2-8 SURFACE WATER HYDROLOGY

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APPENDIX 2-B

SURFACE WATER HYDROLOGY

1.0 PURPOSE AND SCOPE

In connection with the safety aspects of the proposed nuclear power plant on Dradanelle Reservoir, near Russellville, Arkansas, certain surface water investigations were made. These included the source and dependability of the cooling water supply, location and extent of lakes and reservoirs, the magnitude of floods, and effect of possible failure of upstream dams.

2.0 WATER SUPPLY

The plant site is located on a peninsula on the left bank of Dardanelle Reservoir on the Arkansas River, about 7 river-miles upstream from the dam. The downstream side of the peninsula is formed by the flooded valley of Illinois Bayou, a left bank tributary to the Arkansas River. The plant will require 1,700 cfs for once-through cooling for a one-unit installation or 3,400 cfs for two units. This water will be taken from the Illinois Bayou embayment. The discharge will flow into the reservoir south from the plant. (see Figure 2-2 in section 2) Consumptive use will be about 20 cfs for the unit. 6

2.1 OPERATION OF DARDANELLE RESERVOIR

Dardanelle Reservoir is part of the Arkansas River navigation project, presently under construction. The project will provide a minimum 9 foot navigation depth from the mouth of the Arkansas River at the Mississippi River to Catoosa, Oklahoma, near Tulsa, on the Verdigris River, a distance of more than 500 miles. There are 17 locks and dams in the system. Thirteen of these are simple locks and dams, providing navigation lifts of 30 feet or less. Dardanelle, Ozark, Robert S. Kerr, and Webbers Falls Dams (in order from downstream to upstream) are higher, with lifts up to 54 feet, and include some storage for hydropower generation.

Upstream from the head of navigation, there are seven large multi-purpose reservoirs. These reservoirs control the flow from about 140,000 square miles of drainage area with about 12,000,000 acre-feet of storage of which about 6,000,000 acre-feet are reserved for flood control.

Dardanelle Reservoir is 258 miles upstream from the mouth. A navigation lift of 54 feet raises shipping to the top of the power pool at elevation 338 feet. The minimum navigation pool elevation is 336 feet, providing a normal two feet of storage in the reservoir for power generation. Power generation is on the basis of mean daily inflow equaling mean daily outflow, within the 336-338 feet limits.

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2.2 HISTORICAL RECORDS OF FLOW

Daily streamflow records for the period January 1923, to September 1957, collected at the Dardanelle gaging station just below the dam, have been adjusted by the Corps of Engineers to reproduce flows as they would have been regulated by the complete system of dams upstream. The maximum regulated daily discharge during this 35 year period was 480,000 cfs, while the minimum was 400 cfs.

2.3 LOW FLOW

It is possible for the inflow to the reservoir to be zero under very exceptional circumstances, but these conditions would exist for only a few hours, during which time there would be more than enough water in storage in the reservoir to supply the comsumptive use of the plant.

3.0 LAKES AND RESERVOIRS IN VICINITY

Lakes and reservoirs with a surface area of 100 acres or more within a 50 mile radius of the site, and details on ownership, location, use, and size of these bodies of water are shown in Figure 2-11. No drinking water supplies are taken from the Arkansas River between Dardanelle Reservoir and the mouth at the Mississippi River.

4.0 FLOODS

The highest flood experienced at the Dardanelle Dam site occured in 1943, with a peak flow of 683,000 cfs. Dardanelle Dam is designed to hold a water level no higher than 338 feet to a discharge of about 900,000 cfs. At higher discharges, the reservoir level would rise. The levels along the river channel in this area are generally designed for flows of 830,000 cfs.

4.1 MAXIMUM PROBABLE FLOOD

The Corps of Engineers has computed the maximum probable flood flow at Dardanelle Dam as 1,500,000 cfs. At this flow the water level at Dardanelle Dam would be 353 feet. The upper end of Dardanelle Reservoir is at Ozark Dam, about 51 miles upstream. During maximum probable flood conditions, the level of Dardanelle Reservoir at the downstream side of Ozark Dam would be 389.5 feet. No profile for this condition is available, but it is reasonable to assume a straight-line variation. On this basis, the maximum probable flood level at the plant site is 358 feet.

4.2 FAILURE OF UPSTREAM DAMS

The seven storage reservoirs in the headwaters of the Arkansas River are from about 180 to nearly 300 miles upstream from the site. Water from Eufala and Tenkiller Reservoirs must pass through five other impoundments to reach the site; from Keystone and Ft. Gibson, six: from Oolagah and Markham Ferry, seven; and from Pensacola, eight. In the extremely unlikely event of total failure of one of these dams, the flood wave would be so attenuated by valley and reservoir surcharge storage as to be negligible by the time it reached the plant site. It is considered, therefore, that failure of one of these dams would not constitute a hazard to the plant.

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The failure of Ozark Dam, the next dam upstream from Dardanelle, presents a possible flood danger. Under normal operating conditions, with Ozark at maximum power pool level of 372 feet and Dardanelle at minimum navigation pool level of 336 feet, there would be a head of 36 feet.

The following assumptions were made:

1. Ozark Dam fails completely and instantaneously.

2. The flood wave released is 36 feet high.

3. The channel between Ozark Dam and the plant site is of uniform cross-section identical with the section just downstream from the dam.

4. There is no overflow from the channel.

5. No gate changes are made at Dardanelle Dam.

Using these assumptions, the hydrograph of the reservoir level at the site was computed. The maximum rise was about 6.6 feet (reservoir level, 342.6 ft) about 15 hours after the failure of the dam.

All of the assumptions in this analysis are co servative. Complete and instantaneous dam failures is essentially impossible. The head above Ozark Dam would be less than 36 feet by the amount of slope in the surface of the 51 miles length of Dardanelle Reservoir. The cross-section of Dardanelle Reservoir throughout most of its length is much larger than that directly below Ozark. There would be sufficient time to open the gates at Dardanelle Dam and lower the reservoir level.

These actual conditions all differ from the assumptions in such a way as to lower the flood level at the site, so that the computed level represents a theoretical maximum value and the true level would be considerably lower.

The standard project flood used by the Corps of Engineers in the design of Ozark Dam was 600,000 cfs and for Dardanelle Dam it was 625,000 cfs. Under these conditions, the head across Ozark Dam would be only 5.0 feet. As failure of Ozark Dam at this time would release a flood wave only 5.0 feet high, no further study was made.

For the maximum probable flood, the head differential at Ozark would be 11.5 feet. The effect at the plant site of a flood wave of this height resulting from an Ozark failure was investigated, using the same assumptions as for the previous study, except as follows:

1. The flood wave released is 11.5 feet high.

2. Locks and Dams 13 and 14 are completely submerged so that surcharge storage upstream to Robert S. Kerr Dam (86.5 miles above Ozark) will contribute to the flood.

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This computation indicated a maximum theoretical rise in the water level at the site of 6.8 feet 18 hours after the Ozark failure. As in the previous case, however, the complete and instantaneous failure of the dam is so unlikely as to be practically impossible. All levees would be overtopped and an additonal estimated 50 square miles would be flooded, providing a great amount of extra valley storage. It has been estimated that the actual rise at the plant site resulting from failure of Ozark Dam would be about 3 feet. Therefore, the failure of Ozark Dam during a maximum probable flood would result in a maximum 361 foot water level.