2.4S.11 Low Water Considerations

The following site-specific supplement addresses COL License Information Item 2.20.

The main cooling system for STP 3 & 4 is a closed-cycle circulating water system with the Main Cooling Reservoir (MCR) as the heat sink. The MCR is not a safety-related facility. STP 3 & 4 have a safety-related Ultimate Heat Sink (UHS) to remove heat load from the Reactor Building Cooling Water System (RCW) using the Reactor Service Water (RSW) system during normal, safe shutdown and the design basis accident. Each unit has a counterflow mechanically induced draft cooling tower with six cooling tower cells, of which two cells are dedicated to each of the three RSW divisions to remove heat from their respective RCW/RSW division.The UHS basin is sized for a water volume adequate for 30 days of cooling under the design basis accident. The primary source of makeup water to the UHS cooling towers is site wells and the backup source is the MCR.

The normal maximum operating level of the MCR is El. 49.0 ft MSL (or NGVD29). Its capacity at this elevation is 202,700 acre-ft. Makeup water to the MCR is supplied from the Colorado River and is pumped into the MCR intermittently throughout the year via the Reservoir Makeup Pumping Facility (RMPF). The only natural inflow into the MCR is direct rainfall, as the reservoir is self-contained and has no drainage area other than the reservoir surface. The minimum operating level of the MCR is El. 25.5 ft MSL (Reference 2.4S.11-1); this level applies to existing STP 1 & 2 and STP 3 & 4. STP 3 & 4 will be shut down safely if and when the reservoir water level drops below this elevation. At this level, the volume of water remaining in the MCR is approximately 38,150 acre-ft (Reference 2.4S.11-1).

The MCR is adequate to supply the existing STP 1 & 2 and STP 3 & 4 considering the additional evaporation that is induced by the new units. The MCR is not expected to be drawn down to its minimum operating level such that the circulating water systems for all units would be shutdown. The basis for these conclusions is provided in Subsection 2.4S.11.1.

In 1992, the Lower Colorado River Authority (LCRA) completed an analysis of in-stream flow needs for the Colorado River, which involved the estimation of critical and target flows (Reference 2.4S.11-2). Critical flows are those required to maintain species population during severe drought conditions. Target flows are those necessary to provide an optimal range of habitat complexity for the support of a well-balanced native aquatic community.

For the critical flows, in addition to maintaining various rates at the Austin stream gauge (USGS station number 0815800) which are dependent on the prevailing flow record, a mean daily discharge of 120 cfs will be maintained at the Bastrop stream gauge (USGS station number 08159200), immediately downstream of Austin. The purpose of maintaining this minimum flow rate is to provide adequate water quality conditions in the Colorado River. Additionally, during a six-week period between March and May, a minimum flow of 500 cfs must be maintained at the Bastrop stream gauge. Critical flows mandated by the LCRA are presented in Table 2.4S.11-1. Target flows differ from critical flows in that they are classified as interruptible demand subject to curtailment during drought conditions.

2.4S.11.1 Low Flow in Rivers and Streams

The major river near the STP 3 & 4 site is the Colorado River. The site is located within the tidal estuary region of the river on the west bank near river mile 14.6. Tidal effects extend up to river mile 22, which is several miles upstream from the Reservoir Makeup Pumping Facility (RMPF). During periods of low river flows freshwater flow to the tidal estuary is regulated by the operation of an inflatable dam across the river located one mile downstream from Bay City and immediately upstream from the USGS stream gauge at Bay City (station number 08162500). This dam is intended to maintain a minimum water level in the river upstream of the dam to facilitate pumping into irrigation canals. Low flows are regulated by the dam, whereas flood peaks are allowed to pass freely.

Discharge measurements at the Bay City stream gauge were initiated in 1948 by the USGS, well after the construction of Mansfield Dam in 1942 and Buchanan Dam in 1936. Therefore, all available data at this gauge are influenced by flow regulation at Mansfield Dam and other upstream reservoirs. Flow measurements at Bay City are also influenced by water withdrawals from the river between Bay City and Mansfield Dam.

Between 1951 and 1956, zero daily discharge was recorded on 13 occasions at Bay City. In the June-July 1967 period, withdrawals for irrigation reduced the downstream releases to 1 cfs for a period of 58 days. Based on these observations, the probable mean-daily minimum flow rate at Bay City is estimated as zero. If there is no downstream flow, the Colorado River near the RMPF will be occupied by tidal water.

Table 2.4S.11-2 presents the annual 1-day low flows at Bay City for water years 1948 through 2006, while Table 2.4S.11-3 presents the annual 7-day low flows for the same period based on data from Reference 2.4S.11-3. The minimum 1-day and 7-day low flows for the period of record are zero and 0.5 cfs, respectively. The 1-day and 7-day low flows for water years 1948-2006 are shown in Figure 2.4S.11-1.

For the construction of STP 1 & 2, the required storage volume of the MCR was determined from operation studies using 40 years of stream flow data, which included the severe dry period 1950-1956. These operation studies assumed that no makeup water would be pumped when the Colorado River flow is less than 300 cfs in accordance with STP's water rights (References 2.4S.11-1 and 2.4S.11-4). Although only STP 1 & 2 were built, the MCR was originally sized for four units. With the addition of STP 3 & 4, sufficient MCR water inventory can be maintained to offset evaporation, seepage, and blowdown by diverting sufficient make-up water at the RMPF and recognize available precipitation. STP is entitled to divert 55% of the river flow in excess of 300 cfs at the RMPF as MCR makeup. The annual flow diversion in any given year can exceed the 102,000 acre-ft average annual limit provided that this limit is not exceeded on a 5-year rolling average basis (Reference 2.4S.11-4). During a repeat of the Lower Colorado River's Drought of Record (DOR) from 1947 to 1957, the LCRA is required by contract to make available an additional 40,000 acre-ft per year of firm water. This firm water will be made available, without restriction on river flow, for MCR makeup when the water level in MCR is below El. 35 ft MSL (Reference 2.4S.11-4). These arrangements are expected to be adequate to maintain sufficient water in MCR for continuous operation of all four units. This assessment is supported by the water management plan for the Lower Colorado River (Reference 2.4S.11-5) as well as the MCR water inventory analysis that shows that arrangement for these water diversion rights are necessary to keep MCR in continuous operation with four units. The inventory analysis tracks MCR water inventory by balancing the available diversion flows at RMPF and precipitation against losses of evaporation, seepage and blowdown and factors in future water use projections by LCRA.

The primary source of makeup water to the UHS cooling tower basin for STP 3 & 4 will be onsite groundwater wells. The well water system is not affected by low flows in the Colorado River. MCR is the backup source of the UHS makeup. As described earlier, even at its minimum operation level of 25.5 ft MSL the MCR has approximately 38,150 ac-ft of water inventory which is more than enough water to safely shut down the plant should MCR is activated as a backup source of UHS makeup water. Hence, low-flow considerations will not affect the dependability of the source of makeup water for the UHS.

There are currently no downstream dams that could affect the water supply to the makeup water intake and no future dams are contemplated.

2.4S.11.2 Low Water Resulting from Surges, Seiches, or Tsunamis

Low water in the Colorado River resulting from surges, seiches, or tsunamis will not affect the ability of the groundwater wells to supply water to the safety-related UHS cooling tower basin. Low water from these phenomena would also not affect the performance of the non-safety–related MCR, since its storage permits an extended period of no makeup flow without interfering with its operation.

Ice formations or ice jams causing low flows are not anticipated based on historical air and water temperature data described in Subsection 2.4S.7.

2.4S.11.3 Historical Low Water

2.4S.11.3.1 Drought Events

Texas has suffered from a drought in each decade of the twentieth century with severe droughts occurring every 20 to 40 years. The most severe drought between 1898 and 2004 was the 10 year “drought of record” (DOR) period (May 1947 to April 1957). LCRA estimates of available water supplies reflect the amount of water that is reliably available during a repeat of the DOR conditions (Reference 2.4S.11-2).

2.4S.11.3.2 Colorado River

The Colorado River experiences a wide range of flows. Low flows below Bay City have been subject to regulation since the installation of the inflatable dam at Bay City in 1963, as discussed in Subsection 2.4S.11.1. Low flows have also been affected by upstream dams and irrigation demands.

The lowest stages on the Colorado River at the RMPF can be expected to occur when low-flow conditions are combined with tidal cycles originating from the Colorado-Lavaca estuary. Tidal effects extend upstream several miles above the RMPF. During extreme low-flow conditions, the water surface elevation at the Screen Intake Structure of RMPF would be approximately equal to the tidal elevation.

2.4S.11.4 Future Controls

The safety-related systems of STP 3 & 4, including the UHS, do not rely directly upon river flows. While the MCR is a back-up water source for supplying makeup water to the UHS basin, the availability of this makeup water for the UHS is assured because the plant would be shut down when the MCR level drops below El. 25.5 ft MSL. At this elevation, the MCR still retains 38,150 acre-ft, which is sufficient to maintain a 30-day UHS makeup water inventory without consideration of the normal makeup source from groundwater supplies. Any changes in the quality or availability of MCR water will be slow to occur, allowing sufficient time for any remedial measures that may be necessary.

The LCRA, which holds rights to stored waters of the Colorado River above STP, has contracted with STPNOC to provide such waters, up to 40,000 acre-ft per year, when necessary for the normal operation thus providing additional assurance against having to shut down STP due to extended low-flow conditions in the Colorado River (Reference 2.4S.11-4). Additionally, STPNOC holds a run-of-river water right (References 2.4S.11-1 and 2.4S.11-4), allowing it to divert water directly out of the Colorado River based on the contract with the LCRA.

2.4S.11.5 Plant Requirements

The RSW and UHS systems are designed to cool the Reactor Building Cooling Water (RCW) during normal operation, normal shutdown, emergency shutdown, testing, and loss of preferred power and to dissipate the heat into the atmosphere without exceeding the water temperature in the UHS basin water of 35°C. The UHS water storage basin is sized to allow the shutdown and cooldown of the unit and maintain the unit in a safe shutdown condition for the design basis accident for 30 days with no makeup and blowdown. The system requirements are addressed in Subsections 9.2.5 and 9.2.15, following the guidance provided in RG 1.27. The water losses due to forced and natural evaporation, drift, and seepage and blowdown are to be replaced by makeup water provided primarily from the site wells or from the MCR via the Turbine Service Water System, as a secondary source of makeup water.

The main cooling water system with the MCR as a heat sink is described in detail in Subsection 10.4.5. The capability of the MCR to maintain a sufficient water level during periods of drought in the Colorado River is discussed in Subsection 2.4S.11.1. In addition, the MCR operation will be closely monitored by filling the reservoir to normal full level of El. 49 ft MSL, whenever possible using all the water diversion rights available to STP to ensure sufficient water level in case of a repeat of the DOR in the Colorado River.

Compliance with EPA 316(b) regulations for existing facilities is satisfied in terms of meeting the performance standards to reduce impingement, mortality, and entrainment because:

- The RMPF was designed and built for a maximum capacity of 1200 cfs for an anticipated four units at the time, and no change to this maximum flow is anticipated, and;
- The makeup flow is for use in a closed-cycle cooling scheme as opposed to a once-through system.

2.4S.11.6 Heat Sink Dependability Requirements

The UHS cooling tower basin will maintain a water inventory adequate for 30 days of cooling under the design basis accident with no makeup and blowdown as discussed in Section 9.2.5. There will be sufficient suction submergence water depth and pump net positive suction head (NPSH) to ensure proper operation of the pump station contiguous with the UHS basin for the entire 30-day period following an accident.

Adherence of the existing facility to EPA 316(b) is satisfied in terms of meeting the performance standards to reduce impingement, mortality, and entrainment as explained in Subsection 2.4S.11.5

A detailed description of how the UHS is designed to meet the dependability requirements is provided in Subsections 9.2.5 and 16.3.7.

2.4S.11.7 References

2.4S.11-1 “STPEGS Updated Final Safety Analysis Report, Units 1 & 2,” Revision 13.

2.4S.11-2 “Region ‘K’ Water Plan for the Lower Colorado Regional Water Planning Group,” Lower Colorado Regional Water Planning Group, 2006.

2.4S.11-3 “Daily Streamflow Data for Bay City Gauging Station, Texas,” U.S. Geological Survey, 2007, Available at http://waterdata.usgs.gov/nwis/dv/?site_no= 08162500&referred_module=sw, accessed May 24, 2007.

2.4S.11-4 Amended and Restated Contract by and between the Lower Colorado River Authority and STP Nuclear Operating Company, Effective as of January 1, 2006.

2.4S.11-5 Water Management Plan for the Lower Colorado River Basin Effective September 20, 1989 including amendments through May 14, 2003.

Table 2.4S.11-1 In-Stream Flow Requirements for the Colorado River

Month	Critical Flows (cfs)	
	Austin Gauge [1]	Bastrop Gauge
January	46	120
February	46	120
March	46	500 [2]
April	46	500 [2]
May	46	500 [2]
June	46	120
July	46	120
August	46	120
September	46	120
October	46	120
November	46	120
December	46	120

Source: Reference 2.4S.11-2

[1] LCRA will maintain a mean daily flow of 100 cfs at the Austin gage at all times, to the extent of inflows each day to the Highland Lakes as measured by upstream gages, until the combined storage of Lakes Buchanan and Travis reaches 1.1 million acre-feet of water. A mean daily flow of 75 cfs, to the extent of inflows each day to the Highland Lakes as measured by upstream gages, will then be maintained until the combined storage of Lakes Buchanan and Travis reaches 1.0 million acre-feet of water, then a subsistence/critical flow of 46 cfs will be maintained at all times, regardless of inflows. In addition, if the subsistence/critical flow of 46 cfs should occur for an extended period of time, then operational releases will be made by LCRA to temporarily alleviate the subsistence/critical flow conditions. Specifically, should the flow at the Austin gauge be below a 65 cfs daily average for a period of 21 consecutive days, LCRA will make operational releases from storage sufficient to maintain daily average flow at the Austin gauge of at least 200 cfs for two consecutive days. If this operational release conditions persists for three consecutive cycles (69 days), then a minimum average daily flow of at least 75 cfs will be maintained for the next 30 days.

[2] This flow should be maintained for a continuous period of not less than six weeks during these months. A flow of 120 cfs will be maintained on all days not within the six week period.

Table 2.4S.11-2 Historical Annual 1-Day Low Flows for the Colorado River at Bay City for Water Years 1948-2006

Water Year	1-day Low Flow (cfs)	Date of Occurrence	Water Year	1-day Low Flow (cfs)	Date of Occurrence
1948	16.0	6/5/1948	1978	161.0	3/22/1978
1949	81.0	5/19/1949	1979	363.0	10/30/1978
1950	137.0	7/29/1950	1980	0.9	8/17/1980
1951	0.0	6/1/1951	1981	15.0	5/17/1981
1952	0.0	6/23/1952	1982	314.0	9/1/1982
1953	0.0	4/23/1953	1983	38.0	4/29/1983
1954	2.3	4/24/1954	1984	3.1	5/15/1984
1955	1.4	5/7/1955	1985	87.0	8/4/1985
1956	0.0	7/5/1956	1986	48.0	4/7/1986
1957	92.0	12/9/1956	1987	380.0	4/30/1987
1958	1400.0	7/25/1958	1988	6.8	4/30/1988
1959	510.0	7/31/1959	1989	33.0	6/3/1989
1960	500.0	9/15/1960	1990	36.0	10/17/1989
1961	800.0	6/2/1961	1991	61.0	10/2/1990
1962	4.9	5/16/1962	1992	439.0	11/14/1991
1963	12.0	5/16/1963	1993	39.0	6/10/1993
1964	1.3	9/15/1964	1994	51.0	5/12/1994
1965	2.3	10/14/1964	1995	147.0	5/3/1995
1966	2.0	9/2/1966	1996	20.0	3/2/1996
1967	0.4	8/12/1967	1997	188.0	1/8/1997
1968	205.0	9/30/1968	1998	15.0	9/6/1998
1969	0.4	8/27/1969	1999	118.0	9/3/1999
1970	0.4	10/8/1969	2000	9.5	8/22/2000
1971	0.7	6/9/1971	2001	48.0	6/24/2001
1972	2.0	4/22/1972	2002	120.0	6/17/2002
1973	31.0	9/22/1973	2003	115.0	5/25/2003
1974	10.0	8/20/1974	2004	206.0	11/30/2003
1975	128.0	9/28/1975	2005	180.0	8/28/2005
1976	111.0	3/23/1976	2006	210.0	8/23/2006
1977	174.0	9/29/1977	-	-	-

Table 2.4S.11-3 Historical Annual 7-Day Low Flows for the Colorado River at Bay City for Water Years 1948-2006

Water Year	7-day Low Flow (cfs)	Date of Occurrence	Water Year	7-day Low Flow (cfs)	Date of Occurrence
1948	61.4	6/9/1948	1978	217.7	3/24/1978
1949	142.7	5/22/1949	1979	374.2	11/5/1978
1950	177.2	8/3/1950	1980	58.6	8/29/1980
1951	1.5	7/14/1951	1981	242.9	5/19/1981
1952	1.9	6/29/1952	1982	455.9	9/3/1982
1953	14.6	8/16/1953	1983	127.0	5/1/1983
1954	58.4	6/21/1954	1984	10.8	8/31/1984
1955	37.1	5/9/1955	1985	205.2	8/7/1985
1956	13.2	7/10/1956	1986	56.0	4/8/1986
1957	121.0	12/15/1956	1987	598.4	10/11/1986
1958	1788.6	9/20/1958	1988	82.6	6/18/1988
1959	684.0	7/10/1959	1989	41.4	6/5/1989
1960	714.3	9/18/1960	1990	68.4	10/18/1989
1961	890.0	6/8/1961	1991	90.2	10/4/1990
1962	6.7	5/16/1962	1992	502.9	12/8/1991
1963	13.3	5/18/1963	1993	348.3	6/11/1993
1964	1.4	8/27/1964	1994	137.0	9/29/1994
1965	16.7	9/10/1965	1995	199.6	10/1/1994
1966	2.0	9/8/1966	1996	20.0	5/22/1996
1967	0.5	8/18/1967	1997	285.9	10/15/1996
1968	312.4	10/7/1967	1998	68.3	9/8/1998
1969	0.5	8/7/1969	1999	209.9	9/5/1999
1970	0.5	10/10/1969	2000	13.7	8/23/2000
1971	1.3	6/10/1971	2001	110.0	6/26/2001
1972	19.0	8/19/1972	2002	206.0	6/17/2002
1973	366.4	7/23/1973	2003	213.6	5/27/2003
1974	35.0	8/24/1974	2004	375.3	10/7/2003
1975	348.4	9/30/1975	2005	287.7	8/28/2005
1976	223.4	3/23/1976	2006	266.4	8/23/2006
1977	297.2	9/30/1977	-	-	-

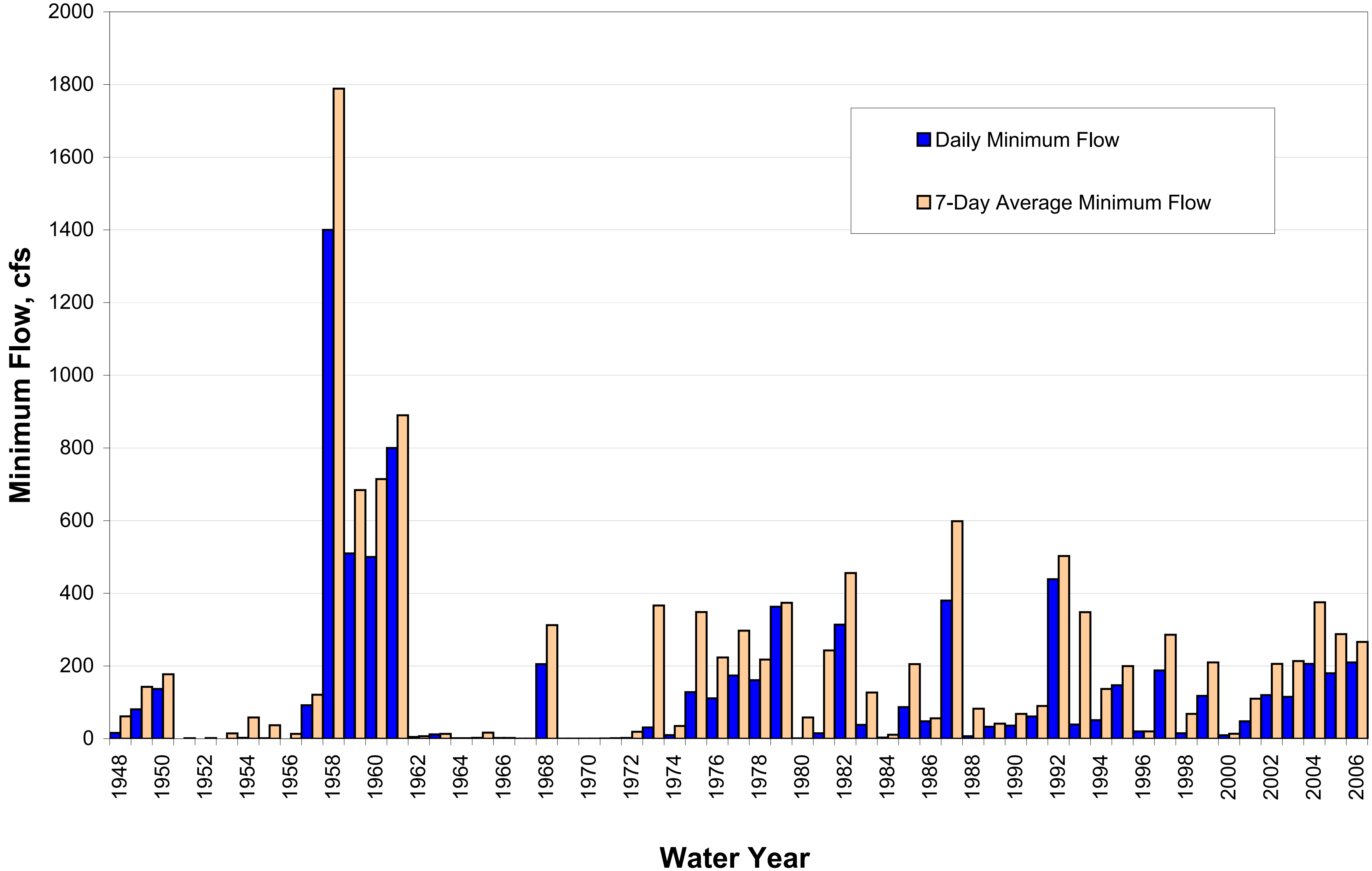

Figure 2.4S.11-1 Annual 1-Day and 7-Day Low Flows for the Colorado River at Bay City for Water Years 1948-2006