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16.9 AUXILIARY SYSTEMS

16.9.7 KEOWEE LAKE LEVEL

COMMITMENT

Ensure the proper requirements are met for the following Lake Keowee level ranges.

APPLICABILITY: Maintain level to ensure operability of specified systems and/or components.

NOTE: An instrument error of ± 1.15 ft has been applied to lake levels identified in this SLC. This is based on a computer point being used to verify level. Absolute lake level can be determined at the Keowee Hydro intake structure. Levels identified as (abs) are absolute values without instrument error included.

LAKE LEVEL	REQUIRED ACTION	REQUIRED ACTION NOT MET
A. All Lake Levels	A.1 Verify availability of the EWST and HPSW-25 to supply flow to the CCW Pumps, or Verify lake level ≥ minimum level required for gravity (non-siphon) flow per Table 16.9-7.	A.1.1 If the EWST or HPSW-25 are unavailable and lake level < minimum level for gravity flow per Table 16.9-7, then LPSW is inoperable. Enter Tech. Spec. 3.0.
B. Lake Level < 801.15 ft. (800.0 abs)	B.1 Verify at least two sources of CCW siphon flow are available to the LPSW pumps suction by operating 3 CCW pumps each on at least two units (6 pumps total). or Verify lake level ≥ minimum level required for gravity (non-siphon) flow per Table 16.9-7.	B.1.1 If only one siphon source is available and lake level < minimum level for gravity flow per Table 16.9-7, then enter a 72 hour LCO per T.S. 3.3.7. B.1.2 If no siphon sources are available and lake level < minimum level for gravity flow per Table 16.9-7, then LPSW is inoperable. Enter T.S. 3.0.
C. Lake level < 794.15 ft. (793.0 abs)	C.1 Restore lake level to greater than 794.15.	C.1.1 The LPSW system cannot withstand a single failure. Enter a 72 hour LCO per T.S. 3.3.7.

LAKE LEVEL	REQUIRED ACTION	REQUIRED ACTION NOT MET
D. Lake level <784.15 ft. (783.0 abs)	D.1 Declare the Keowee Oil Storage Room Water Spray System inoperable AND Refer to SLC 16.9.2 to establish the required firewatch.	D.1.1 Notify Regulatory Compliance of the need to meet the reporting requirements of SLC 16.9.2.
E. Lake level <781.15 ft. (780.00 abs)	E.1 To retain adequate water supply for 7 days emergency operation, stop Keowee generation to the grid	E.1.1 Notify the Plant Operations Review Committee (PORC) per NSD-308. AND Request plant operation (and reportability) guidance.
H. Lake Level < 780.60 ft. (779.45 abs)	H.1 Declare the Keowee Step-up Transformer Mulsifyre inoperable AND Refer to SLC 16.9.2 to establish required firewatch.	H.1.1 Notify Compliance of the need to meet the reporting requirements of SLC 16.9.2.

SURVEILLANCE: Keowee Lake Level shall be monitored once per shift.

TABLE 16.9-7
MINIMUM LAKE LEVEL FOR GRAVITY FLOW TO LPSW PUMPS SUCTION

If Keowee lake level $\geq$ minimum lake level in the following table, then gravity flow will provide adequate suction for the LPSW pumps without relying on the ECCW siphon:

Number of CCW Pump Discharge Valves Currently Open	**Minimum Lake Level for Gravity Flow * (feet absolute)**
1	803.91
2	800.64
3	799.70
4	799.22
5	798.93
6	798.72
7	798.56
8	798.44
9	798.33
10	798.25
11	798.18
12	798.11

* Note: These lake levels are based on the assumption that all CCW crossover isolation valves (1CCW-40, 2CCW-41, 3CCW-42 and 3CCW-94) are open. If any of these valves are closed, contact Mechanical Systems Engineering to determine the minimum lake level for gravity flow.

BASES:

The CCW system provides the source of water to the CCW crossover piping which supplies suction to the LPSW system. Normally, this crossover header is aligned to all three Oconee units, and CCW pumps provide adequate flow for the requirements of the LPSW systems for all 3 units. To meet the requirements of T.S. 3.3.7, the Emergency CCW (ECCW) system must be capable of supplying suction to the LPSW pumps in the event of a Loss of Off-site Power (LOOP). The ECCW supply to LPSW must be capable of withstanding a single active failure.

After a loss of power to the CCW pumps, the ECCW System is designed to supply suction to the LPSW pumps using an unassisted siphon. To maintain siphon flow capability, the ECCW piping must be relatively air-free and leak-tight. At high lake levels, gravity flow may be adequate to supply suction to the LPSW pumps without relying on the siphon.

To help maintain ECCW siphon flow capability, HPSW must supply seal water to the CCW pump shafts to prevent air inleakage that may defeat the siphon. The Elevated Water Storage Tank (EWST) through valve HPSW-25 provides the seal water necessary to the CCW pumps immediately following a LOOP (Refer to SLC 16.9.1 for HPSW pump requirements).

If the lake level is greater than 799.26 feet (798.11 abs), it may be possible to provide adequate suction pressure to the LPSW pumps due to gravity flow without dependance upon siphon flow. The minimum lake level for gravity flow depends on the number of open CCW pump discharge valves before and during the LOOP event. Since the CCW pump discharge valves remain as is after a LOOP event, the number of open CCW pump discharge valves during a LOOP is the same as the number of open CCW pump discharge valves before the LOOP event. Table 16.9-7 provides the minimum lake level for gravity flow as a function of the number of open CCW pump discharge valves.

With the lake level less than 801.15 feet, siphon flow capability must be established if gravity flow is not available. To ensure siphon capability will be established in the event forced flow is stopped, the CCW inlet piping from the intake structure to the CCW crossover must be maintained water-solid. Since the Continuous Vacuum Priming connections to the CCW inlet piping are normally isolated, the CCW piping is maintained water-solid by requiring a minimum number of CCW pumps operating on a given unit. "Water-solid" is defined as sufficient positive pressure to prevent gases from coming out of solution and sufficient flow to ensure accumulated gases will be swept away. The CCW flowpath is maintained water-solid by operating at least three CCW pumps on each Oconee unit being used as a siphon source.

Two siphon sources shall be capable of providing siphon flow to the LPSW pumps and the two siphon sources shall be from different units. A "siphon source" is defined as a water-solid flow path consisting of two 8 ft. CCW pump discharge valves open to a common 11 ft. CCW inlet header. Whenever 3 CCW pumps are operating on a given unit, siphon flow is assured only in the 11 ft. CCW inlet header being fed by the two pumps, because the 11 ft. CCW inlet header being fed by only one pump cannot be assured to be water-solid. Therefore, another unit with at least 3 CCW pumps operating is necessary to provide another siphon source.

The failure of a siphon source is not postulated since the siphon sources contain no active components. Two siphon sources originating from different units is required to maintain adequate NPSH to each LPSW pump. If only one

siphon source is available due to maintenance, testing, etc., then the LPSW System cannot withstand a single failure which causes the loss of an LPSW pump, and a 72 hour LCO shall be entered per T.S. 3.3.7. If a 72 hour LCO has been declared because lake level has fallen below 794.15 ft, then at least one siphon source must continue to be maintained to avoid entering T.S. 3.0.

With lake level below 794.15, calculations show that the LPSW pumps could experience inadequate NPSH with siphon flow if a single failure causes only the minimum number of LPSW pumps (one for Unit 3 or two for the shared Unit 1 and 2 systems) to be available during a design basis event. Therefore, the LPSW system must be considered unable to withstand a single failure for lake level below 794.15 and a 72 hour LCO must be entered per T.S. 3.3.7.

Should lake level fall below 784.15, the Keowee Oil Storage Room water spray system may not provide the required flowrates. For this reason, the spray system should be declared inoperable and the appropriate compensatory actions taken.

With lake level below 781.15, the water supply (for Keowee Hydro Station to provide emergency power to the overhead path at 46.5 MVA and the underground path at 22.35 MVA) could be inadequate for 7 days of continuous operation at these levels. Neither Keowee Hydro or Oconee Nuclear Station should be considered inoperable at this lake level. Keowee Hydro should not generate to the grid at lake levels below 781.15 in order to ensure ample water capacity for emergency power operation.

Should lake level fall below 780.60, the Keowee main Step-up Transformer Mulsifyre system may not provide the required flowrates. For this reason, the Mulsifyre should be declared inoperable and the appropriate compensatory actions taken.

REFERENCES:

1. PIR 0-092-0535, Potential Insufficient NPSH for LPSW pumps
2. LER 269/93-04, Rev. 0 and Rev. 1
3. OSS-0254.00-00-1003, Rev. 7, Design Basis Specification for the CCW System
4. OSS-0254.00-00-1039, Rev. 6, Design Basis Specification for the LPSW System
5. Calculation OSC-2895, Rev. 4, Hydraulic Calculations for Keowee Deluge Systems
6. Calculation OSC-5325, Rev. 0, Keowee Lake Level Uncertainty Calculation
7. Calculation OSC-5304, Rev. 1, Minimum Lake Level for Radwaste Equipment Cooling System Isolation
8. Calculation OSC-5022, Rev. 1, USQ Evaluation for Operability Evaluation of PIR O-092-0535
9. Calculation OSC-2280, Rev. 7, LPSW NPSH and Minimum Required Lake Level
10. Calculation OSC-5349, Rev. 1, Minimum Lake Level Required to Maintain Sufficient NPSH to the LPSW pumps via Gravity Flow
11. Calculation OSC-5670, Rev. 3, Required Number of CCW Intake Flow Paths
12. Calculation OSC-5461, Rev. 1, Isolation of the Continuous Vacuum Priming System to the CCW Intake Piping
13. Calculation OSC-5409, Rev. 3, Single Failure Analysis of the ECCW System Supply to the LPSW Supply
14. Calculation OSC-3528, Rev. 3, Keowee Lake Level Minimum Administrative Limits

STATION MANAGER APPROVAL B Rule DATE 9-22-97