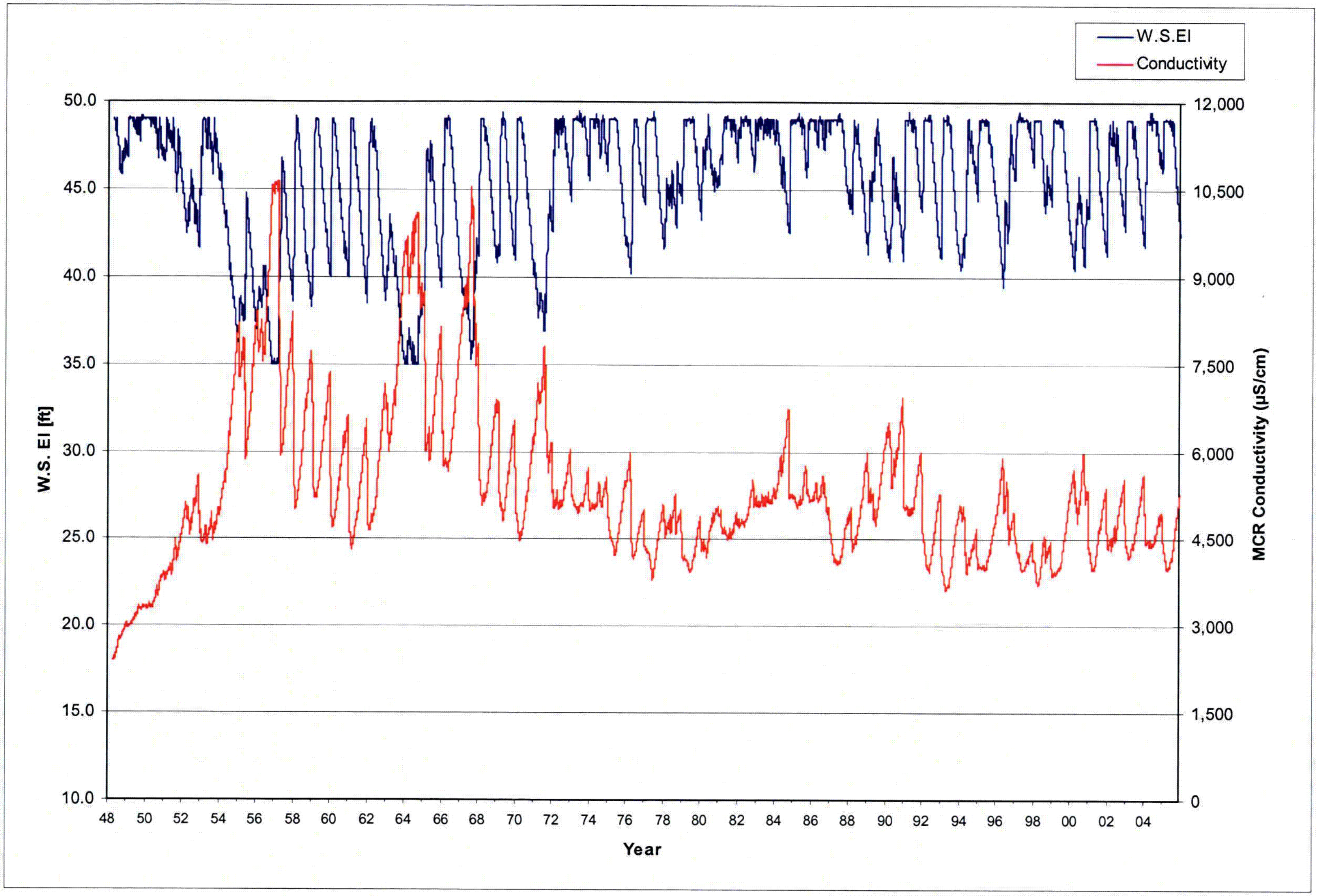

Figure 5: Predicted MCR Water Surface Elevations and Conductivity Levels for 4-Unit Operation

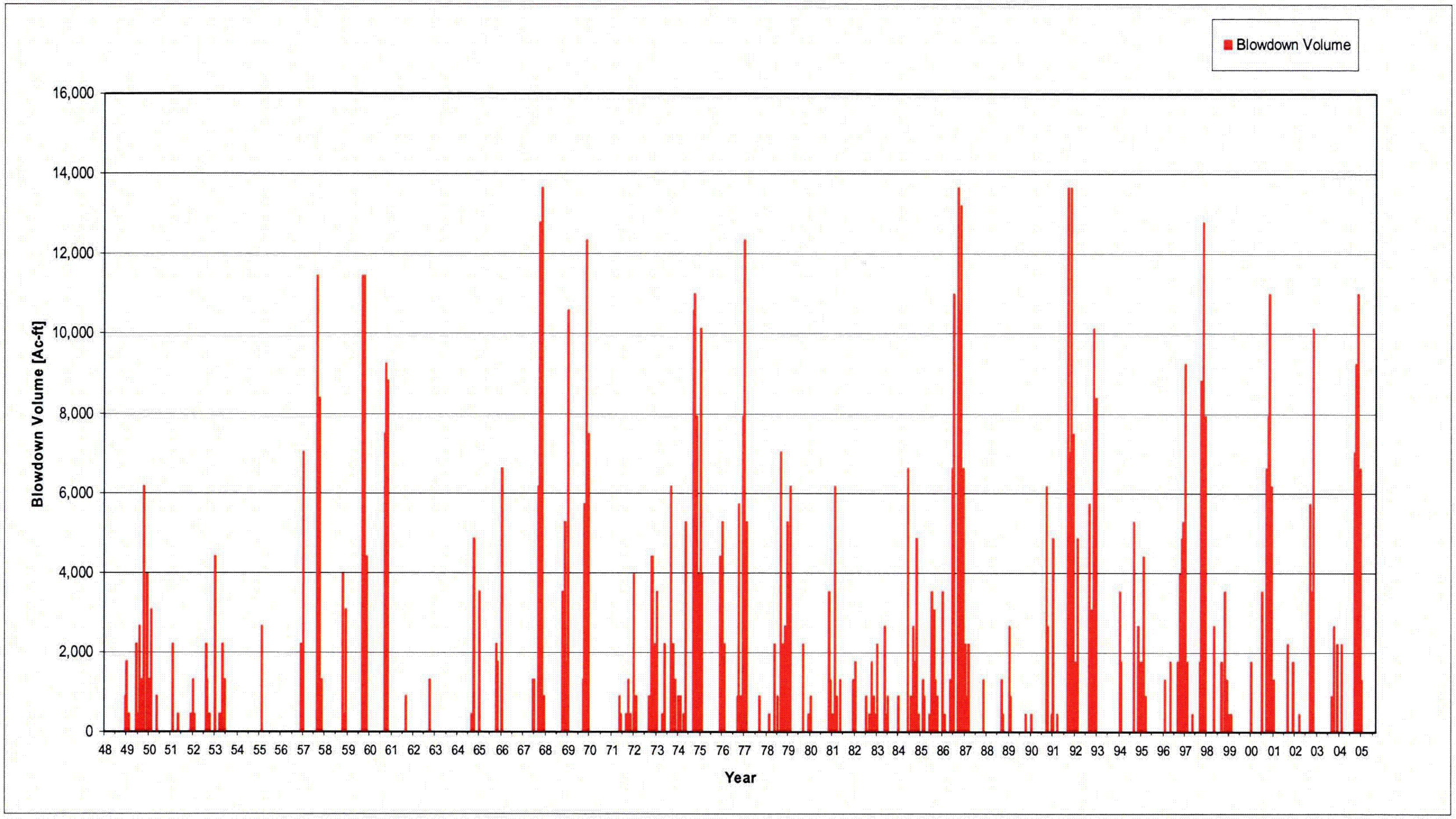

Figure 6: Predicted Monthly Blowdown Volume for 4-Unit Operation

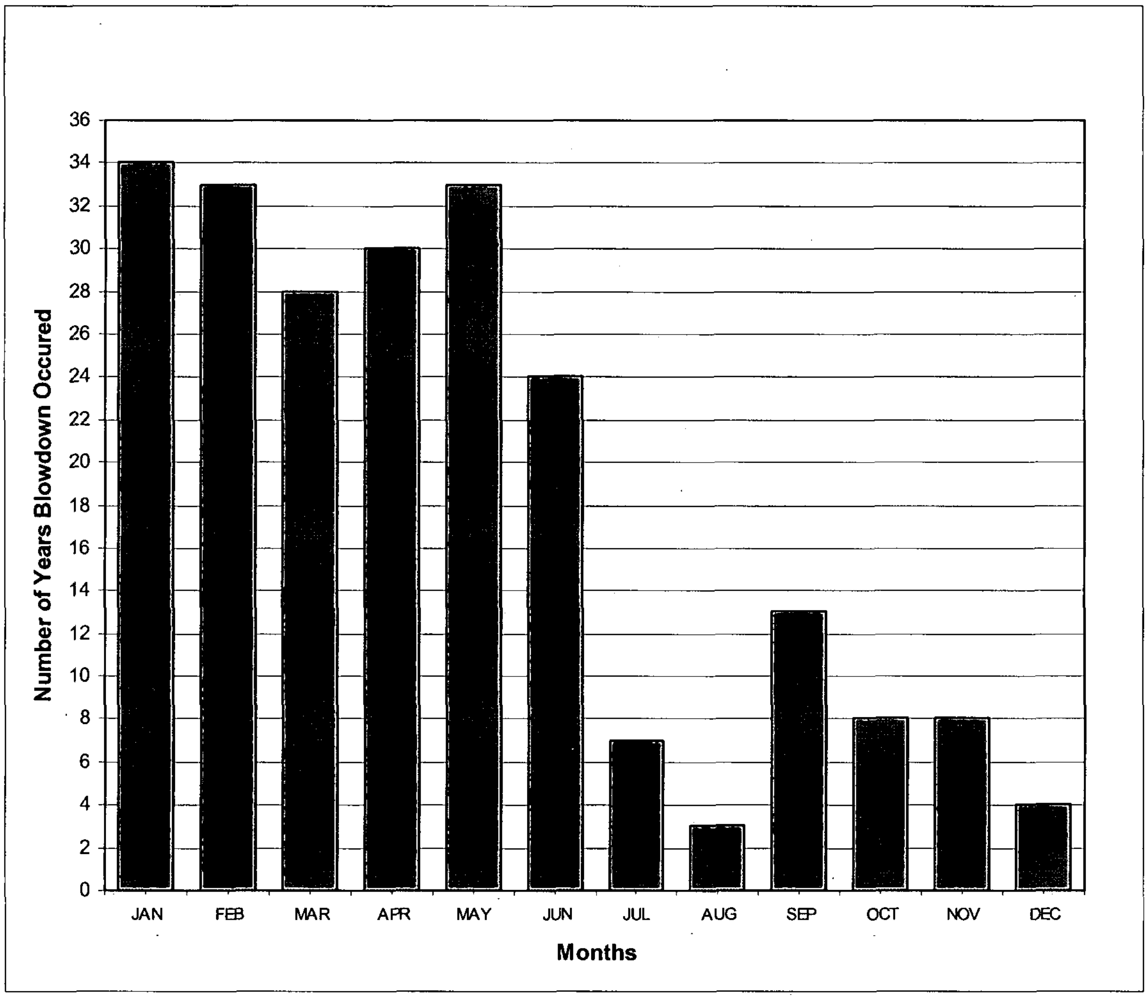

Figure 7: Predicted Occurrences of Blowdown by Month for 4-Unit Operation (defined as the number of years in which blowdown occurs at least one day in the month).

Restatement of Question Part 5:

Provide details of frequencies of operation of the RMPF for existing two-unit operation and for future four-unit operation.

Supplemental Response to Question Part 5:

Based on the MCR water budget and water quality model presented in the supplemental response to Question Part 4, the frequency of operation of the RMPF for the four-unit operation has been estimated as shown in Figure 8. The results show that for almost 70% of the time, the RMPF will not be pumping. On the other hand, the RMPF will be pumping at its maximum capacity of 1200 cfs (2380 ac-ft per day) for approximately 4% of the time. The remaining portion of time (26%), the RMPF will be operating between 0 and 1200 cfs (0 and 2380 ac-ft of daily makeup volume).

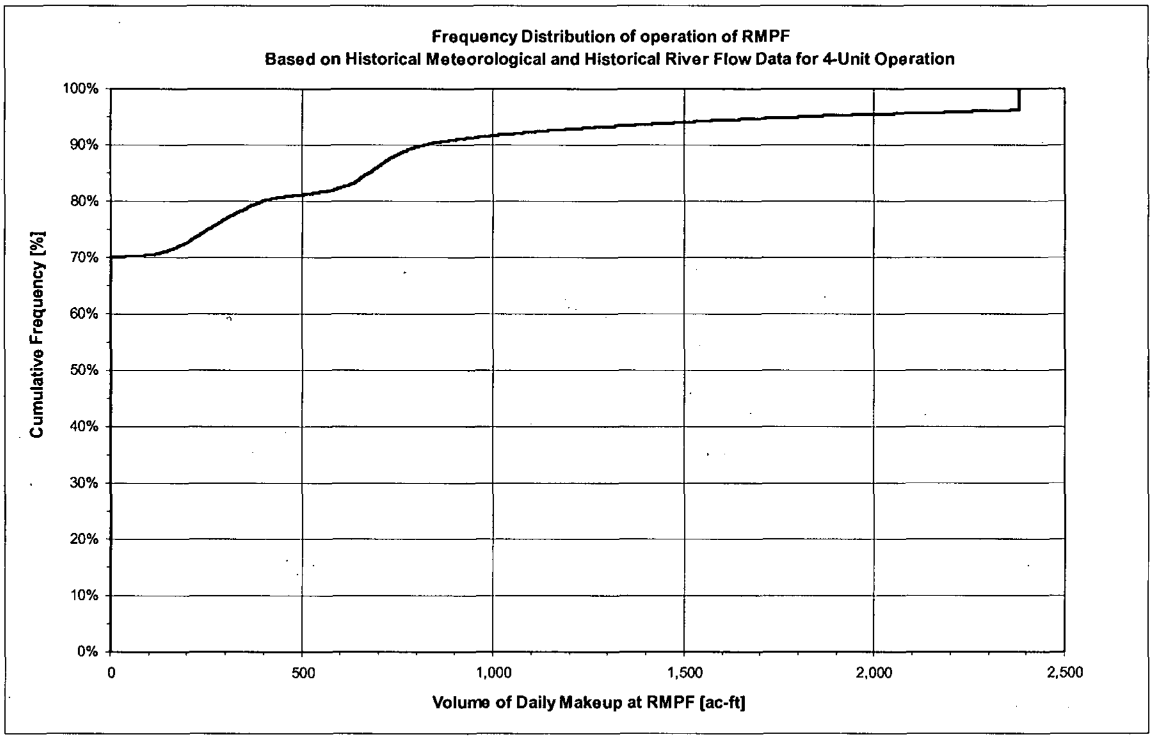

Figure 8: Predicted Frequency of Operation of the RMPF for the 4-Unit Operation

The predicted monthly diversion (makeup) volume from the RMPF for the four-unit operation (similar to Figure 3.4-15 of the ER-CP, Section 3.4 – Heat Dissipation System, Reference 1) is shown in Figure 9.

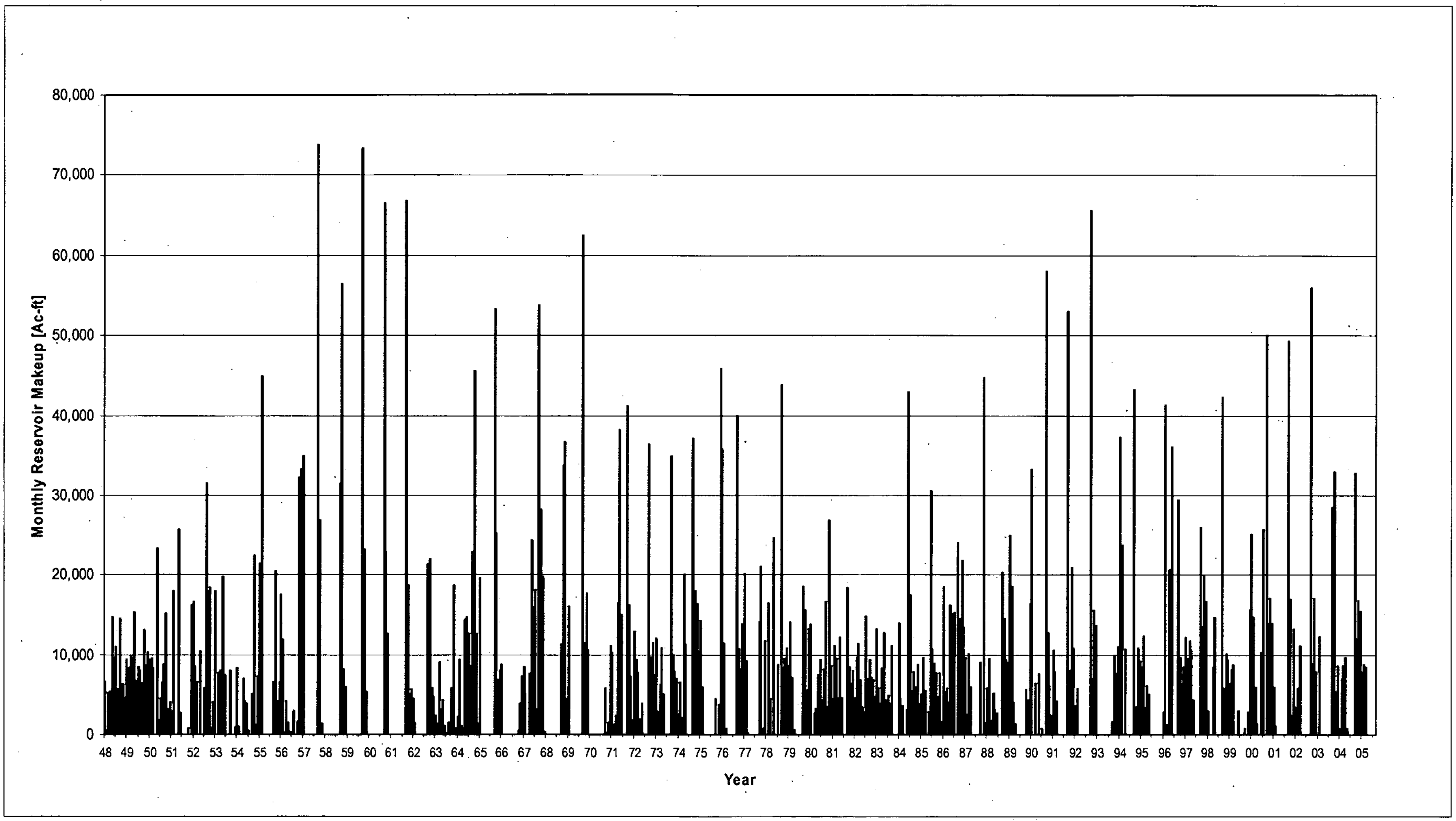

Figure 9: Predicted Monthly Diversion Volume from the RMPF for the 4-Unit Operation

Restatement of Question Part 6:

Provide details of existing water use for Units 1 and 2 as well as estimated water use for all four units, including (1) maximum annual makeup from Colorado River, (2) maximum monthly makeup from the Colorado River for each month, (3) maximum annual consumptive use, and (4) maximum monthly consumptive use for each month.

Supplemental Response to Question Part 6:

For four-unit operation:

(1) The maximum annual makeup from the Colorado River is predicted to be about 117,150 acre-ft, which exceeds the amount allocated under the river permit and will need to be supplemented by the firm water supply. This estimate is based on four units operating at a 100% station load factor.

(2) Based on the rules and analysis of the model presented in the supplemental response to Question Part 4, the predicted maximum monthly makeup volume from the Colorado River for four units operating at a 100% station load factor is summarized in the following table. As shown in the table, the maximum makeup volumes for the 12 months occur in different years and therefore the sum does not implicate the maximum annual makeup volume as discussed in (1) above.

Month, Year	Maximum Makeup from the Colorado River Historical Flows (acre-feet)
January, 1958	73,785
February, 1959	60,527
March, 1981	50,240
April,1976	48,173
May, 1976	39,839
June, 1955	44,568
July, 1982	12,071
August, 1996	20,615
September, 1971	38,112
October, 1984	43,666
November, 1967	19,284
December, 1952	31,458

(3) The evaporative loss from the MCR is the primary consumptive water use. Other consumptive water uses are relatively minor and are not included in the following discussion. For the four-unit operation, the maximum annual consumptive use is estimated to be about 75,100 acre-feet based on a 100% station load factor.

(4) The following table summarizes the maximum monthly consumptive use for the simulation period assuming full load operation (100% station load factor). These maximum monthly values occur in different years.

Month, Year	Maximum Consumptive Use for 100% Load Factor (acre-feet)
January, 2000	6,229
February, 1962	6,186
March, 1972	6,794
April, 1967	6,525
May, 2003	6,660
June, 1953	6,646
July, 1997	6,901
August, 2005	6,785
September, 1999	6,502
October, 1962	6,615
November, 1973	6,458
December, 1970	6,052

Restatement of RAI 2.3-6 from ER RAI Letter No. 2, dated November 18, 2008:

Provide an update on the modeling effort currently underway for the MCR water budget and water quality. Include details pertaining to the approach adopted in the development of these models. Also include details regarding input data requirements for these models, with particular emphasis on modeling/simulation time steps. Describe the anticipated approach adopted for using these models to predict impacts on water use in the Colorado River Basin and on water quality in the Colorado River.

Response to RAI 2.3-6 from ER RAI Letter No. 2, dated November 18, 2008:

The information requested in RAI Letter No. 2 for RAI 2.3-6 related to the MCR modeling effort is provided in the responses above to the questions in Parts 4, 5 and 6. The assessment of impacts on water use in the Colorado River Basin and on water quality in the Colorado River has been addressed in the responses to RAIs 5.2-1, 5.3.2-1, 5.3.4-1, 5.3.4-2, and 10.5S-2.

REFERENCES:

1. Texas Commission on Environmental Quality, Permit to Discharge Wastes under Provisions of Section 402 of the Clean Water Act and Chapter 26 of the Texas Water Code-Texas Pollutant Discharge Elimination System (TPDES) Permit No. WQ0001908000, Austin, Texas, July 21, 2005.

2. Certificate of Adjudication 14-5437, TWC (Texas Water Commission) 1989, June 28, 1989.

3. Amended and Restated Contract by and between the Lower Colorado River Authority and STP Nuclear Operating Company, Effective as of January 1, 2006.

4. STPEGS Updated Final Safety Analysis Report, Units 1 and 2, Revision 13.

5. Environmental Report-Construction Phase (ER-CP) STPNOC Units 1 and 2, Amendment 8, September 22, 1975.

CANDIDATE COLA REVISION:

ER Subsection 3.3.1:

The second paragraph of ER Subsection 3.3.1 will be revised as follows:

The MCR loses water from evaporation and seepage and gains water through makeup from the Colorado River and rainfall. Surface water consumptive use due to STP 3 & 4 heat loads during normal operating conditions is estimated to be approximately ~~23,170~~23,190 gpm for full heat load and 21,600 gpm on a long-term average basis for 93% heat load. STP 3 & 4 groundwater use is approximately 1,250 gpm on average, with a maximum of approximately 4,150 gpm. During normal operation, approximately 550 gpm of plant effluent water (UHS basin blowdown, filter backwash, etc.) is discharged to the MCR as surface water. Table 3.3-1 identifies the normal and maximum water and effluent streams for STP 3 & 4, and Figure 3.3-1 provides a diagram to illustrate the normal operation flows.

ER Table 3.3-1 STP 3 & 4 Water Flow Table:

The values for the normal and maximum water flow for Stream Number 9 in ER Table 3.3-1 will be revised as shown below:

Stream	Stream Description	Normal [1] (gpm)	Maximum [1, 2, 7] (gpm)	Comments
	MCR Streams			
9	MCR Forced Evaporation from STP 3 & 4	~~23,170~~23,190	~~23,427~~49,000	[12]
	Surface Water (Colorado River) Streams			
3	Total Required River Water to MCR	~~22,692~~22,660	~~24,867~~24,837	[15]

12. The forced evaporation shown includes STP 3 & 4 only. The natural evaporation of the MCR is constant and is not impacted by the number of units at the STP site. The natural evaporation of the MCR is not included in the

discussion of surface water consumption in section 3.3.1. The normal forced evaporation rate based on a 93% load factor on a long-term average basis is 21,600 gpm. The maximum forced evaporation rate is the daily maximum value based on a 100% load factor.

13. Minimum water availability has no impact on the water balance for STP 3 & 4. The MCR accommodates fluctuations in makeup water availability. Change in the MCR level does not significantly impacts the evaporation.
14. Details on the groundwater sources and construction requirements for plant water use are discussed in Sections 2.3, 4.2, and 3.9S. Information regarding STP 1 & 2 plant water use can be found in Reference 3.3-2
15. The normal value is based on subtracting the normal effluent plant discharge to the MCR from the normal forced evaporation based on a 100% load factor. The maximum value is based on the average from the annual limit of consumptive use, which is 80,125 acre-ft/year, in accordance with the Certificate of Adjudication 14-5437 of the Texas Water Commission.

ER Subsection 10.5S.2.2:

The fourth paragraph of ER Subsection 10.5S.2.2 will be revised as follows:

Additional makeup water will be diverted from the Colorado River to support the operation of STP 3 & 4. ~~Operation of STP 1 & 2 at its current power level results in the forced evaporation of up to approximately 37,100 acre-feet/year (Table 2.9S-1) from the MCR. Operation of STP 3 & 4 is predicted to result in the forced evaporation of an additional 37,400 acre-feet/ year from the MCR, for an approximate total of 74,500 acre-feet/year.~~ The normal and maximum forced evaporation of STP 1 & 2 is approximately 33,200 acre-feet/year and 37,200 acre-feet/year, respectively. For STP 3 & 4, the normal and maximum forced evaporation is estimated to be approximately 34,850 acre-feet/year and 38,050 acre-feet/year, respectively. The normal and maximum forced evaporation for all 4 units are approximately 67,950 acre-feet/year and 75,100 acre-feet/year, respectively. The normal forced evaporation values are based on a 93% load factor, while the maximum values are based on a 100% load factor. Natural evaporation and seepage from the MCR, which occur now ~~and~~ will not increase significantly as a result of the operation of STP 3 & 4. Because the MCR has sufficient storage to allow flexibility in scheduling ~~of~~ diversions from the Colorado River, the combined operation of STP 1 & 2 and STP 3 & 4 will continue to comply with the existing limits on diversion of water from the river. Compliance with these limits assures that the cumulative impacts on downstream users due to withdrawal of water from the Colorado River to support 4-unit operation will be SMALL, not warrant mitigation, and not have a regional effect.