KANSAS GAS & ELECTRIC COMPANY
WOLF CREEK GENERATING STATION

ULTIMATE HEAT SINK
FILL SPECIAL PROCEDURE

SU8 0001

Revision 3

Classification: Non-Nuclear Safety Related

INFO ONLY

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1.0 OBJECTIVES

The objectives of this procedure are to provide a method to initially fill the ultimate heat sink portion of the cooling lake using temporarily installed piping, to record and transmit specific data required by Nuclear Plant Engineering during the hold period, to fill the temporary lake on the southwest side of the Ultimate Heat Sink Dam, to document and control the water levels on either side of the Ultimate Heat Sink (UHS) Dam, and to minimize overtopping of the Ultimate Heat Sink Dam.

2.0 LIMITING CONDITIONS

2.1 The Ultimate Heat Sink (northeast of the UHS dam) shall be filled to approximately elevation between 1969.0' and 1969.5' and maintained within those elevations until directed by Nuclear Plant Engineering. The water on the southwest side of the UHS dam shall be maintained below elevation 1955' to the extent practical.

2.2 After Nuclear Plant Engineering has determined that the water has been retained behind the UHS dam for a sufficient period of time (approximately 30 days) the water level in the Ultimate Heat Sink shall be maintained between elevations 1969.0' and 1969.5', and the water level on the southwest side of the UHS dam may be increased.

2.3 When the water level on the southwest side of the UHS dam reaches the water level on the northeast side of the UHS dam, the water levels on both sides of the UHS dam shall be allowed to increase until the temporary lake is filled. Care shall be exercised to minimize waterflow across the top of the UHS dam (overtopping).

3.0 REFERENCES

3.1 Piping and Instrumentation Diagrams

3.1.1 M-21, Rev. D, Circulating Water System P&ID

3.1.2 M-24, Sheet 1, Rev. E, Cooling Lake Makeup and Blowdown System P&ID

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3.1.3 M-24, Sheet 2, Rev. C, Cooling Lake Makeup and Blowdown System P&ID

3.1.4 M-25, Sheet 1, Rev. D, Makeup Demineralizer System P&ID

3.1.5 M-26, Sheet 2, Rev. C, Screen Wash System P&ID

3.2 Schematic Diagrams

3.2.1 E1005-PG/WL010, Rev. C, Auxiliary Raw Water Pump OA

3.2.2 E1005-PG/WL011, Rev. D, Auxiliary Raw Water Pump OB

3.2.3 E1005-PG/WM010, Rev. D, Raw Water Pump 1A

3.2.4 E1005-PG/WM011, Rev. D, Raw Water Pump 1B

3.3 Daniel Temporary Fill Line drawing for UHS

3.4 Telephone conversation between G. Boyer and M.L. Johnson, 27 May 1980, 11:20 A.M.

3.5 Sargent and Lundy letter to M.L. Johnson, ALK-3543, June 3, 1980, Filling the Ultimate Heat Sink Reservoir.

4.0 EQUIPMENT

4.1 Two 600 gpm engine driven portable pumps, or equivalent

4.2 Four lengths of suction hosing for pumps specified in Section 4.1

4.3 Three lake level indication markings, in 1/10 foot increments, located in the UHS basin and in the pond on SW side of the UHS dam and in the toe of the UHS dam on the SW side. The upper most increment shall be above 1970 .0'.

5.0 NOTES AND PRECAUTIONS

5.1 Due to the extremely large area which drains into the northeast side of the UHS dam, the northeast side of the UHS dam is expected to fill rapidly during periods of heavy precipitation.

5.2 Care should be exercised to avoid a raw water pump trip on low suction water level in the Makeup Discharge Structure.

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7.1.5 Maintain the water level in the Ulimate Heat Sink between 1969.0' and 1969.5' until directed by Nuclear Plant Engineering to proceed with the fill of the temporary lake finger.

7.2 Filling the Temporary Lake Finger

Note: Lake level monitoring and adjustment shall be performed in accordance with section 7.3.

7.2.1 At the direction of Nuclear Plant Engineering, begin fill of the temporary lake finger.

7.2.2 Fill the southwest side of UHS dam to the same elevation as the northeast side of the UHS dam equalizing the water levels on both sides of the UHS dam.

7.2.3 Complete filling of the temporary lake finger. Care shall be exercised to minimize waterflow across the top of the UHS dam.

7.3 Lake Level Monitoring and Adjust

7.3.1 During the hold period, daily level measurements will be recorded for the UHS basin, the downstream toe of the UHS dam, and the downstream pond on the SW side of the UHS dam. Pumping flow rates and time durations will also be recorded. These records will be transmitted to KG&E Construction and the Dames and Moore Geotechnical Engineer for disposition per instructions by Nuclear Plant Engineering.

7.3.2 All lake measurements and pumping rates shall be recorded on Appendix B.

7.3.3 Water level on either side of the UHS dam shall be maintained as practical by appropriate use of the temporary pumps.

7.3.4 Following periods of heavy precipitation and because of the large area draining into the northeast side of the UHS dam, it may be necessary to align the temporary pumps to transfer water from the northeast to the southwest side of the UHS dam to minimize waterflow over the top of the dam.

5.3 The two 600 gpm pumps shall be capable of pumping water in either direction through the temporary piping shown in Appendix C.

5.4 The elevation on the both sides of the UHS dam will be measured at the elevation markers.

6.0 PREREQUISITES

6.1 Provision has been made to supply water to the auxiliary raw water pumps.

6.2 All testing has been completed on the raw water pumps, auxiliary raw water pumps and associated piping and systems required to supply water to the UHS.

6.3 The Makeup Discharge Structure Raw Water Pump suction pit is clear of personnel and debris.

6.4 Complete the Initial Valve Lineup as shown in Appendix A.

6.5 Notify Dames and Moore before pumping any water into the UHS to allow them to monitor erosion of the discharge water if erosion may occur.

7.0 PROCEDURE

7.1 Filling the Ultimate Heat Sink

7.1.1 If the makeup water line has been dewatered, start the Auxiliary Raw Water Pumps OWL02PA and OWL02PB according to operating procedure WL-002. If the makeup water line is filled, start the Auxiliary Raw Water Pumps OWL02PA and OWL02PB according to operating procedure WL-001.

7.1.2 The Makeup Discharge Structure Raw Water pump suction pit has filled with water as identified by a water discharge over the weir.

7.1.3 Start the Raw Water Pumps 1WM01PA and 1WM01PB according to operating procedure WM-001.

NOTE: Lake level monitoring and adjustment shall be performed in accordance with section 7.3.

7.1.4 Fill the Ultimate Heat Sink to an elevation between 1969.0' and 1969.5' as indicated on the elevation markers located in the UHS basin (after being corrected to the SNUPPS elevaton datum).

APPENDIX A

INITIAL VALVE LINEUP

VALVE NUMBER	DESCRIPTION	POSITION
OWL024A	OWL02PA Discharge PI Isolation	O
OWL004A	OWL02PA Discharge Isolation	CL
OWL005	Makeup Line PI Isolation	O
OWL001A	OWL01PA Discharge Isolation	CL
OWL024B	OWL02PB Discharge PI Isolation	O
OWL004B	OWL02PB Discharge Isolation	CL
OWL001C	OWL01PC Discharge Isolation	CL
OWL001B	OWL01PB Discharge Isolation	CL
OWL029	Manhole #2 High Point Vent Isol	O
OWL007	Manhole #2 High Pt Manual Vent	CL
OWL030	Manhole #3 High Point Vent Isol	O
OWL009	Manhole #3 High Pt Manual Isol	CL
OWL010	Manhole #3A Dewatering Isolation	CL
OWL031	Manhole #4 High Point Vent Isol	O
OWL012	Manhole #4 High Pt Manual Vent	CL
OWL032	Manhole #5 High Point Vent Isol	O
OWL027	Manhole #5 High Pt Manual Vent	CL
OWL033	Manhole #6 High Point Vent Isol	O
OWL028	Manhole #6 High Pt Manual Vent	CL
1WM003A	1WM01PA Discharge PI Isolation	O
1WM002A	1WM01PA Discharge Isolation	CL
1WM003B	1WM01PB Discharge PI Isolation	O
1WM002B	1WM01PB Discharge Isolation	CL

O = Open CL = Closed T = Throttled L = Locked (Prefix)

APPENDIX A

INITIAL VALVE LINEUP

VALVE NUMBER	DESCRIPTION	POSITION
(Later)	Temp Fill Line ISOL	L.T.
1CW002	Circ Wtr Warming Line Isolation	CL
"A"	8" PVC Fill Line Isolation	O
"B"	4" PVC Bypass	CL
"C"	6" PVC Pressure Tap	CL

O = Open CL = Closed T = Throttled L = Locked (Prefix)

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APPENDIX B

UHS LEVEL MONITOR RECORD
"Example Only"

WATER LEVELS*

DATE/TIME	UHS BASIN	DOWNSTREAM POND	DOWNSTREAM TOE OF UHS DAM

*Actual readings on level indicators. Elevation markers are marked in increments of 0.1 foot. Read to nearest 0.1 foot.

Recorded by _____

DAILY PUMPING RECORDS: (Record type of pump, run time, and location to where water was pumped).

DATUM ELEVATIONS	UHS BASIN	DOWNSTREAM POND	DOWNSTREAM TOE OF UHS DAM

WATER ELEVATIONS*

DATE	UHS BASIN	DOWNSTREAM POND	DOWNSTREAM TOE OF UHS DAM

*In feet (by KG&E)

Calculation by _____

DAILY PUMPING ACTIVITY Summary: (Record total amount of water, in gallons, and location it was pumped to).

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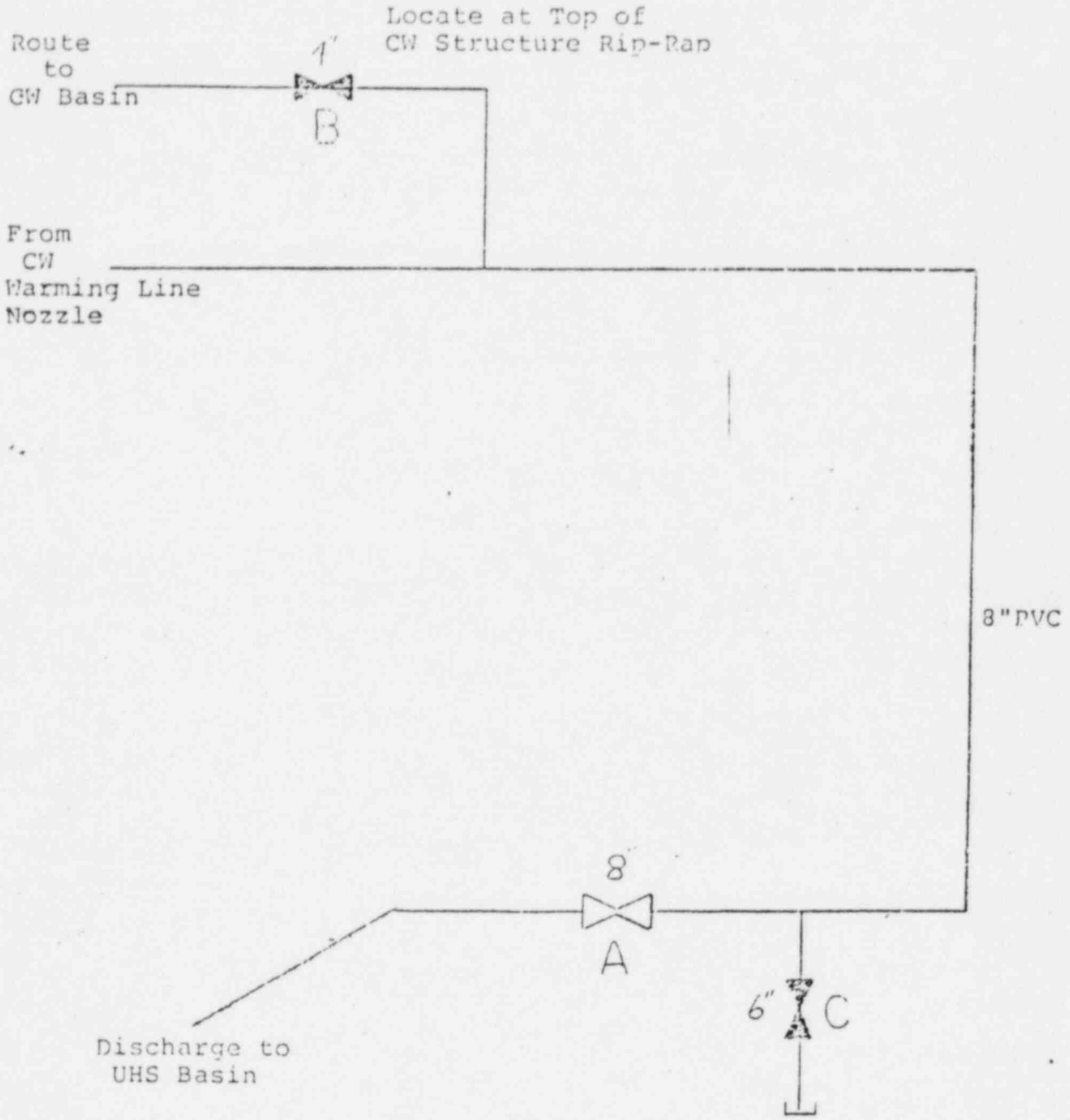
APPENDIX C
Temporary Piping - Circulating Water
Intake Structure to Ultimate Heat Sink



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Q241.23WC Solution channels filled with clay were discovered in the Plattsmouth Limestone formation during geologic mapping of the UHS dam foundation excavation. This was not reported in the FSAR.

1. What was the areal extent and depth of these solution channels, and are there any continuous channels across the dam foundation?

2. How did you determine the presence or absence of these solution features within the limestone formations?

3. Was the soil in the solution cavities tested for the properties resistant to piping and for erosion under the design conditions?

4. Evaluate the effect of these solution channels on the safety of the UHS dam.

R241.23WC 1. A description of these features is provided in revised FSAR Section 2.5.1.2.5.3.

2. Determination of the presence or absence of solution features was made by subsurface exploration, water pressure testing in boreholes, and detailed geologic mapping of foundation excavations. The subsurface exploration program for the UHS and the UHS dam are described in FSAR Section 2.5.6.2.1. This section also describes the rock conditions observed during this exploration program. The lithology, physical characteristics, percent recovery, and rock quality designation (RQD) of the rock core were logged in the field (FSAR Section 2.5.4.3.1). Joints, partings, and solution features were also identified in the field during the subsurface exploration program. Detailed descriptions of the rock core, including the presence of any of these features, are presented on the logs of individual borings included in FSAR Section 2.5.

The presence or absence of significant solution features at the UHS and the UHS dam were also indirectly determined by observations of any drilling water loss during drilling, and by conducting water pressure tests in boreholes after completion of drilling. As described in FSAR Section 2.5.6.4.1.4, no drilling water losses were encountered in any of the soil or rock borings during the subsurface exploration

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for the UHS dam. Water pressure tests in boreholes were performed as described in FSAR Section 2.5.4.3.2.1. The results of water pressure testing and evaluation of rock mass permeabilities for the Plattsmouth and Leavenworth limestones in the UHS are presented in FSAR Sections 2.5.1.2.2.2.1.1.-1.3.2 and 2.5.1.2.2.2.1.1.1.3.4, and on the logs of individual boreholes included in FSAR Section 2.5. A summary of the results of water pressure testing at the UHS relative to estimated UHS dam seepage is presented in FSAR Section 2.5.6.6.4. No large water takes occurred during the water pressure testing.

The results of the subsurface exploration program and the water pressure testing indicated that no significant solution features that have the potential to act as seepage pathways were present.

After excavation to foundation grade, the presence or absence of solution features was determined by direct observation. Detailed geologic maps of the exposed foundation strata were prepared at a scale of 1:120. A description of the extent and depth of the solution features observed in the UHS dam foundation is provided in revised FSAR Section 2.5.1.2.5.3. The geologic maps are presented in Dames & Moore's final mapping report (August 13, 1981).

3. No tests related to resistance to piping and erosion were performed on the material in the solution features. However, see Item 4 below.

4. The solution features discovered in the Plattsmouth Limestone during the mapping of the UHS dam foundation are discussed in revised FSAR Section 2.5.1.2.5.3. In summary, all the observed solution widened joints were clay filled, and none were observed to go deeper than one foot below the foundation surface. Also, no water loss was observed during drilling, and no large water take was observed in the borings along the UHS dam alignment during the water pressure testing. In addition, all joints containing loose material were cleaned out by

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hand excavation and sealed with compacted clay. It is therefore unlikely that any open paths or channels, which are necessary for dispersive piping to start (Sherard, et al., 1972) are present. Therefore, the observed solution features in the UHS dam foundation should have no impact on the safety of the UHS dam.

REFERENCE

Sherard, James L., Decker, Ray S., and Ryker, Norman L., (1972), Hydraulic Fracturing in Low Dams of Dispersive Clay; Proceedings of the Specialty Conference on Performance of Earth and Earth-Supported Structures, Purdue University, Lafayette, Indiana, June 11-14.

out at the cooling lake site are the Plattsmouth Limestone and Toronto Limestone Members of the underlying Oread Limestone Formation.

No evidence of solutioning of the limestone units in the vicinity of the spillway at John Redmond Reservoir was noted during field investigations. B.J. Bishop, Chief, Operation Division, Tulsa District of the U.S. Army Corps of Engineers (1975) has stated that Foundations and Materials Section personnel observed no indications of any large-volume solutioning of limestone in the vicinity of John Redmond Reservoir.

Two types of features were found during the site explorations and excavation mapping which can be attributed specifically to limestone weathering or solutioning. One type of feature, irregular elongated hollows (karren), are formed by the concentration of solution activity along lines of weakness such as joints. Another type of feature is a group of non-linear hollows that curve in an irregular manner and are not associated with joints. This latter pattern may have been caused by organism trails or burrows prior to lithification. Trail or burrow fillings may have been preferentially dissolved.

Within the site area, karren separated by rounded divides have been noted in areas where the Plattsmouth and Toronto Limestone Members are exposed as the surficial bedrock units and in the main dam keytrench where the Plattsmouth and Toronto occur at or near ground surface. The curved solution features not associated with joints have been mapped in portions of the ultimate heat sink dam foundation approximately between Stations -0+50 and 1+00 at approximately SNUPPS Elevation 1962.8 to 1962.4 (Dames & Moore, 1981, Figures 8MM, 8DD, and 8EE). Linear solution features (karren) occur approximately between Stations 10+08 and 14+15 at approximately SNUPPS Elevation 1965.6 to 1969.2 (Dames & Moore, 1981, Figures 8U through 8BB and 8OO through 8TT). In both areas the Plattsmouth Limestone had been covered by clayey soils prior to excavation (Dames & Moore, 1981, Figures 8B, 8G, 8E, 8F, and 8J). Linear solution grooves have also been mapped in portions of the excavation surface of the ultimate heat sink pond between Station AM (SNUPPS N98,184.1, E103,911.8, Elevation 1977.5) and Station BC (SNUPPS N98,933.5, E103,643.0, Elevation 1966.7) where the Plattsmouth Limestone had been covered by slightly weathered Heumader Shale (Dames & Moore, 1981, Figures 9I through 9L). As noted in the preliminary site investigation and during construction, this feature is generally not found in areas where the Plattsmouth and/or the Toronto are overlain by other stratigraphic units (Dames & Moore, 1979b).

Typically, karren at the site have rounded divides between the grooves that are spaced from one to several feet apart. The grooves are usually about an inch wide at the surface of the limestone outcrop. However, they narrow quickly with depth and disappear within several feet of the surface.

As observed and mapped in the main dam keytrench, solution activity in the Plattsmouth and Toronto Limestones occurred at joint intersections and along existing joints and resulted in widening those joints. These joints are presently filled with reddish brown clay.

Erosion by ancestral Wolf Creek has formed a valley that is floored by successively lower stratigraphic units ranging from the Plattsmouth Limestone Member at higher elevations to the Lawrence Formation at lower elevations (Figure 2.5-22). Mapping in the main dam keytrench, transverse to Wolf Creek valley, indicates that solution activity along joints has occurred in the Plattsmouth and Toronto Limestone Members where those units had occurred as the uppermost bedrock unit. This solution activity did not affect overlying or underlying shales or the shale layer within the plattsmouth limestone. Solution activity did not occur at locations where the Plattsmouth and Toronto limestones are covered by the Heumader and Snyderville shales, respectively. This fact is documented in geologic maps of the main dam keytrench walls (Dames & Moore, 1979b, Figure 10J, Sta. 37+06 to Sta. 38+00; Dames & Moore, 1981, Figure 11A, Sta. 42+00 to Sta. 43+50) Many of the features shown on the two figures referred to above represent solution activity which had occurred along joint intersections and along individual joint surfaces. Blocks of sound limestone between joints which are shown on these figures were plucked away from the keytrench wall during blasting and excavation giving the impression of wide solution features where sound rock had actually occurred between clay-filled fractures.

Coring and pressure testing data obtained during the main dam foundation investigation had indicated that the Plattsmouth and Toronto limestones have relatively low permeabilities below the upper weathered zone and where overlain by the Heumader and Snyderville Shales. (For example see Dames & Moore, 1976c, Figures A-2-8, A-2-9, A-2-33, and A-2-36 for borings D-14, D-18, D-40 and D-43, respectively). No solution features were observed in the main dam keytrench from Sta. 8+00 to Sta. 18+00 (Dames & Moore, 1979b, Figure 10D). Subsurface investigations and excavation surface mapping indicate that solution features do not occur throughout the Plattsmouth and Toronto limestones, but occur along near-surface joints at locations where overlying rock units have been removed by stream erosion in Wolf Creek valley.

As observed and mapped in the ultimate heat sink dam foundation between Stations -0+50 and 1+00, the irregular, non-linear solution features occur in areas where the Plattsmouth Limestone Member was overlain by 5 to 8 feet of topsoil, silty clay, clay, and extremely to moderately weathered Heumader shale (Dames & Moore 1981, walls on Figures 8B and 8G, floors on Figures 8M, 8DD, 8EE, and 8FF. Widths of clay-filled fractures are noted on each figure). Most of the features in this area appear similar to those shown to scale on the detail inset on Figure 8M (Dames & Moore, 1981). These curving, irregular features differ from the linear karren observed elsewhere and do not appear to be associated with fractures. None of the curved solution features were continuous across the UHS dam foundation. Clay-filled joints, apparently widened by solution activity, are rare but occur at approximately Station 0+35, 70'R of centerline; Station 0+38, 60'L of centerline; and Station 1+00, 83'L of centerline. Both the curving irregular features and the joints discussed above were mapped on excavation surfaces ranging in elevation from approximately 1962.8 to 1962.1 (SNUPPS Datum). No solution features were observed on the foundation surface at approximately 1961.0 to 1960.4 (i.e., south and east of the excavation ledge) (Dames & Moore, 1981, Figures 8N, 8M, 8EE, and 8FF). This observation, coupled with hand excavation of several of the clay-filled solution features and joints, indicates that these features range up to almost 1 foot in depth. These data indicate that both solution features along joints and the irregular features are restricted to the uppermost 1-foot of rock and implies that the occurrence of the curving irregular features is lithologically controlled. Solution features in the Plattsmouth Limestone at the UHS dam between Station 1+00 and approximately Stations 2+55 to 3+00 (i.e., below SNUPPS elevation 1961) are rare and appear to be joint controlled (Dames & Moore, 1981, Figures 8N, 8O, and 8GG).

Solution activity appears to have widened many joints occurring between Stations 10+08 and 14+15 at the southeast end of the ultimate heat sink dam (Dames & Moore, 1981, Figures 8W through 8BB and 8OO through 8TT). The excavation surfaces which contain these clay-filled joints range in elevation from 1964.4 to 1969.2 and had been overlain, prior to excavation, by 4 to 8 feet of silty clay and extremely weathered limestone (Dames & Moore, 1981, Figures 8E, 8F, and 8J). [illegible] clay-filled joints in this area range up to almost 2 [illegible] in width. Hand excavation and observations across ledges indicate that these features are generally on the order of up to 1 foot in depth. Only two clay-filled fractures in the Plattsmouth Limestone are continuous across the dam foundation and cross the centerline at approximately Stations 11+15 and 11+20 (SNUPPS elevation approximately 1966.5 - Dames & Moore, 1981, Figures 8X and 8PP). Other portions of the Plattsmouth foundation surface between Stations 8+60 and 10+08 contain

either tight joints or more widely spaced, clay-filled joints up to 1 inch wide (Dames & Moore, 1981, Figures 8U, 8V, 8MM, and 8NN). Mapping of abutment surfaces containing the base of the Plattsmouth Limestone indicates that solution features are not through-going to the top of the underlying Heebner Shale (Dames & Moore, 1981, Figure 8ZZ; also see Figure 8WW).

Logs for Borings HS-15 and HS-1 indicate that no joints and solution features were observed within the Plattsmouth limestone beneath the northwestern portion of the foundation and that both core recovery and RQD were high (Figures 2.5-30, 2.5-36o, and 2.5-36a). No solution features were observed in borings HS-3, HS-5, HS-16, and HS-31 where the Plattsmouth limestone occurs as the upper bedrock unit in the southeastern portion of the ultimate heat sink dam foundation (Figures 2.5-36c, -36e, -36p, and -36gg). No water losses were reported during drilling. The presence of delicate calcite crystals in isolated 0.08 ft. diameter vugs near the base of the Plattsmouth limestone are another indication that solution features do not occur throughout this unit. These data and a cross-section along the UHS dam axis indicate that, as at the main dam, solution features in the Plattsmouth limestone appear to occur only where it is the uppermost bedrock unit in the vicinity of Quaternary stream channels (Figure 2.5-48). Solution features at the southeast end of the ultimate heat sink dam foundation are similar to those at the main dam keytrench in that stratigraphically lower horizons in the Plattsmouth are affected at locations where stream erosion has cut down through the limestone. The irregular, curved solution features and more widely spaced joints in the northern portion of the ultimate heat sink dam foundation differ in that their occurrence is restricted to approximately a 1-foot interval.

Some solution pitting and karren were mapped in the ultimate heat sink pond between Stations AI and BC (SNUPPS Elevations 1978 to 1966.7, respectively) (Dames & Moore, 1981, Figures 9 and 9H through 9L). Observation across ledges and hand excavation indicate that these features generally range up to 0.5 to 0.6 foot in depth. This general area had been covered by 5.5 to 7.7 feet of topsoil and silty clay prior to excavation.

Pressure testing in Borings HS-8 and HS-22 in the vicinity of these features indicated no water take within the Plattsmouth limestone (Figures 2.5-36h and 2.5-36v). Additional pressure testing in borings HS-10, HS-20, HS-24, and HS-29 indicated no water takes within the Plattsmouth limestone in the ultimate heat sink pond area (Figures 2.5-36j, -36t, -36x, and -36cc). These data and the rock core descriptions indicate the absence of solution features in the Plattsmouth limestone and infer that the three joints described as open in logs for Borings HS-5, HS-20, and HS-22 had been closed or filled prior to drilling (Figures 2.5-36e, -36t, and -36v). In addition to

these subsurface data, no solution features were mapped within the Plattsmouth limestone where excavated for the essential service water pipeline corridor within the ultimate heat sink pond (Dames & Moore, 1981, Figures 6III through 6TTT), for the foundation for the essential service water pumphouse (Dames & Moore, 1981, Figures 7A through 7D), or for foundations within the power block (Dames & Moore, 1978, see Figures 1A and 1B for locations of maps within power block). See Section 2.5.6.6.4 for a discussion of estimated seepage through the foundation rock of the UHS dam.

The cooling lake (WCGS-ER(OLS) Sections 3.3 and 3.4) receives water from runoff, precipitation, and make-up water released from John Redmond Reservoir and loses water through seepage, evaporation, and discharge. The results of analyses for a 16-year period indicate (WCGS-ER(OLS) Rev. 3, Section 3.3 and Table 3.3-1) that with one unit operating, an average of 46.9 cfs released from John Redmond Reservoir will be pumped into the lake from the Neosho River for make-up and 27.3 cfs will come ito the lake from rainfall and runoff. With two units operating, these figures will be 60.9 and 27.3 cfs, respectively. Discharge will average 21.7 cfs with one unit in operation. Discharge will average 20.8 cfs with a second unit in operation. Seepage is assumed to be 3.5 cfs with either one or two units in operation. The remaining water loss will occur through evaporation. (See Sections 2.4.8.2 and 2.4.11.5.)

Q241.24WC Provide the following information on the UHS dam filling test:

1. What was the quantity of water pumped into the UHS dam during the 30-day monitoring period?

2. What was the quantity of water pumped from the downstream toe to maintain a water level of elevation 1955 feet?

3. What were the estimate seepages through the UHS dam and through the UHS dam foundation?

4. Compare the estimated vertical and lateral deformation of the UHS dam with "those measured during the filling and subsequent 30-day monitoring of the UHS dam." Evaluate the impact of any differences between the measured and estimated deformations on the safety of the UHS dam.

5. Provide a copy of the report "Final Report, Surveillance of Earthwork, UHS and UHS Dam" by Dames & Moore, 1981.

R241.24WC 1. The quantity of water pumped into the UHS reservoir during the 30-day monitoring period was 388,740 cubic feet.

2. The quantity of water pumped from the downstream toe of the UHS dam to maintain a water elevation of 1955 feet during the 30-day monitoring period was 57,710 cubic feet.

3. The UHS dam has a zone extending 30 feet beyond the toe of the embankment which has been excavated to rock and backfilled to grade elevation with riprap stone. This is shown on FSAR Figures 2.5-116 and 2.5-117.

During the 30-day observation period, water was pumped from a sump at the low point in this area to maintain the water level in this area below elevation 1955 feet. The net cumulative amount of water pumped from this area during the period 11/7/80 to 12/6/80 was 347,400 gallons which corresponds to a seepage rate of 8.3 gpm. The net cumulative amount was obtained by taking the total amount of water pumped and subtracting the volume of precipitation falling on the downstream face and excavated toe area during the 30-day period.

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The seepage during this period was 8.3 gpm which corresponds to 0.154×10^{-4} cfs/ft length of dam. This is less than the predicted seepage rate of 0.23×10^{-4} cfs/ft as given in FSAR Section 2.5.6.6.4.

4. No estimates of deformation of the UHS dam during filling were made. The locations of movement monuments are provided in Figur 241.24-4-1, and the measured deformations for each monument are presented in Tables 241.24-4-1 through 241.24-4-4. From these tables, it may be seen that the vertical movements during the filling period are on the order of less than 0.5 inch and on the order of 0.1 inch during the observation period (Table 241.24-4-2). The UHS dam has been constructed with a conservative 3.5 percent camber, so that the crest elevation will remain above elevation 1970.0 feet, as described in Sargent & Lundy Report No. SL-3831, Paragraph 2.2.3.5 (which is provided in response to Question 241.25).

The observations of the horizontal movements for September 24, 1980 (Table 241.24-4-4) show deformations up to 3 inches along the axis of the UHS dam and deformation close to 1 inch transverse to the axis of the UHS dam. However, the survey data for the prior and subsequent periods, including the observation period, show movement on the order of 1 inch or less. It is, therefore, felt that the data for September 24, 1980 does not reflect actual movements. Actual movements should, therefore, be considered on the order of 0.5 inch for vertical displacements ments and 1 inch or less for horizontal displacements.

These recorded horizontal and vertical movements are considered normal and have no impact on the safety of the UHS dam.

VERTICAL MOVEMENT MONUMENT DATA
UHS DAM

Monument Number	Location (feet)		Date of Survey and Elevation										
	Station	Offset	05/20/80	05/27/80	06/03/80	06/10/80	06/17/80	06/24/80	07/01/80	07/08/80	07/15/80	07/22/80	07/29/80
1	(-) 2+00	0	1978.031	1978.023	1978.022	1978.021	1978.038	1978.036	1978.039	1978.046	1978.030	1978.030	1978.038
2	0+00	0	1978.276	1978.269	1978.264	1978.266	1978.282	1978.279	1978.282	1978.290	1978.274	1978.275	1978.279
3	2+00	0	1978.369	1978.364	1978.360	1978.363	1978.370	1978.376	1978.378	1978.387	1978.374	1978.380	1978.377
4	4+00	0	1978.753	1978.740	1978.733	1978.732	1978.736	1978.739	1978.740	1978.744	1978.733	1978.74[illegible]	1978.733
5	5+50	0	1978.663	1978.653	1978.648	1978.650	1978.656	1978.656	1978.661	1978.666	1978.654	1978.664	1978.656
6	7+00	0	1978.565	1978.555	1978.554	1978.555	1978.559	1978.563	1978.568	1978.573	1978.559	1978.573	1978.563
7	8+50	0	1978.414	1978.404	1978.401	1978.406	1978.410	1978.414	1978.414	1978.416	1978.408	1978.424	1978.410
8	10+00	0	1978.289	1978.280	1978.276	1978.283	1978.287	1978.291	1978.296	1978.296	1978.288	1978.304	1978.291
9	12+00	0	1978.093	1978.084	1978.084	1978.089	1978.094	1978.098	1978.100	1978.101	1978.094	1978.113	1978.095

Notes: 1. Elevations refer to SNUPPS reference datum.
2. See Figure 241.24-4-1 for locations of the movement monuments.

Monument Number	Location (feet)		Date of Survey and Elevation										
	Station	Offset	08/05/80	08/12/80	08/19/80	08/26/80	09/02/80	09/09/80	09/16/80	09/23/80	09/30/80	11/04/80	12/01/80
1	(-) 2+00	0	1978.034	1978.040	1978.035	1978.037	1978.036	1978.046	1978.032	1978.035	1978.030	1978.031	1978.026
2	0+00	0	1978.276	1978.283	1978.273	1978.280	1978.277	1978.287	1978.275	1978.277	1978.272	1978.275	1978.272
3	2+00	0	1978.373	1978.375	1978.367	1978.377	1978.375	1978.380	1978.379	1978.373	1978.372	1978.375	1978.379
4	4+00	0	1978.729	1978.730	1978.720	1978.728	1978.724	1978.726	1978.731	1978.721	1978.719	1978.720	1978.722
5	5+50	0	1978.651	1978.652	1978.642	1978.652	1978.648	1978.649	1978.653	1978.643	1978.642	1978.643	1978.644
6	7+00	0	1978.557	1978.560	1978.550	1978.558	1978.556	1978.556	1978.560	1978.551	1978.549	1978.550	1978.553
7	8+50	0	1978.406	1978.407	1978.397	1978.406	1978.404	1978.403	1978.406	1978.397	1978.394	1978.396	1978.397
8	10+00	0	1978.288	1978.286	1978.280	1978.291	1978.287	1978.288	1978.288	1978.281	1978.278	1978.284	1978.289
9	12+00	0	1978.090	1978.089	1978.084	1978.096	1978.091	1978.093	1978.092	1978.083	1978.081	1978.084	1978.085

Monument Number	Location (feet) Station	Offset	Date of Survey and Elevation 01/05/81
1	(-) 2+00	0	1978.019
2	0+00	0	1978.264
3	2+00	0	1978.379
4	4+00	0	1978.709
5	5+50	0	1978.632
6	7+00	0	1978.542
7	8+50	0	1978.387
8	10+00	0	1978.278
9	12+00	0	1978.073

VERTICAL MOVEMENT MONUMENT DATA
UHS DAM

Monument Number	Location (feet) Station	Offset	Date of Survey and Cumulative and Movement 05/27/80	06/03/80	06/10/80	06/17/80	06/24/80	07/01/80	07/07/80	07/15/80	07/22/80	07/29/80	08/05/80
1	(-) 2+00	0	0.10	0.11	0.12	-0.08	-0.06	-0.10	-0.18	0.01	0.01	-0.08	-0.04
2	0+00	0	0.08	0.14	0.12	-0.07	-0.04	-0.07	-0.17	0.02	0.01	-0.04	0.00
3	2+00	0	0.06	0.11	0.07	-0.01	-0.08	-0.11	-0.22	-0.06	-0.13	-0.10	-0.05
4	4+00	0	0.16	0.24	0.25	0.20	0.17	0.16	0.11	0.24	0.13	0.24	0.29
5	5+50	0	0.12	0.18	0.16	0.08	0.08	0.02	0.04	0.11	-0.01	0.08	0.14
6	7+00	0	0.12	0.13	0.12	0.07	0.02	-0.04	-0.10	0.07	-0.10	0.02	0.10
7	8+50	0	0.12	0.16	0.10	0.05	0.00	0.00	-0.02	0.07	-0.12	0.05	0.10
8	10+00	0	0.11	0.16	0.07	0.02	-0.02	-0.08	-0.08	0.01	-0.18	-0.02	0.01
9	12+00	0	0.11	0.11	0.05	-0.01	-0.06	-0.08	-0.10	-0.01	-0.24	-0.02	0.04

Notes: 1. All movements are in inches.
2. Positive number indicates settlement.

Monument Number	Location (feet) Station	Offset	Date of Survey and Cumulative Movement 08/12/80	08/19/80	08/26/80	09/02/80	09/09/80	09/16/80	09/23/80	09/30/80	11/04/80	12/01/80	01/05/81
1	(-) 2+00	0	-0.11	-0.05	-0.07	-0.06	-0.18	-0.01	-0.05	0.01	0.00	0.06	0.14
2	0+00	0	-0.08	0.04	-0.05	0.01	-0.13	0.01	-0.01	0.05	0.01	0.05	0.14
3	2+00	0	-0.07	0.02	-0.10	-0.07	-0.13	-0.12	-0.05	-0.04	-0.07	-0.12	-0.12
4	4+00	0	0.28	0.40	0.30	0.35	0.32	0.26	0.38	0.41	0.40	0.37	0.53
5	5+50	0	0.13	0.25	0.13	0.18	0.17	0.12	0.24	0.25	0.24	0.23	0.37
6	7+00	0	0.06	0.18	0.08	0.11	0.11	0.06	0.17	0.19	0.18	0.14	0.28
7	8+50	0	0.08	0.20	0.10	0.12	0.13	0.10	0.20	0.24	0.22	0.20	0.32
8	10+00	0	0.04	0.11	-0.02	0.02	0.01	0.01	0.10	0.13	0.06	0.00	0.13
9	12+00	0	0.05	0.11	-0.04	0.02	0.00	0.01	0.12	0.14	0.11	0.10	0.24

HORIZONTAL MOVEMENT MONUMENT DATA
UHS DAM

Monument Number	Location (feet) Station	Offset	Date of Survey and Coordinates 5/23/80 North	5/23/80 East	6/25/80 North	6/25/80 East	07/23/80 North	07/23/80 East	08/21/80 North	08/21/80 East	09/24/80 North	09/24/80 East
1	(-) 2+00	0	98071.529	102244.256	98071.461	102244.139	98071.488	102244.226	98071.541	102244.106	98071.617	102244.011
2	0+00	0	97916.880	102370.959	97916.857	102370.923	97916.859	102370.892	97916.920	102370.821	97916.975	102370.700
3	2+00	0	97762.179	102497.783	97762.165	102497.714	97762.147	102497.762	97762.226	102497.689	97762.259	102497.564
4	4+00	0	97607.647	102624.344	97607.657	102624.361	97607.654	102624.372	97607.712	102624.279	97607.786	102624.192
5	5+50	0	97491.336	102719.270	97491.337	102719.282	97491.314	102719.276	97491.387	102719.188	97491.426	102719.123
6	7+00	0	97375.299	102814.312	97375.269	102814.293	97375.246	102814.345	97375.330	102814.233	97375.366	102814.123
7	8+50	0	97259.144	102909.218	97259.135	102909.257	97259.146	102909.296	97259.200	102909.149	97259.246	102909.063
8	10+00	0	97143.284	103004.258	97143.275	103004.245	97143.259	103004.270	97143.362	103004.213	97143.393	103004.082
9	12+00	0	97022.872	103158.715	97022.851	103158.725	97022.771	103158.652	97022.843	103158.647	97022.993	103158.567

Notes: 1. Coordinates refer to SNUPPS reference grid.
2. See Figure 241.24-4-1 for location of the movement monument.

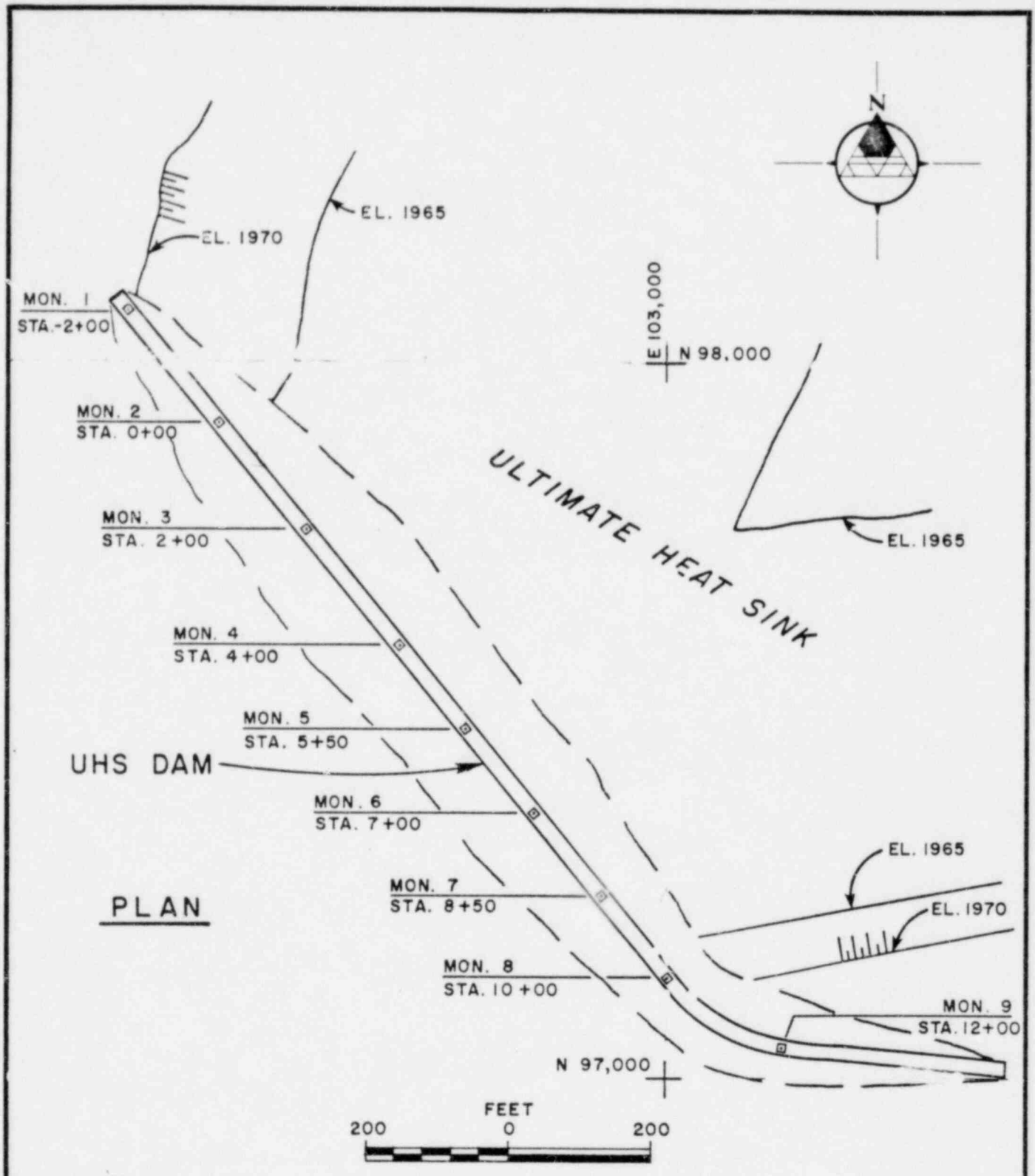
Monument Number	Location (feet)		Date of Survey and Coordinates			
			11/06/80		02/16/81	
	Station	Offset	North	East	North	East
1	(-) 2+00	0	98071.593	102244.267	98071.541	102244.188
2	0+00	0	97916.919	102370.906	97916.934	102370.861
3	2+00	0	97762.230	102497.783	97762.218	102497.745
4	4+00	0	97607.713	102624.324	97607.687	102624.313
5	5+50	0	97491.402	102719.254	97491.357	102719.227
6	7+00	0	97375.346	102814.315	97375.310	102814.237
7	8+50	0	97259.206	102909.233	97259.194	102909.198
8	10+00	0	97143.374	103004.231	97143.362	103004.267
9	12+00	0	97022.952	103158.714	97023.002	103158.732

Table 241.24-4-4

HORIZONTAL MOVEMENT UHS DAM

Monument Number	Location (feet) Station	Offset	Date of Survey and Cumulative Movement 06/25/80 South	West	07/23/80 South	West	08/21/80 South	West	09/24/80 South	West	11/06/80 South	West	02/16/81 South	West
1	(-) 2+00	0	0.82	1.40	0.49	0.36	-0.14	1.80	-1.06	2.94	-0.77	-0.13	-0.14	0.82
2	0+00	0	0.28	0.43	0.25	0.80	-0.48	1.66	-1.14	3.11	-0.47	0.64	-0.65	1.18
3	2+00	0	0.17	0.83	0.38	0.25	-0.56	1.13	-0.96	2.63	-0.61	0.00	-0.47	0.46
4	4+00	0	-0.12	-0.20	-0.08	-0.34	-0.78	0.78	-1.67	1.82	-0.79	0.24	-0.48	0.37
5	5+50	0	-0.01	-0.14	0.26	-0.07	-0.61	0.98	-1.08	1.76	-0.79	0.19	-0.25	0.52
6	7+00	0	0.36	0.23	0.64	-0.40	-0.37	0.95	-0.80	2.27	-0.56	-0.04	-0.13	0.90
7	8+50	0	0.11	-0.47	-0.02	-0.94	-0.67	0.83	-1.22	1.86	-0.74	-0.18	-0.60	0.24
8	10+00	0	0.11	0.16	0.30	-0.14	-0.94	0.54	-1.31	2.11	-1.08	0.32	-0.94	-0.11
9	12+00	0	0.25	-0.12	1.21	0.76	0.35	0.82	-1.45	1.78	-0.96	0.01	-1.56	-0.20

Notes: 1. + indicates movement towards south or west.
- indicates movement towards north or east.
2. All movements are in inches.



KEY:

□ MON. 1 — MOVEMENT MONUMENT LOCATION AND NUMBER

Rev. 9

WOLF CREEK GENERATING STATION
UNIT NO. 1
FINAL SAFETY ANALYSIS REPORT

FIGURE 241.24.4-1

MOVEMENT MONUMENT LOCATION
UHS DAM

DRAWING REFERENCE:

CAMPBELL, BARBER, LAMBETH & ASSOCIATES, P.A.
6223 SLATER
SHAWNEE MISSION, KANSAS 66201
P.O. BOX 315
PHONE: 913-722-1220

R241.24WC 5. The requested report is provided as Attachment 241.24-5-1.

R241.25WC Provide copies of the following reports:

1. "Engineering Data Compilation for the Wolf Creek Lake" Sargent Lundy Report SL-3830

2. "Engineering Data Compilation for Water Control Structures at Wolf Creek Lake" Sargent and Lundy Report SL-3831

R241.25WC The requested documents are provided as Attachments 241.25-1 and 241.25-2.