WOLF CREEK GENERATING STATION, UNIT NO. 1
ENVIRONMENTAL REPORT OPERATING LICENSE STAGE

REVISION 2
INSTRUCTIONS FOR INSERTING REVISION 2

Remove and insert the pages, tables, figures, and tabs listed below. Dashes (--) in the remove or insert column of the instructions indicate no action required. The Revision 2 tab, transmittal letter, and these instructions should be placed at the end of Revision 1 Insertion Instructions. Tab 1 should be placed as per instructions in the Revision 1 Insertion Instructions. Tab NRC Q &A should be placed before the Revision 1 Insertion Instructions.

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REVISION 2	
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DEPENDENT VARIABLE: LMIKWH

Right Hand Variable	Estimated Coefficient	Standard Error	"T" Statistic
C	19.988	.933	21.4
LSFRB	.522	.083	6.3
PZ	-.200	.050	-4.0
SEAS	.068	.008	[illegible]
DDCUS	.037	.013	2.8
PPZ	-.006	.001	-4.1

$R^2 = .968$

$\bar{R}^2 = .957$

DW = 2.00

C = Constant

R^2 = Coefficient of Determination

$\bar{R}^2$ = R^2 Adjusted

DW = Durbin/Watson coefficient

LMIKWH = Log (Missouri Industrial Sales Excluding Armco)*

LSFRB = Log (FRB Production Index)

PZ = Log (Real Price of Electricity/Real Price of Gas Fuels)

SEAS = Seasonal Production Variable

DDCUS = Dummy to Account for Customer Reclassification in 1970

PPZ = PZ Subsequent to 1973 Oil Embargo, 0 Otherwise (Test for changing price elasticity)

* All Log values referenced in this documentation are natural logs

The variable PZ is the ratio of electric price to gas price and as such represents a combined price elasticity for both gas and electricity.

Armco Steel is involved in the production of wire, wire rope, steel products and ingots. Future yearly estimates of electric usages to 1983 were obtained from Armco and reflect greater intensity of future use. Alternative modeling efforts were undertaken to analyze the relation of Armco usage to external production indices. These models showed that there has been a historical relationship between the FRB durable index and Armco usage, but because of the nature of the large discrete Armco load additions, the models were judged to have relatively low explanatory power. Afer analyzing a detailed survey questionnaire answered by Armco, the forecast supplied by Armco, and applying judgment, it was concluded that subsequent to 1983 Armco usage would increase by 2 percent per year.

TABLE 1.1-29

KCPL

MONTHLY LOADS AND INTERCHANGE,
FIRST TWO YEARS WITH WCGS IN SERVICE

Year	Month	Peak (MW)	Energy (1000 MWH)	Purchases (1000 MWH)	Sales (1000 MWH)
1984	Apr	1541	809	25.08	10.04
	May	1793	857	37.39	14.86
	Jun	2305	981	32.01	22.48
	Jul	2460	1205	88.51	14.97
	Aug	2485	1140	54.24	30.19
	Sep	2269	918	29.91	41.03
	Oct	1584	872	57.74	41.32
	Nov	1573	872	49.73	46.34
	Dec	1694	925	45.68	19.28
1985	Jan	1723	986	17.35	21.98
	Feb	1702	898	17.00	14.00
	Mar	1615	905	21.89	28.78
	Apr	1606	843	37.28	10.29
	May	1864	889	16.25	32.88
	Jun	2397	1025	25.79	26.96
	Jul	2574	1257	81.27	12.50
	Aug	2574	1181	101.44	15.65
	Sep	2358	954	60.24	32.43
	Oct	1547	907	45.17	18.79
	Nov	1663	910	20.45	13.00
	Dec	1762	961	21.22	15.46

TABLE 1.1-30

PROJECTED FUEL MIX
FIRST THREE YEARS OF PLANNED OPERATIONS WITH AND
WITHOUT WCGS (TOTAL GENERATION)
IN PERCENT

Fuel Type	High Capacity Factor[a]						Low Capacity Factor[a]					
	1984		1985		1986		1984		1985		1986	
	With WCGS	Without WCGS	With WCGS	Without WCGS	With WCGS	Without WCGS	With WCGS	Without WCGS	With WCGS	Without WCGS	With WCGS	Without WCGS
KG&E												
Coal	61.7	61.7	57.4	57.4	60.4	60.4	61.7	61.7	57.4	57.4	60.4	60.4
Oil	0.3	0.3	1.7	5.4	1.2	4.9	0.3	0.3	2.3	5.4	1.8	4.9
Gas	16.3	38.0	13.4	37.2	9.7	34.7	19.9	38.0	17.4	37.2	13.5	34.7
Nuclear	21.7	-	27.5	-	28.7	-	18.1	-	22.9	-	24.3	-
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
KCPL												
Coal	82.3	97.3	78.1	97.0	75.3	93.2	84.5	97.3	80.8	97.0	78.7	93.2
Oil	1.9	2.6	1.9	2.9	3.6	6.8	1.8	2.6	1.9	2.9	3.9	6.8
Gas	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Nuclear	15.7	-	19.9	-	21.0	-	13.6	-	17.2	-	17.4	-
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

NOTE: May not add due to rounding.

[a] Represents the fuel mix for high and low capacity factors of the WCGS expected operating range.

LIST OF FIGURES

CHAPTER 2.0 - THE SITE AND ENVIRONMENTAL INTERFACES

LIST OF FIGURES (continued)

LIST OF FIGURES (continued)

CHAPTER 2.0

THE SITE AND ENVIRONMENTAL INTERFACES

2.1 GEOGRAPHY AND DEMOGRAPHY

2.1.1 SITE LOCATION AND DESCRIPTION

2.1.1.1 Specification of Location

The Wolf Creek Generating Station, Unit No. 1 (WCGS) is located in eastern Kansas approximately 75 miles southwest of Kansas City, 53 miles south of Topeka, and 100 miles east-northeast of Wichita, Kansas. The plant site is near the center of Coffey County in Hampden Township, 3.5 miles northeast of the city of Burlington and 3.5 miles east of the Neosho River and the main dam at John Redmond Reservoir. Figure 2.1-1 shows the location of the site in Kansas, and Figure 2.1-2 locates it in Coffey County.

The plant site is located in Township 21 South, Range 16 East of the Sixth Principal Meridian, and Townships 20 and 21 South, Range 15 East of the Sixth Principal Meridian. The reactor is located 4,235,500 meters north and 264,600 meters east within zone 15 at Universal Transverse Mercator Coordinates Latitude 38°14'20" North and Longitude 95°41'20" West. The WCGS is a Standardized Nuclear Unit Power Plant System (SNUPPS) plant, which locates the reactor centerline at hypothetical SNUPPS coordinates Latitude 100,000 North and Longitude 100,000 East. The Kansas State plane coordinates corresponding to these hypothetical coordinates are Latitude 584,670 North and Longitude 2,807,250 East.

2.1.1.2 Site Area

Of the 11,882 acres owned by the applicant on and near to the WCGS site, 9,818 acres are occupied by the site, and 1,976 acres lie outside of the site boundary. The acreage beyond the site boundary is leased as farmland and pastureland. The railroad right-of-way to the site boundary occupies about 148 acres, 88 acres of which are owned by the applicant. Figure 2.1-3 shows the lands owned by the applicant. The station property lines include both the land inside the site boundary and the leased land outside the boundary. Areas modified by construction of the plant include 135 acres for the station, 60 acres for the cooling lake dams and dikes, and 5,090 acres for the cooling lake at a normal elevation of 1,087 feet above mean sea level (MSL). Figure 2.1-4 shows the location and orientation of principal plant structures, and Figure 2.1-5 shows the layout for the cooling lake, dams, dikes, and spillways.

The plant exclusion area, shown on Figure 2.1-6, lies within the site boundary and encompasses approximately 1,118 acres, which are owned by the applicant. This area is traversed only by the access road to the plant.

There are no residential, commercial, or industrial structures within either the exclusion area or the plant site area. The effects of the Wolf Creek cooling lake are discussed in Section 2.8. (see note below)

The transportation network in the site vicinity is shown on Figure 2.1-7. The main highway artery in the plant site area is U.S. Highway 75, which runs in a north-south direction about 0.25 mile west of the site boundary and 2.8 miles west of the reactor location at its closest point. The four other major roads within a 5-mile radius of the plant are the federal-aid secondary routes 10, 149, 153, and 1472. There is no commercial water traffic on the Neosho River or the John Redmond Reservoir. The nearest existing railroad to the site is the Missouri Pacific Railroad located 9.5 miles southeast of the site boundary. A spur connecting the site with this track was constructed to provide rail access to the site. Another railroad, (Santa Fe Railroad) and right-of-way, running in a north-south direction, located 0.3 mile west of the plant site is abandoned. By Interstate Commerce Commission Order in Finance Docket No. 26591, dated February 4, 1972, captioned Atchinson, Topeka, and Santa Fe Railroad Company Abandonment, B.H. Junction and Gridley, Franklin and Coffey Counties, it was ordered that the branch line of the railroad extending between milepost 0.0 at B.H. Junction, Kansas, and milepost 52 plus 1,518 feet at Gridley, Kansas, be abandoned. With this abandonment, title of the right-of-way property reverted to the fee simple title owners.

Offsite activities which may be considered as possible contributors to the risk associated with WCGS are transportation, mining and mineral exploration and operations, industrial activities and military activities. Air transportation does not pose any undue risk to the safe operation of WCGS (FSAR Addendum Section 3.5.1.6). Water transportation poses no hazards to WCGS since there is no commercial water traffic

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Note: For consistency the term "cooling lake" is used in this Environmental Report to designate the entire body of impounded cooling water and its related structures and appurtenances. This use is not necessarily consistent with the definition of "cooling lake" found in 40 CFR 423.11 or any subsequent specialized definitions, but is used in the context of prior WCGS documentation as portrayed in that context.

on John Redmond Reservoir or Neosho River (FSAR Addendum Section 2.2.1.5). Land transportation routes are of a sufficient distance from WCGS that they do not pose any hazard to the plant (FSAR Addendum Sections 2.2.1.4, 2.2.3.1, and 2.2.3.2). Gas pipelines and petroleum storage facilities were evaluated and determined not to present a hazard to WCGS (FSAR Addendum Sections 2.2.1.6 and 2.2.3). Industrial and military activites do not pose a hazard to WCGS operation due to the distance between WCGS and any industrial or military facility (FSAR Sections 2.2.1.1, 2.2.1.2, and 2.2.3). FSAR Section 2.2.1.2.3 discusses mining activities which are small and pose no hazard to WCGS. In summary, no external activities pose a threat or hazard to WCGS operation.

2.1.1.3 Boundaries for Establishing Effluent Release Limits

The restricted area, which is used for establishing effluent release limits, enable the applicant to fulfill their obligations with respect to the requirements of 10 CFR Part 20. This area and the distance from the station vent stack to the boundary line of the restricted area is shown on Figure 2.1-6. The restricted area boundary coincides with the exclusion area boundary.

continued to 2020 for each MCD. County sums derived from these divisions were then reproportioned to county totals derived from the step-down procedure (Greenberg and others, 1973). Thus, if an area had grown in the past, it was assumed it would continue to grow. The MCD projections were allocated to various segments in the 0- to 50-mile area with the area-distribution method previously described.

In cases where new residential developments occurred within the 0- to 5-mile area and historic population trends were not reliable, projections were based on the number of planned home sites within each development. An occupancy factor of 2.9 people per dwelling (determined from a field survey and verified by the 1970 census data) was used to derive a total population for each new residential area. This approach provides a conservative or high population projection for these areas.

It is assumed that no permanent residents would live within 1 mile of the plant site or within the area occupied by the cooling lake beyond 1980. Demographic surveys performed in 1980 have confirmed these assumptions.

2.1.2.1 Population Within 10 Miles

The total 1970 population within the 10-mile area was 4,059, which results in a density of 13 people per square mile and clearly depicts the area's rural nature (Table 2.1-2). Within 5 miles of the plant site, the 2,537 residents provide a density of 32 people per square mile. However, when Burlington with its population of 2,099 is excluded, the area within 5 miles of the plant site then has a density of six people per square mile.

The 2020 population projection for the area within 10 miles of the plant site indicates a decline in nearly all segments except in those which encompass Burlington and New Strawn. These communities are located principally in the 3- to 4- and 4- to 5-mile segments described in Table 2.1-2 and on Figure 2.1-8. However, the 2020 projection is not the maximum. As shown in Table 2.1-2, the 10-mile population increases very slowly from 4,059 in 1970 to 6,120 in 2000. After the year 2000 the 10-mile population declines to 5,370 in 2020. The increase and decline is related to the age-structure of the population and the out-migration history of the area. Figures 2.1-9 through 2.1-14 present the projected populations in the 0- to 10-mile area from 1970 to 2020.

The only incorporated communities within 10 miles of the plant site are at Burlington, 3.5 miles to the southwest, and New Strawn, 3 miles to the west-northwest of the plant site (Table 2.1-1).

Burlington had a 1970 population of 2,099, a January 1979 population of 2,511, and is expected to undergo only moderate growth by 2020.

New Strawn was created when the U.S. Army Corps of Engineers relocated Strawn (an unincorporated settlement) from the area to be inundated by the John Redmond Reservoir, and was incorporated in 1971 (Brown, 1979). The town did not appear in the 1970 U.S. Census. Therefore, in the absence of historic population trends, estimates for the future have been based on the number of planned lot sites.

New Strawn is currently growing, and has the capability to accommodate significant new residential development. Within New Strawn 668 home and trailer lots have been subdivided, with approximately 150 single family homes and 63 trailers presently occupied within the town (Jones, 1979; Boyce, 1979). Present growth in New Strawn is estimated at 12 to 15 single family homes per year (Jones, 1979).

Assuming development of an additional 30 single family residences and 22 trailers (remaining capacity in the Arrowhead Park Trailer Camp), the 1980 population of New Strawn could be as high as 800 residents (assuming about 2.9 people per dwelling unit). As New Strawn occupies parts of two of the geographic sectors, approximately 534 of these people would live in the west-northwest segment from 3 to 4 miles from the site, and 266 residents would live in the northwest segment from 3 to 4 miles from the site.

In addition to incorporated New Strawn, there are two adjacent developments, Remer's Point and Hillview, in an unincorporated area west of New Strawn. Presently, there are a total of 11 homes and 2 mobile homes in the two developments - 7 homes and 2 trailers in Hillview, and 4 homes in Remer's Point. It is estimated that there exists space for approximately 40 additional dwelling units within the two developments (Remer, 1979; Harris, 1979). Full development of these two areas would result in a total population of approximately 150 residents (assuming 2.9 persons per dwelling unit). However, this development is unlikely to occur until well after 1980 (Remer, 1979; Harris, 1979).

Of this potential total of 150 residents in Remer's Point and Hillview, 10 would locate in the west-northwest segment, 5 to 10 miles from the plant, and the remainder would locate in west-northwest segment, 4 to 5 miles from the site.

It should be noted that, as the historic growth trends for the region suggest decreased population growth for most communities, the above increased projections are therefore likely to be conservative or high estimates of future populations for these communities.

The midpoint of station operating life, rounded to the nearest census date, is 2000. The distribution for age categories 0 to 12, 12 to 18, and over 18 is shown in Table 2.1-3. The U.S. projected age distributon for 2000 was used because the 1970 age distribution for Coffey County did not differ significantly from the 1970 U.S. age distribution. Appendix D of Regulatory Guide 4.2 Revision 2, Preparation of Environmental Reports for Nuclear Power Stations, defines a "significant difference" as more than a 10 percent difference of the age distribution of the county in which the proposed station is to be located from the U.S. age distribution in the 1970 decennial census. The 10-percent difference criterion is to be applied to any of the three age groups. Table 2.1-3 shows the 1970 age distribution for the U.S., Coffey County (the county in which the plant is located), and the counties in which all or a portion are located within 50 miles of the plant. None of the age categories differ significantly from the 1970 U.S. age distribution. The year 2000 age distributions for 0 to 10 miles from the site and 10 to 50 miles are the same.

2.1.2.2 Population Between 10 and 50 Miles

Cities and towns within 10 to 50 miles of the plant site are shown on Figure 2.1-8 and their 1960 and 1970 census populations are listed in Table 2.1-1. Many of these incorporated places experienced a decline in population from 1960 to 1970.

Emporia, Kansas, with 23,327 residents in 1970 and 26,174 residents in 1978 is the largest city in the 10- to 50-mile region, while the next largest is Ottawa with 11,036 people in 1970 and 10,693 people in January 1978 (Knight, 1979). The majority of the incorporated places contain less than 1,000 people.

The population rose for the area from 10-to-50 miles is divided into 64 segments ranging in size from 59 to 177 square miles. The current and projected population distribution from 10 to 50 miles is listed in Table 2.1-4. The 1970 through 2020 population distributions are compared on Figures 2.1-15 through 2.1-20. The total cumulative 1970 population within the entire 50-mile area surrounding the site was 163,834 or about 21 persons per square mile.

In the region within 10 to 50 miles of the plant site, the projections clearly depict a decline in the rural areas with moderate growth occurring only in the vicinities of major cities and towns (Figure 2.1-8 and Table 2.1-1). A net population decline of 4 percent over the entire 0- to 50-mile area is projected for the 50-year period from 1970 to 2020.

The year 2000 age distribution for the 10 to 50 mile area around the site is shown in Table 2.1-3. The means by which this distribution was generated is discussed in Section 2.1.3.1.

2.1.2.3 Transient Population

Transient population within 10 miles of the site is low. Most seasonal or daily shifts in population are associated with public facilities such as the John Redmond Reservoir, schools, and parks.

Figure 2.1-21, Public Facilities and Institutions, illustrates the geographic location of the transient population centers within 5 miles. Tables 2.1-5 through 2.1-8 provide a description of the faci ities shown on Figure 2.1-21. The Flint Hills National Wildlife Refuge (Table 2.1-8) is primarily outside the 10-mile study area.

By comparing the population statistics (enrollment and usage) on Tables 2.1-5 through 2.1-8 with the geographic locations (Figure 2.1-21), current transient concentrations can be identified in relation to the plant location. For future projections, there were no anticipated expansions to public facilities within 5 miles of the site. There is presently no commitment by the Applicants to public use of the WCGS cooling lake or surrounding land (see Section 2.8). If this commitment is made in the future, an increase in the transient population within 5 miles of the site would result.

One Federal-Aid Primary highway (FAP 75) and four Federal-Aid Secondary highways (FAS 10, FAS 149, FAS 153, and FAS 1472) occur within 5 miles of the site (Figure 2.1-21). Based on the 1978 annual average daily traffic (ADT) count for FAP 75 and the 1975 ADT counts for the secondary highways, the following ranges of traffic volumes were recorded within 5 miles of the site (Ijans, 1978):

Route	Orientation	Range of ADT (vehicles per day)
FAP 75	N-S	2810 - 3800
FAS 10	E-W	485 - 875
FAS 149	N-S	95 - 110
FAS 153	E-W	75 - 225
FAS 1472	E-W	90 - 125

The most important source of transient seasonal population in the general area is the recreational usage of John Redmond Reservoir. The conservation pool of John Redmond Reservoir extends 3.5 to 7.2 miles west of the site. The facilities that attract a transient population are boat launching ramps, fishing, picnic facilities, and campgrounds. The peak monthly usage was 79,400 during July 1978 (Duncan, 1979). The yearly visitation at John Redmond Dam and Reservoir averages about 380,000 (yearly change in visitation is largely dependent on weather conditions [Chester, 1979]). Actual 1972 visitation was reported to be 692,300 (Kansas Park and Resources Authority, and Oblinger-Smith Corporation, 1975, Table IX.1). The recreational season is year round, but the peak months are during the summer. Major sources of transient or seasonal populations, such as that experienced during recreational use of John Redmond Reservoir, have established visitor trends which can be utilized as a guide for future usage of these areas.

With the exception of visitation at Kansas reserviors and state parks, transient populations at distances of 5 to 50 miles are minimal due to the absence of major industrial facilities or recreational attractions.

The Pomona, Melvern, Toronto, and Fall River reservoirs and state parks are located within 50 miles of the site. The recreational facilities available at each of these reservoirs consist of boat launching ramps, picnic shelters, sanitary facilities, campgrounds and swimming beaches. Location and actual 1978 visitation for each of these reservoirs are given below (Herndon, 1979):

Reservoir and State Park	Location	1978 Visitation
Pomona	29 miles north	885,380
Melvern	19 miles north	896,054
Toronto	34 miles south-southwest	419,900
Fall River	45 miles south-southwest	433,500

The two largest cit[illegible] within 50 miles are Emporia (28 miles west-northwest) and [illegible]awa (32.5 miles northeast). The 1978 populations of these cities, 26,174 and 10,693, respectively, reflect the absence of a large population-industrial source in the 16-county area surrounding the site. Transient population in the area is not expected to increase due to the projected population decline (4 percent, Section 2.1.2.2) in the next 50 years.

2.1.2.4 Low Population Zone

The low population zone (LPZ) is defined as the area within 2.5 miles (4,023 meters) from the reactor center as shown on Figures 2.1-6 and 2.1-21. The LPZ meets the requirements as stated in 10 CFR Part 100. The LPZ does not include Burlington, New Strawn, or Highway 75, nor does it contain any areas of heavy residential use.

The 1970 population of the 20-square mile area of the LPZ was 101 people. By 1980, the permanent resident population should be about 130 people. Table 2.1-9 presents the estimated distribution of population in 1970 and 1980 within the LPZ. All exit routes within the LPZ are presently unsurfaced two-lane county roads. Some of these roads may be impassable during periods of rainy weather except for tracked vehicles, four-wheel drive vehicles, and farm tractors. Detailed evacuation provisions will be addressed in the detailed emergency procedures (Section 13.3 of the Final Safety Analysis Report). Two improved access roads (one all-weather) will be constructed which will provide exit routes within the site property boundary and from the LPZ area.

There are no sources of transient population within the LPZ. [There is presently no commitment by the Applicants to public use of the cooling lake or surrounding land (Section 2.8)] With the exception of residential traffic, there is no transient population in the LPZ, neither during the working day nor seasonally. No data are available on the frequency of residential traffic within the LPZ. The roads are not major highways but are unsurfaced country roads which serve scattered residences. The railroad passing through the site area was abandoned, and the rails have been removed. There are no commercial facilities within 2.5 miles of the site.

2.1.2.5 Population Center

The population center or city closest to the site with a population greater than 25,000 persons, is Emporia, Kansas, 28 miles west-northwest of the site. In 1975 its population was estimated to be 26,145 persons (DeMott, 1979). The next city eligible for designation as a population center is Topeka, Kansas, 53 miles north of the site. Topeka's reported populations for 1970 and 1978 were 155,322 and 144,221 persons, respectively (Schlicher, 1979).

2.1.3.3.3 Land Use Capabilities

A description of the soils on the site and their capabilities regarding agricultural potential, wildlife habitat and general construction characteristics are presented in Section 2.2.2.8 of the ER(CPS).

Since the ER(CPS) several of the soil units mapped on the site have been designated as prime farmland by the Soil Conservation Service (Swanson, 1979). These prime farmland soil types are listed below:

41B - Bates loam, 1 to 4 percent slopes

41C - Bates loam, 4 to 7 percent slopes

42B - Dennis silt loam, 1 to 4 percent slopes

32 - Kenoma silt loam, 1 to 3 percent slopes

32B3 - Kenoma silt loam, 1 to 4 percent slopes, eroded

15 - Lanton silty clay loam. This is a new name; previously mapped as Oakwood silty clay loam.

16 - Leanna silt loam

21(23) - Lula silt loam. This is a new designation; it includes Labette silt loams, 0 to 2 percent slopes that were mapped previously

18 - Osage silty clay loam.

14 - Osage silty clay

22B - Summit silty clay loam, 1 to 4 percent slopes

12 - Verdigris silt loam. This has been changed to also include the Mason silt loam that was mapped previously

31 - Woodson silt loam

These prime farmland designations are subject to change prior to publishing the Coffey County Soil Survey, which is expected to be completed in 1981. There are no designated unique farmlands or farmlands of state or local significance in Coffey County (Swanson, 1979).

2.1.3.3.4 Projected Land Use and Visitors Center

A lake use study was conducted to determine the feasibility of allowing public use of the WCGS cooling lake for recreational purposes. Currently, there are no plans for public use of the cooling lake or lands within the site boundary adjacent to the cooling lake not needed during operation of the station and related facilities (see Section 2.8). At present the only area of the site which will be open for public use will be the visitor center. The visitors center is located in the Emergency Operations Facility Complex. (See Figure 2.1-6)

2.1.3. Water Use Within 50 Miles

2.1.3.4.1 Municipal, Industrial, Irrigation and Recreation Uses

This section discusses the regional ground-water use and the principal surface-water users of the Neosho River downstream of the WCGS site to the Kansas-Oklahoma state line (approximately 170 river miles). Regarding surface-water use, only users downstream of the plant discharge are described since these are most likely to be affected by plant effluent releases. Descriptions of the Neosho River and its major tributaries, streamflow gauging stations, major reservoirs and ground-water gradients are presented in Section 2.4. The effects of regional consumptive water use by the plant on water supplies are discussed in Sections 2.4, 3.3 and 5.7. Water and sewage treatment processes of the plant are discussed in Sections 3.6, 3.7, 5.3 and 5.4.

The water use estimates presented herein are based primarily on unpublished data which consisted primarily of estimated annual totals. Little information was available for monthly or seasonal variations, or for past and projected water use.

The principal water withdrawal from the Neosho River downstream of the site is for municipal use, followed by industrial, irrigation and recreational uses. Listed in Tables 2.1-19 and 2.1-20 are the major water users and dischargers on the Neosho River downstream of the site. The locations of the major water users are indicated on Figure 2.1-25. The City of LeRoy is the nearest municipal water user downstream of Wolf Creek (13.5 miles).

More detail regarding the incorporated municipal water supply systems downstream of the site is presented in Table 2.1-21. These municipal systems supply water for domestic, commercial, industrial and public-water requirements. Rural water districts (RWD) utilizing the Neosho River, either directly or indirectly, are also listed in Table 2.1-21.

The RWDs have been formed in those areas where ground-water resources are limited.

Municipal ground-water supplies within a 20-mile radius of the site are listed in Table 2.1-22; their locations are shown on Figure 2.1-26. Many rural residences rely on individual wells for domestic needs and livestock watering.

There is no commercial water traffic on either the Neosho River or on the John Redmond Reservior.

2.1.3.4.2 Commercial and Recreational Fish Harvest

The principal fishing waters that are contiguous with the WCGS discharge and that may be influenced by the station effluents include the Neosho River downstream from the John Redmond Dam and tributary streams to the Neosho River. Within 50 miles of the plant site this includes approximately 100 anglable river miles of the Neosho River and approximately 24 tributaries with 240 stream miles of anglable waters. Fish cannot move upstream on the Neosho River past the John Redmond Dam. Therefore, fisheries upstream of the John Redmond Dam would not be influenced by station effluents. Although numerous city and county lakes, farm and ranch ponds, and other small lakes may also be considered contiguous with waters receiving station effluents (since their waters eventually flow into the Neosho River), they are not considered in the following discussion since many small dams block continuous flow during dry seasons and are also barriers to fish moving upstream.

Commercial Fishing - Commercial fishing on the Neosho River and John Redmond and other reservoirs in Kansas began in 1978. This Kansas Fish and Game Commission controlled program only allows the harvesting of large rough fish. The catch in the John Redmond vicinity in 1980 was 421,000 pounds.

Mussels are also commercially harvested from the Neosho River, but none of the catch is used for human consumption. The shells are exported for seeding pearls in clams. The most recent annual mussel harvest estimate was for the 1969-1970 season and included both the Neosho and Verdigris rivers; total harvest was 600,000 pounds (272 metric tons) and was valued at $21,000. The annual harvest for the three previous seasons was 32,000 pounds (14.5 metric tons) in 1966-1967, 24,000 pounds (10.9 metric tons) in 1967-1968, and 8,750 pounds (3.9 metric tons) in 1968-1969 (Hartmann, 1979).

Recreational Fishing - The Neosho River and many of its tributaries within 50 miles of the WCGS provide good sportfishing, primarily for panfish and catfish. The species of fish caught by anglers in these waters are listed below (Ray, 1976):

channel catfish	bullheads	walleye
flathead catfish	largemouth bass	spotted bass
carp	white bass	paddlefish
white crappie	sunfish	blue catfish
freshwater drum	buffalo	

The principal fishing areas on the Neosho River are generally restricted to adjacent towns, road crossings, low water or overflow dams and reservoir tailwaters. The most popular areas within 100 river miles downstream of the John Redmond Dam are the John Redmond Dam stilling basin area and dams at the cities of Burlington, LeRoy, Neosho Falls, Iola, Humboldt, Erie and Chanute (Jirak, 1979; Ray, 1976).

Although recreational fish harvest estimates for the Neosho River and its tributaries are not available, angler utilization of these waters has been reported (Ray, 1976). The estimated angler use for the 100 miles of the Neosho River below the John Redmond Dam and for the 24 anglable tributaries is estimated to be approximately 54,0) man-days per year. The catch rate from these waters is expected to be similar to the regional lake harvest objective of approximately two fish per man-day, each weighing 1/2 pound (Brunson, 1979). Based on these estimates the annual harvest from these waters was determined to be approximately 54,000 pounds (24.5 metric tons).

No data were available concerning the amount of sport fish consumed locally. Fishermen residing beyond the 50-mile radius area from the WCGS will likely fish within the area and, therefore, only a portion of the harvest would be expected to be consumed locally.

2.1.3.5 Water Use Within 5 Miles

2.1.3.5.1 Municipal, Industrial, Irrigation and Recreation Uses

All surface water rights within 5 miles of the site, except for two, are located on the Neosho River upstream of the confluence with Wolf Creek. Of the two remaining water rights, one is located on Long Creek, in the adjacent watershed east of the site; the other water right is held by the Applicants for storage of natural flows on Wolf Creek. The water rights on the Neosho River between Wolf Creek and the John Redmond Dam are held for municipal, industrial, irrigation and recreation use. The municipal water rights are for the City of Burlington and Coffey County Rural Water Districts 2 and 3; the industri . water rights are held by

TABLE 2.1-2 Sheet 1 of 3

RESIDENT POPULATION DISTRIBUTION
BY SECTOR AND RADIAL DISTANCE UP TO 10 Miles*

Sector	Year	0-1	1-2	2-3	3-4	4-5	5-10	10-Mile Total
		Radial Distance from Reactor (Miles)						
N	1970	0	3	2	9	1	75	90
	1980	0	2	5	0	5	108	120
	1990	0	10	10	10	10	60	100
	2000	0	10	10	10	10	60	100
	2010	0	10	10	10	0	40	70
	2020	0	10	10	10	0	30	60
NNE	1970	0	1	1	5	18	147	172
	1980	0	0	6	9	16	73	104
	1990	0	10	10	10	20	140	190
	2000	0	10	10	10	20	140	190
	2010	0	10	10	10	10	110	150
	2020	0	0	0	10	10	90	110
NE	1970	0	1	4	11	6	74	96
	1980	0	2	6	12	6	90	116
	1990	0	10	10	10	10	70	110
	2000	0	10	10	10	10	60	100
	2010	0	0	10	10	10	50	80
	2020	0	0	10	10	10	40	70
ENE	1970	0	0	7	3	4	77	91
	1980	0	2	5	2	5	60	74
	1990	0	0	10	10	10	70	100
	2000	0	0	10	10	10	60	90
	2010	0	0	10	10	10	50	80
	2020	0	0	10	10	10	40	70
E	1970	0	3	1	1	1	61	67
	1980	0	8	3	2	4	63	80
	1990	0	10	10	10	10	50	90
	2000	0	10	10	10	10	40	80
	2010	0	10	0	0	0	30	40
	2020	0	10	0	0	0	20	30

*If the projected population is less than 10, the projections have been rounded upward. Thus, if there are 2 persons projected, the number has been rounded to 10.

TABLE 2.1-2 (continued) Sheet 2 of 3

Sector	Year	0-1	1-2	2-3	3-4	4-5	5-10	10-Mile Total
		Radial Distance from Reactor (Miles)						
ESE	1970	0	9	7	3	18	90	127
	1980	0	4	4	5	5	103	121
	1990	0	10	10	10	10	80	120
	2000	0	10	10	10	10	70	110
	2010	0	10	10	10	10	50	90
	2020	0	10	10	10	10	40	80
SE	1970	0	4	7	7	8	107	133
	1980	0	10	5	14	7	199	235
	1990	0	10	10	10	10	90	130
	2000	0	10	10	10	10	90	130
	2010	0	10	10	10	10	70	110
	2020	0	10	10	10	10	50	90
SSE	1970	2	7	7	1	9	260	286
	1980	0	0	1	8	16	144	169
	1990	0	0	0	10	10	250	270
	2000	0	0	0	0	10	240	250
	2010	0	0	0	0	10	200	210
	2020	0	0	0	0	10	150	160
S	1970	0	4	7	14	8	84	117
	1980	0	0	0	14	7	57	78
	1990	0	0	0	10	10	70	90
	2000	0	0	0	10	10	60	80
	2010	0	0	0	10	10	50	70
	2020	0	0	0	10	10	30	50
SSW	1970	0	0	0	0	7	89	96
	1980	0	0	0	0	12	87	99
	1990	0	0	0	0	10	80	90
	2000	0	0	0	0	10	80	90
	2010	0	0	0	0	10	60	70
	2020	0	0	0	0	10	50	60
SW	1970	2	0	6	652	1,431	211	2,302
	1980	0	0	12	854	1,857	377	3,100
	1990	0	0	10	790	1,730	230	2,760
	2000	0	0	10	860	1,880	230	2,980
	2010	0	0	10	780	1,700	200	2,690
	2020	0	0	10	690	1,500	170	2,370

TABLE 2.1-2 (continued) Sheet 3 of 3

Sector	Year	0-1	1-2	2-3	3-4	4-5	5-10	10-Mile Total
		Radial Distance from Reactor (Miles)						
WSW	1970	0	0	11	29	13	66	119
	1980	0	0	11	10	26	76	123
	1990	0	0	10	30	10	50	100
	2000	0	0	10	30	10	50	100
	2010	0	0	10	20	10	40	80
	2020	0	0	10	20	10	30	70
W	1970	1	0	13	1	0	43	58
	1980	0	0	11	2	0	44	57
	1990	0	0	10	10	0	30	50
	2000	0	0	10	10	0	30	50
	2010	0	0	10	10	0	20	40
	2020	0	0	10	10	0	10	30
WNW	1970	0	0	3	49	14	24	90
	1980	0	0	9	362	11	118	500
	1990	0	0	10	760	90	20	880
	2000	0	0	10	990	100	20	1,120
	2010	0	0	10	1,220	110	10	1,350
	2020	0	0	10	1,240	120	10	1,380
NW	1970	1	0	22	46	9	54	132
	1980	0	8	2	4	14	71	99
	1990	0	0	20	390	10	40	460
	2000	0	0	20	510	10	40	580
	2010	0	0	10	630	10	30	680
	2020	0	0	10	650	10	20	690
NNW	1970	0	0	13	5	5	60	83
	1980	0	0	4	3	0	84	91
	1990	0	0	10	10	10	50	80
	2000	0	0	10	10	10	40	70
	2010	0	0	10	10	10	30	60
	2020	0	0	10	10	10	20	50
Total	1970	6	32	111	836	1,552	1,522	4,059
	1980	0	36	84	1,301	1,991	1,754	5,166
	1990	0	60	140	2,080	1,960	1,380	5,620
	2000	0	60	140	2,490	2,120	1,310	6,120
	2010	0	50	120	2,740	1,920	1,040	5,870
	2020	0	40	110	2,690	1,730	800	5,370

TABLE 2.1-3

AGE DISTRIBUTIONS FOR THE SITE AREA FOR 1970 and 2000[a]

Age Category	1970 U.S. Population	Coffey County[b]	Counties Within 50 Miles Of Site[b]	2000 U.S. Population[c]
0 to 12	24%	19%	23%	19%
12 to 18	12%	10%	12%	9%
Over 18	64%	71%	65%	72%

[a]Year 2000 is the midpoint (rounded to the nearest census date) of the station operating life.

[b]1970 U.S. Census of Population, General Population Characteristics, Kansas

[c]"Projections of the Population of the United States: 1977 to 2050", Population Estimates and Projections, Current Population Reports, Series P-25, No. 704: Bureau of the Census.

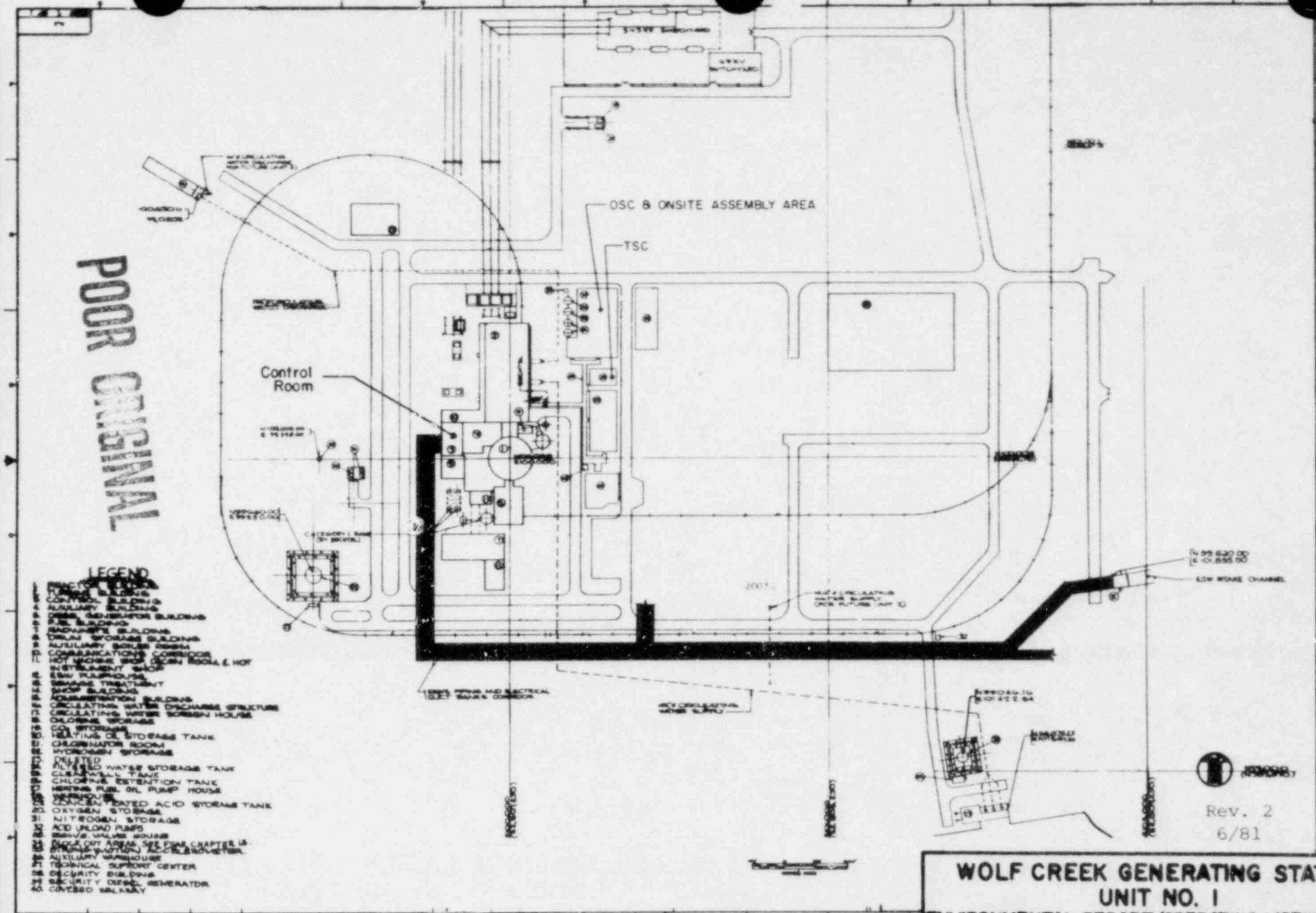
Note: The 0- to 10-mile 1970 distribution is represented by the "Coffey County" column, and the 10- to 50-mile 1970 distribution by the "Counties within 50 miles of the Site" column. The projected age distribution for 2000 for 0-to-10 miles and 10-to-50 miles is found in the "2000 U.S. Population" column.

TABLE 2.1-18a

DISTANCE TO NEAREST PLANT BOUNDARY, RESIDENCE, VEGETABLE GARDEN AND LIVESTOCK WITHIN 5 MILES

	Distance From Reactor (Miles)						
Sector	Nearest Plant Boundary	Nearest Residence	Nearest Vegetable Garden	Nearest Meat Animal	Nearest Dairy Cow	Nearest Dairy Goat	Milk Consumers
N	1.1	1.4	1.4	1.1	None	None	2 adults
NNE	1.1	2.6	2.7	0.8	4.7	None	3 adults/2 children
NE	1.3	1.8	2.1	0.8	None	None	
ENE	1.5	2.0	2.2	0.3	None	None	
E	1.2	1.8	1.8	1.2	1.8	None	2 adults
ESE	1.2	1.6	1.6	1.2	1.7	None	2 adults
SE	1.2	1.4	1.4	1.2	1.4	None	2 adults/2 teens/2 children
SSE	3.0	3.0	3.2	3.2	5.0	None	2 adults/1 infant
S	3.3	3.5	3.5	3.3	None	None	
SSW	1.7	4.6	4.6	4.6	None	None	
SW	1.5	2.2	2.2	1.6	None	None	
WSW	1.5	2.7	2.7	1.5	4.7	None	Various local families
W	1.8	2.2	2.2	2.8	None	None	
WNW	2.1	2.9	2.9	2.1	None	None	
NW	2.6	1.3	1.4	2.2	3.5	None	Various local families
NNW	1.5	2.2	2.2	2.0	None	None	

Source: Field Investigation, Kansas Gas and Electric Company, 1980.



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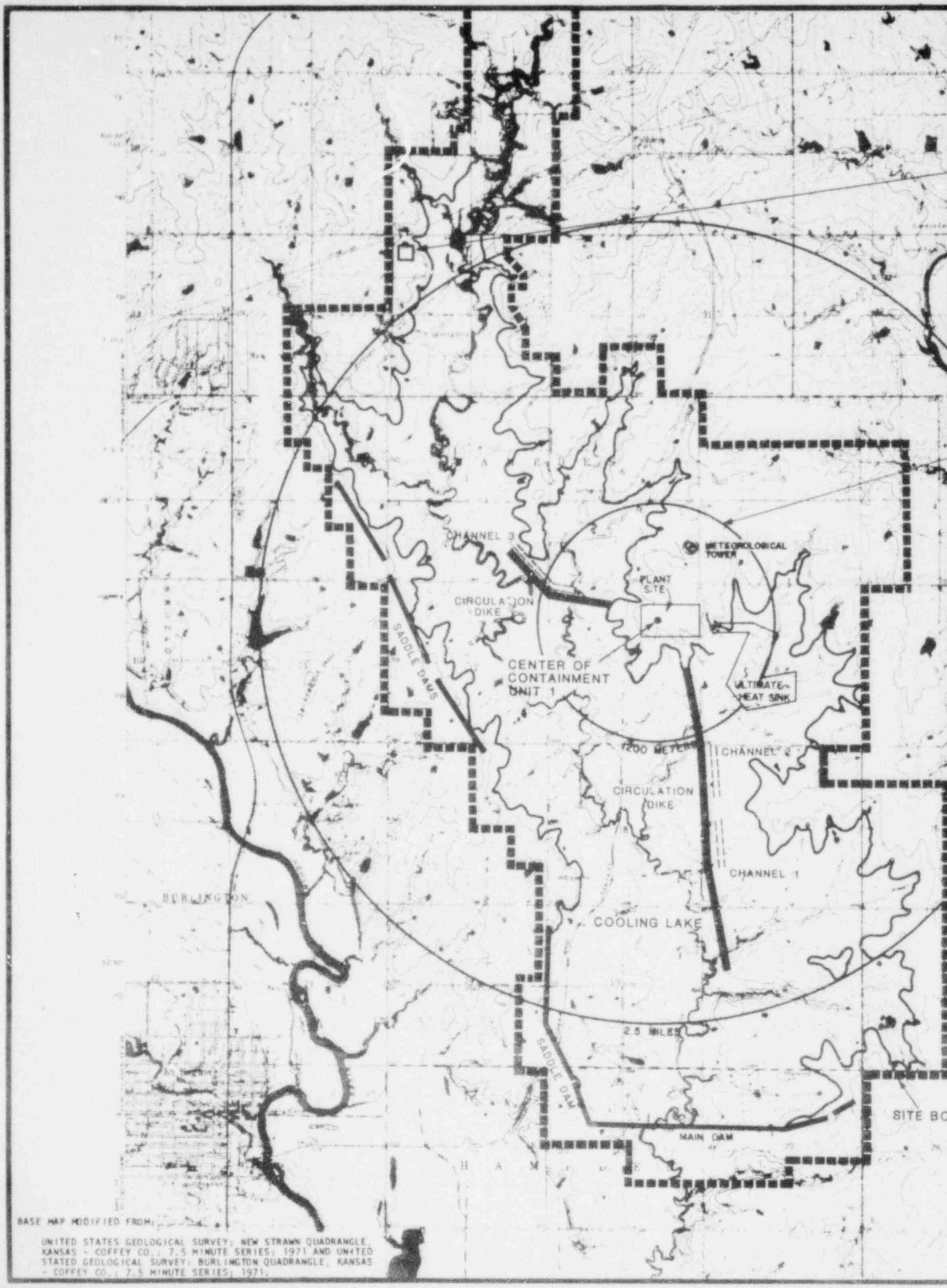
WOLF CREEK GENERATING STATION
UNIT NO. 1
ENVIRONMENTAL REPORT (OPERATING LICENSE STAGE)

Figure 2.1-4

Plant Site Features


METEOROLOGICAL TOWER
CHANNEL 3
PLANT SITE
CIRCULATION DIKE
SADDLE DAMS
CENTER OF CONTAINMENT UNIT 1
ULTIMATE HEAT SINK
1200 METERS
CHANNEL 2
CIRCULATION DIKE
CHANNEL 1
BURLINGTON
COOLING LAKE
2.5 MILES
SADDLE DAM
MAIN DAM
SITE BO
BASE MAP MODIFIED FROM:
UNITED STATES GEOLOGICAL SURVEY; NEW STRAWN QUADRANGLE, KANSAS - COFFEY CO.; 7.5 MINUTE SERIES; 1971 AND UNITED STATED GEOLOGICAL SURVEY; BURLINGTON QUADRANGLE, KANSAS - COFFEY CO.; 7.5 MINUTE SERIES; 1971.

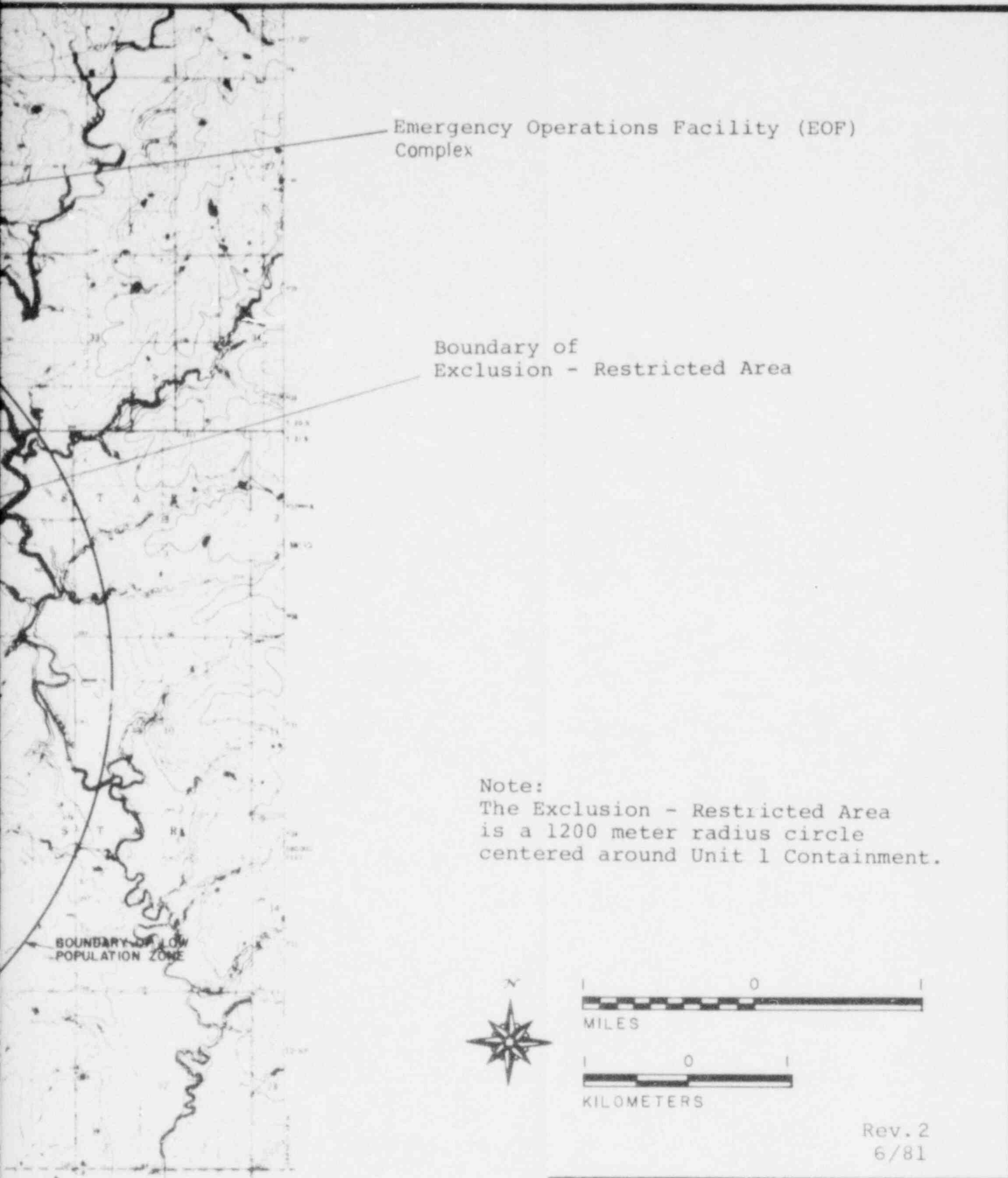


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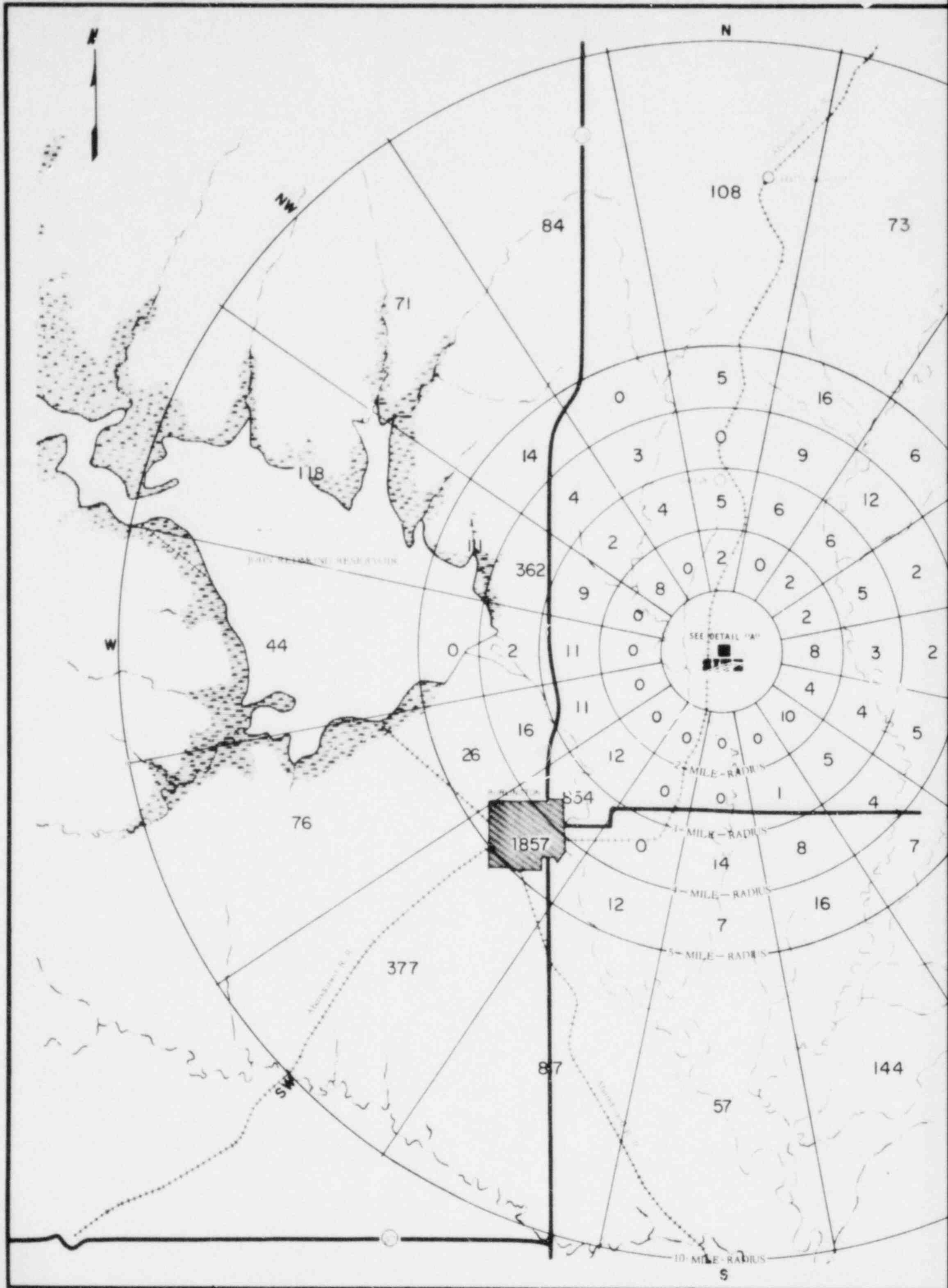
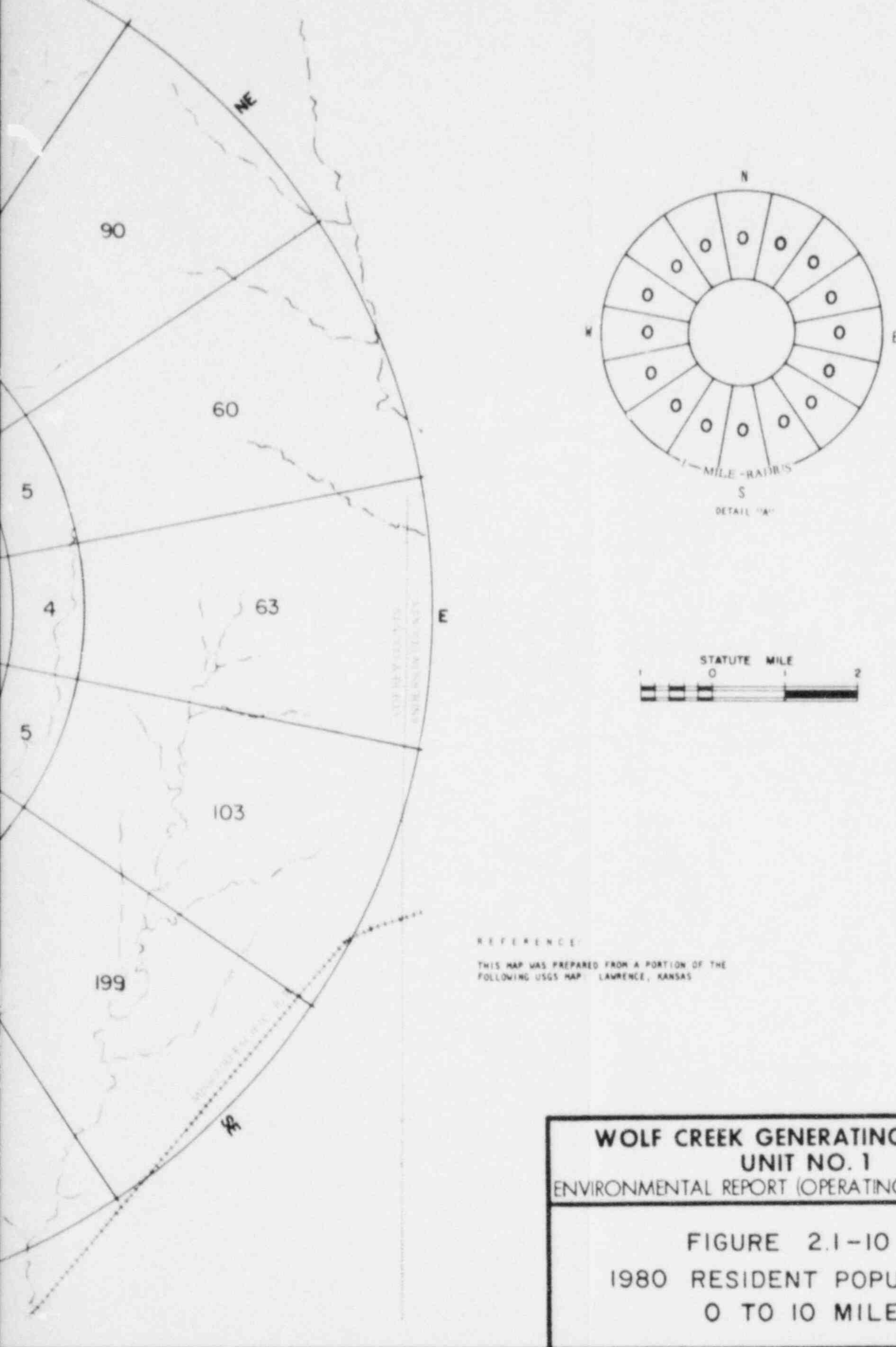
FIGURE 2.1-6

SITE FEATURES



N
NW
W
SW
S
SEE DETAIL "A"
5-MILE-RADIUS
10-MILE-RADIUS
108
73
84
71
118
44
76
377
87
57
144
362
1857
854
26
16
14
11
12
9
7



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WOLF CREEK GENERATING STATIO:N
UNIT NO. 1
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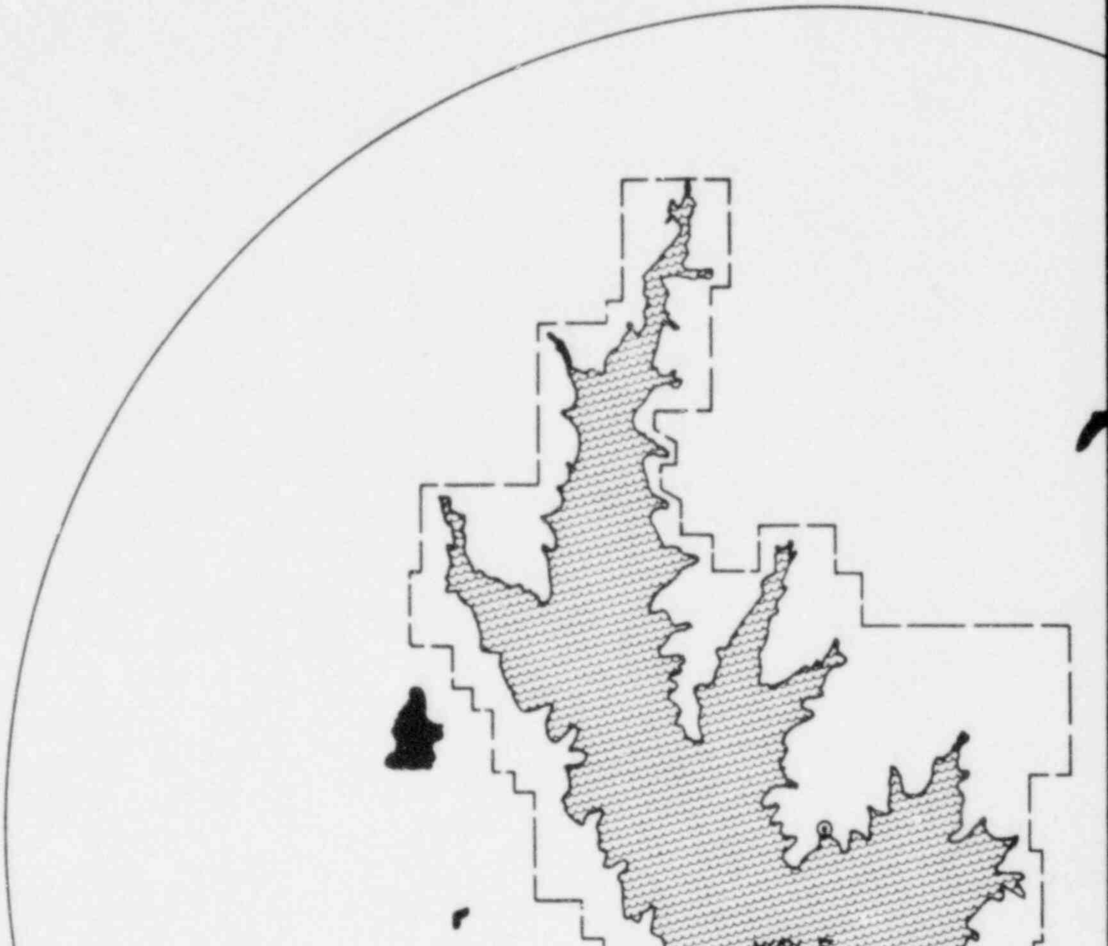
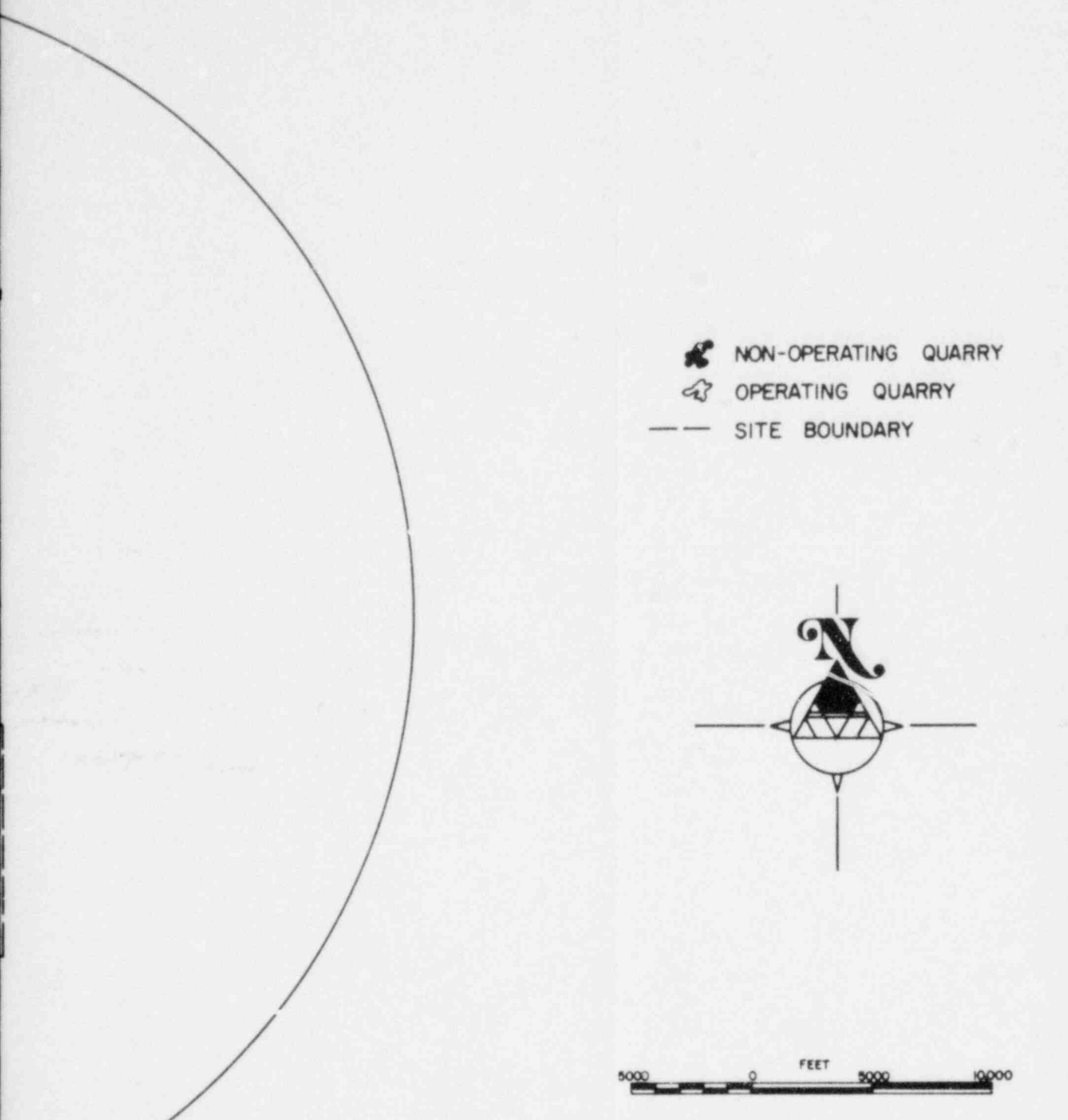
FIGURE 2.1-10
1980 RESIDENT POPULATION
0 TO 10 MILES



FIVE MILES



WOLF CREEK GENERATING STATION
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Figure 2.1-23a

Quarry Locations

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NOTE:
MAP BASED ON DAMES & MOORE FIELD INVESTIGATION AND AERIAL PHOTO INTERPRETATION, 1973. BUILT UP LAND AROUND SITE UPDATED IN 1979.

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TABLE 2.4-3

REGULATED STREAM FLOWS OF THE NEOSHO RIVER FROM 1964 TO 1977

(All Values in Cubic Feet Per Second)

	Recorded Discharges at Burlington, Kansas (RM 338.4)				Recorded Discharges at Iola, Kansas (RM 284.4)			
Month	Monthly Average	Maximum Daily	Minimum Daily	Date of Min. Flow	Monthly Average	Maximum Daily	Minimum Daily	Date of Min. Flow
Oct.	1,774	13,400	2.8	10/2/74	2,284	29,500	25	10/16/66
Nov.	1,397	13,400	29	11/30/66	1,897	24,900	27	11/2/66
Dec.	1,005	6,240	14	12/31/66	1,316	15,200	21	12/31/66
Jan.	951	7,180	14	1/10/67	1,339	12,800	14	1/12-13/67
Feb.	1,024	12,400	21	2/11/67	1,299	14,200	18	2/24-25/67
Mar.	1,461	15,100	20	3/18/67	2,035	22,100	15	3/16-17/67
Apr.	2,002	14,000	30	4/2/67	2,633	30,200	38	4/12/77
May	2,433	12,200	21	5/24/70	2,758	15,100	40	5/23-28/67
June	4,080	14,700	31	6/22/70	5,314	26,100	[illegible]	6/30/66
July	2,884	13,000	18	7/19/73	3,412	29,500	37	7/15/66
Aug.	532	9,750	2.0	8/31/76	698	11,100	31	8/31/66
Sep.	930	11,900	5.9	9/30/74	1,495	24,100	19	9/4/76

Sources: U.S. Geological Survey (1969) and U.S. Department of the Interior (1966-1977).

Note: Period of record is from September 1, 1964 through September 30, 1977. Regulated storage of the John Redmond Reservoir began on September 1, 1964; flow at the Burlington gauge has been completely regulated by the reservoir since 1963; flow at the gauge near Iola has reflected considerable regulation since 1963.

TABLE 2.4-4

IN-CHANNEL HYDRAULIC
PARAMETERS FOR THE NEOSHO RIVER

(1) Near Iola: D.A. - 3,818 sq. mi.

Discharge (cfs)[a]	Width (feet)	Average Depth (feet)	Velocity (fps)
Q_{50}	140	1.6	1.6
Q_{80}	88	.90	1.1
Q_a	220	3.2	2.5

(2) Near Parsons: D.A. - 4,905 sq. mi.

Discharge (cfs)[a]	Width (feet)	Average Depth (feet)	Velocity (fps)
Q_{50}	130	2.1	1.5
Q_{80}	82	1.1	.9
Q_a	220	4.0	2.5

(3) Near Chanute: D.A. - 4,195 sq. mi.

Discharge (cfs)[a]	Width (feet)	Average Depth (feet)	Velocity (fps)
Q_a[b]	254	3.52	2.87

---

a Q_{50}, & Q_{80} are those discharges which are exceeded 50 and 80 percent of the time, respectively. Q_a is average discharge.

b Q_{50} and Q_{80} information are not available.

Source: Kansas Water Resources Board, 1971, Kansas Streamflow characteristics, Part 8, In-channel hydraulic goemetry of streams in Kansas: Technical Report no. 8.

The total costs for the various scenarios and the benefits derived from the use of the lake are summarized in Table 2.8-1. The benefit-cost ratios developed in that table show that the public would benefit from the use of the WCGS cooling lake for only scenario three.

2.8.3 USE OF WCGS LAND

The applicants have purchased 11,882 acres in association with the WCGS project. Property actually necessary for the project within the site boundary totals 9818 acres. Several farmers would only sell their property within the site boundary by selling their entire farm or would only allow right-of-way access if the entire acreage through which right-of-way was desired was purchased. The acres outside the site boundary are being utilized to the extent possible as they were prior to their purchase.

2.8.3.1 Exclusion Area

The applicants own all land within the 1200 meter exclusion area surrounding the WCGS reactor and have the authority to determine all activities inside the area. The majority of the 1118 acre exclusion area is water surface extending over the cooling lake and station structures occupy a large portion of the remainder. See Figure 2.1-6.

The balance of the land within the exclusion a ea will not be utilized for agricultural purposes. Selective land management practices will be utilized as necessary to control vegetation growth for plant security areas and the remaining land in the exclusion area.

2.8.3.2 Land Outside of the Exclusion Area

Approximately 4200 acres are within the WCGS site boundary but outside of areas occupied by the lake, dam and exclusion area. To the extent practical, this land will be used for agricultural purposes.

A buffer zone of natural vegetation will be retained around the lake. The remaining 3700 acres of cropland and rangeland will be continued in agricultural production if practical.

2.8.4 WCGS LAND USE SUMMARY AND CONCLUSIONS

The 9818 acres of Coffey County, Kansas land within the WCGS site boundary is comprised of 5090 acres of water at the cooling lake normal pool elevation of 1087 feet and 4728 acres of land.

2.8.4.1 Cooling Lake

Public use of the WCGS cooling lake and evacuation, security and operational considerations for the use of the lake are discussed in Section 2.8.2. The benefit-cost ratios developed for public use of the lake show that it is beneficial to develop the lake into a recreational facility for only one of the evaluated scenarios. This scenario assumes public boating is allowed on the lake and also assumes the fishery is developed with State assistance. A significant portion of that benefit (42%) is derived from using the lake as a fishery with State stocking of trophy fish increasing use by the public. Only about 33% of the benefit of the lake use is derived from uses for which there is a demand in the region-swimming, boating, camping, and picnicking.

As stated in Appendix 2A there is a surplus of fishing opportunities in the region surrounding WCGS, as well as for the state, and this surplus will persist well into the future. Additionally, although the Appendix 2A citing of a Kansas fish preference survey says the results must be interpreted with caution, there is an apparent low preference for trophy fishing in Kansas. Consequently, the Applicants will not commit to a long term use of the cooling lake whose main benefit will be derived from fishing by the Kansas public that already have an abundance of fishing available and exhibit a low preference for the additional trophy fishing that would develop in the lake.

The Applicants are continuing with their fish stocking program to establish desirable fish species in the lake.

2.8.4.2 Land

Land outside the exclusion area and above the cooling lake normal pool level, but inside the WCGS site property, will be utilized to the extent practical as it was prior to its purchase for the WCGS site.

CHAPTER 3.0

THE STATION

3.1 EXTERNAL APPEARANCE

3.1.1 STRUCTURES AND ARRANGEMENT

The principal building complex at Wolf Creek Generating Station, Unit No. 1, (WCGS) is a group of interconnected buildings oriented in a generally north-south direction as shown in Figure 2.1-4. This complex comprises the central structures and forms the visual foundation for the power block as reflected in the artist's conception, which is included as the frontispiece for this document. Figure 3.1.1 is an oblique aerial photograph of the site looking to the east and Figure 3.1-2 is an overhead aerial photograph of the site. These photos were taken in April 1979. Figures 3.1-2a and 3.1-2b are aerial photographs taken in February 1981. Lake filling began in November 1980 and Figure 3.1-2b shows an impoundment of about 1200 surface acres of water.

The main vertical element in the composition of the power block is the reactor building. The reactor building houses a pressurized water reactor (PWR) and associated reactor coolant and ventilation systems. Interconnecting structures include the fuel building, control building, auxiliary building, the diesel generator building, and the turbine building. The radwaste building is located nearby, facing the fuel building. The turbine building, a horizontal structure, has a lower profile than the reactor building. Its steel structure has metal siding. Also included among the power block structures are the condensate storage tank, the refueling water storage tank, the reactor makeup water storage tank, the demineralized water tank, the emergency fuel oil storage tanks, and several transformer vaults which are located around the power block structures as shown in Figure 2.1-4.

The major non-power block structures include the administration building, the Technical Support Center, the switchyard, the shop building, the security building, the sewage treatment plant, the warehouse, the circulating water pumphouse, the circulating water discharge structure, and the essential service water pumphouse. Also located around the site complex are several storage tanks and small buildings for storage of acid, compressed gases, water, and fuel oil. These items are shown on Figure 2.1-4. The Emergency Operations Facility, Simulator, Vistors Center complex is located about 2 3/4 miles northwest of the station as shown in Figure 2.1-6. Railroad sidings are installed to serve the fuel and turbine buildings. The main access railroad leads into the site from the north and branches into several spurs which provide access to the outlying structures and encircle the principal building complex. Designations of the plant perimeter and exclusion area boundary are shown in Figure 2.1-6

3.1.2 ARCHITECTURAL FEATURES AND AESTHETIC CONSIDERATIONS

The layout of the facility was planned to achieve a blend of functional and aesthetic considerations.

The plant arrangement and structural design are coordinated to establish continuity and to provide both a balance and symmetry of design and a pleasing appearance.

The various site components such as structures, equipment, parking, and railroad spurs are organized in a neat, functional manner with a minimum of visual clutter. Landscaping is planned where possible, to complement plant appearance.

In summary, this is an industrial facility whose plant facilities and grounds have been designed to be visually pleasing and compatible with the surrounding environment.

3.1.3 GASEOUS AND LIQUID RELEASE POINTS

There are two potential release points for radioactive gaseous effluents from the station: the reactor building and the radwaste building. The vents for these buildings through which the effluents exhaust extend 10 feet above the roofs of these buildings and stand 218 feet and 64 feet above the plant grade elevation.

Liquid radioactive wastes discharged from the plant are released from the station into the cooling lake via the circulating water discharge structure.

The locations of the release points are shown in Figure 3.1-3.

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Figure 3.1-2a
Oblique View
of the Site
Looking West

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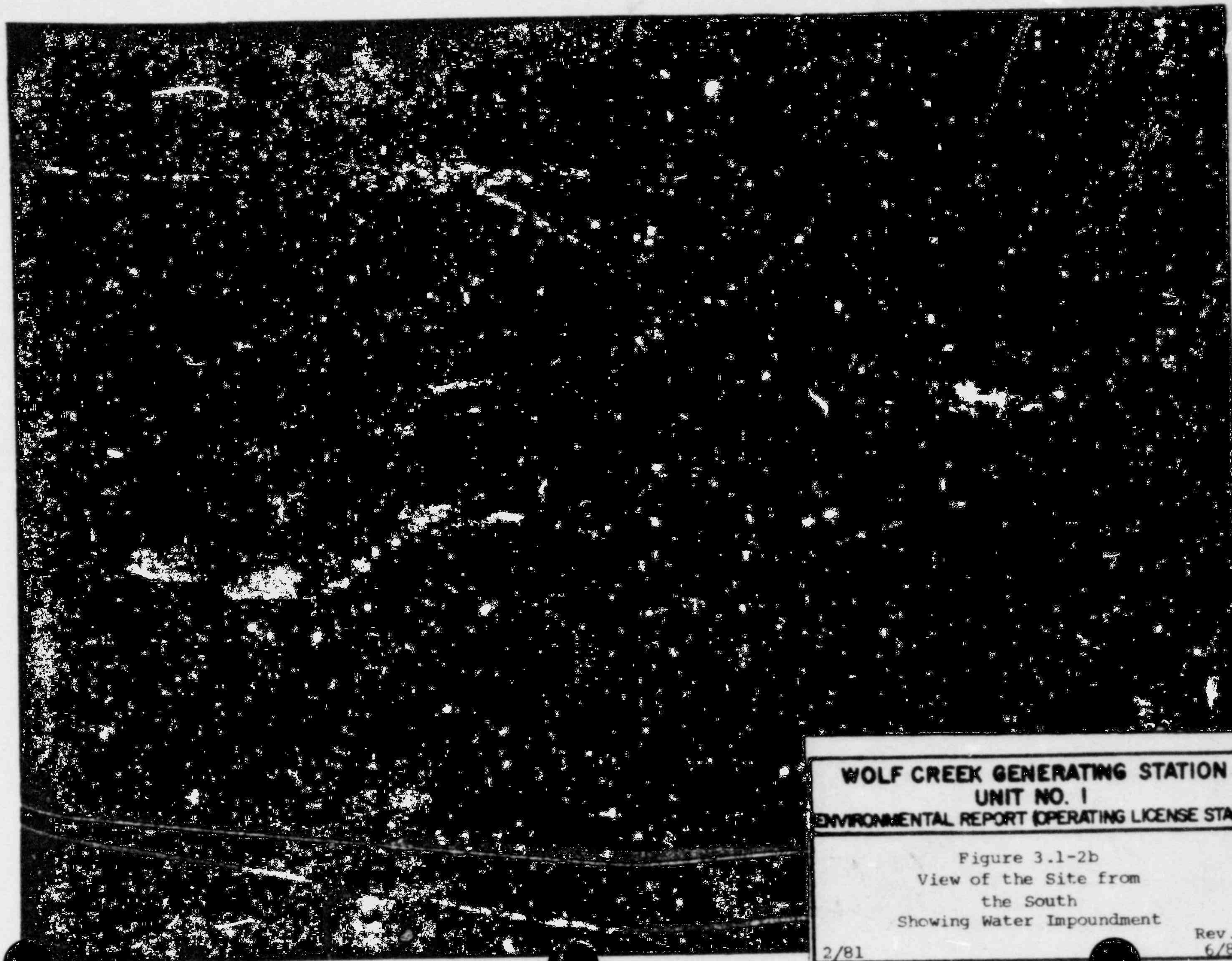

WOLF CREEK GENERATING STATION
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Figure 3.1-2b
View of the Site from the South
Showing Water Impoundment

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TABLE 3.2-1

REACTOR AND STEAM - ELECTRIC SYSTEM

DESIGN AND OPERATING PARAMETERS

A. <u>Reactor Coolant System</u>

Nominal operating pressure, psig	2,235
Total system volume, including pressurizer and surge line, ft^3	12,135
System liquid volume, including pressurizer water at maximum guaranteed power, ft^3	11,393
Pressurizer spray rate, maximum, gpm	900
Pressurizer heater capacity, kW	1,800

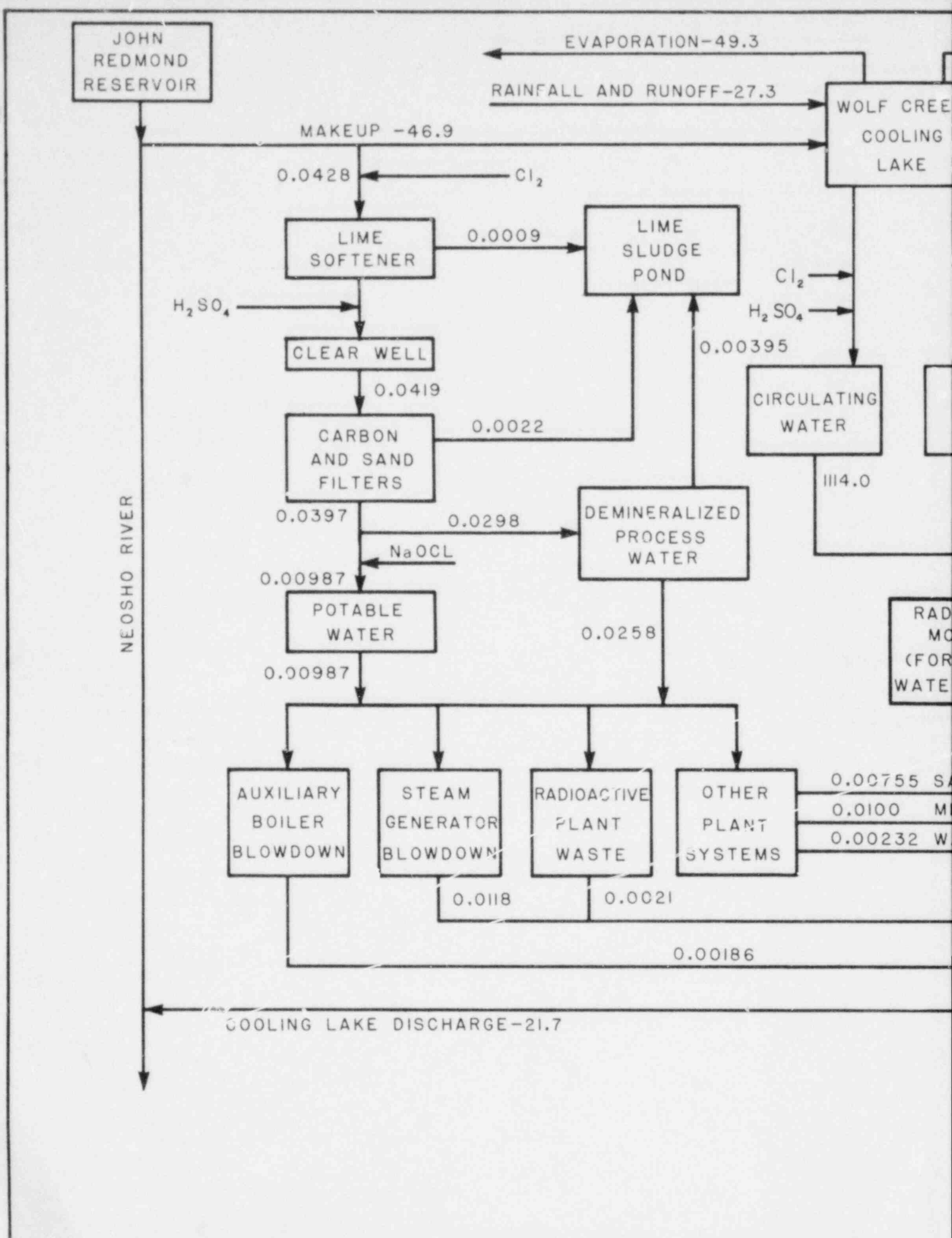
<u>System Thermal and Hydraulic Data</u>

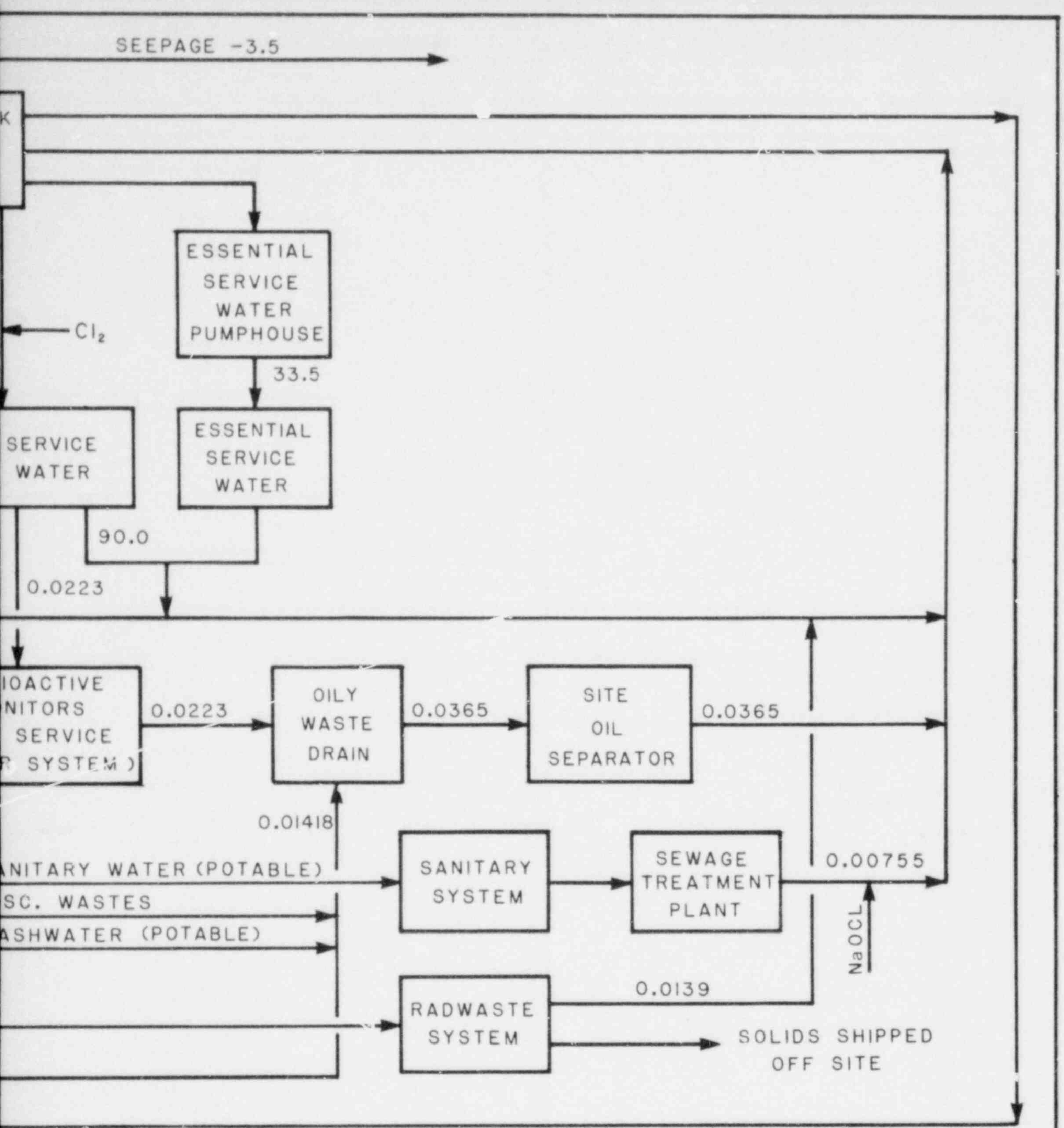
NSSS power, MWt	3,425
Reactor power, MWt	3,411
Ultimate reactor power, MWt	3,565
Thermal design flows, gpm	
Per loop	94,400
Total	377,600
Total reactor flow, 10^6 lb/hr	140.3
Temperatures, F	
Reactor vessel outlet	618.5
Reactor vessel inlet	558.4
Steam generator outlet	558.2
Steam generator inlet	544.6
Feedwater	440.0
Pressurizer	653.0
Pressure, psia	
Design	2,500
Normal	2,250
Average velocity along fuel rods, ft/sec	16.7
Active heat transfer, surface area, ft^2	59,700
Average heat flux, Btu/hr-ft^2	189,800
Maximum heat flux for normal operation, Btu/hr-ft^2	440,300
Average linear power, kW/ft	5.44
Peak linear power for normal operation, kW/ft	12.6
Peak linear power resulting from overpower transients/operator errors, assuming a maximum overpower of 118%, kW/ft	18.0
Heat flux hot channel factor, F_Q	2.32
Peak fuel central temperature at peak linear power for prevention of centerline melt, F	4,700

TABLE 3.2-1 (Sheet 2)

B. Core Mechanical Design Parameters

Design	RCC canless 17 x 17
Number of fuel assemblies	193
UO_2 rods per assembly	264
Rod pitch, in.	0.496
Overall dimensions, in.	8.426 x 8.426
Fuel weight, as UO_2, lb	222,739
Clad weight, lb	45,296
Number of grids per assembly	8 - Type R
Loading technique	3 region nonuniform
Fuel Rods	
Number	50,952
Outside diameter, in.	0.374
Fuel to cladding gap, in.	0.0065
Cladding thickness, in.	0.0225
Cladding material	Zircaloy-4
Fuel Pellets	
Material	UO_2 sintered
Density, % of theoretical	95
Diameter, in.	0.3225
Length, in.	0.530
Rod Cluster Control Assemblies	
Neutron absorber	Ag-In-Cd or Hafnium |
Cladding material	Type 304 SS-cold worked
Clad thickness, in.	0.0185
Number of clusters, full length	53
Number of absorber rods per cluster	24
Core Structure	
Core barrel, I.D./O.D., in.	148.0/152.5
Thermal shield	Neutron pad design
Baffle thickness, in.	0.88
Structure Characteristics	
Core diameter, equivalent, in.	132.7
Core height, active fuel, in.	143.7


JOHN REDMOND RESERVOIR
EVAPORATION-49.3
RAINFALL AND RUNOFF-27.3
WOLF CREE
COOLING
LAKE
MAKEUP -46.9
0.0428
Cl_2
LIME SOFTENER
0.0009
LIME SLUDGE POND
H_2SO_4
Cl_2
H_2SO_4
CLEAR WELL
0.00395
0.0419
CIRCULATING WATER
CARBON AND SAND FILTERS
0.0022
1114.0
0.0397
0.0298
DEMINERALIZED PROCESS WATER
NaOCL
0.00987
POTABLE WATER
0.0258
NEOSHO RIVER
RAD
MO
(FOR
WATE
0.00987
AUXILIARY BOILER BLOWDOWN
STEAM GENERATOR BLOWDOWN
RADIOACTIVE PLANT WASTE
OTHER PLANT SYSTEMS
0.00755 SA
0.0100 MI
0.00232 WI
0.0118
0.0021
0.00186
COOLING LAKE DISCHARGE-21.7



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NOTE:

ALL FLOW RATES ARE CFS

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FIGURE 3.3-1

ANNUAL AVERAGE WCGS-1
WATER USE FLOW DIACRAM

3.4 HEAT DISSIPATION SYSTEM

3.4.1 GENERAL

The Wolf Creek Generating Station, Unit No. 1,(WCGS) cooling system is designed to support two 1150-MWe pressurized water reactors (PWR) operating at a 100 percent average annual load factor for normal conditions. At this rate, a maximum of 8.0×10^9 Btu of heat per hour per unit will be dissipated in the cooling lake. The heat will be dissipated through evaporation, convection, and radiation for the systems shown on Figure 3.4-1.

3.4.2 COOLING LAKE

The station cooling lake is formed by one main earth-rolled dam across Wolf Creek and five perimeter saddle dams. The cooling lake, peripheral dams, dikes, internal canals, and outlet works are shown on Figure 2.1-5. Plans of the service spillway and the outlet works are shown on Figures 3.4-2 and 3.4-3.

The top of the main dam is at elevation 1100 feet above mean sea level (MSL). Each dam has a 3 to 1 (horizontal to vertical) slope on both the upstream and downstream faces. The upstream slope of each dam is riprapped for protection against wind-generated wave erosion while the downstream slope is seeded. The top of the main dam is riprapped to prevent erosion.

A service spillway and an auxiliary spillway on the east abutment of the main dam are designed to accommodate the probable maximum flood. The service spillway is an uncontrolled, concrete, ogee-crested semicircular spillway. The auxiliary spillway is located about 1500 feet east of the service spillway and is an open-cut type.

A low-level outlet works is located near the west abutment of the main dam. The outlet works is provided with a 60-inch diameter outlet pipe. A 30-inch diameter blowdown pipe branches from the outlet pipe. The low-level outlet works is designed to blowdown water (from 0 to 60 cfs) to regulate the water quality of the cooling lake. In addition, the low-level outlet works enable drainage of the cooling lake to permit inspection and repairs of the main dam.

3.4.3 INTAKE AND DISCHARGE STRUCTURES

3.4.3.1 Makeup Water

Makeup water for the WCGS cooling lake is drawn from the Neosho River immediately downstream from the John Redmond Reservoir. A makeup water screen house is situated on the east bank of the river downstream of John Redmond Reservoir and contains one bar grill, three vertical traveling screens, and three vertical wet-pit pumps, each with a normal operation capacity of 40 to 60 cfs. The three pumps in parallel have a maximum capacity of 170 cfs when the river elevation at the pumphouse is at flood stage. Two auxiliary raw water pumps, each with a capacity of 400 gpm, are located in the makeup screen house to provide makeup to the plant, potable water and demineralizer water systems when the makeup water pumps are not operating. A general arrangement of the makeup water screen house is shown in Figures 3.4-4 and 3.4-5.

The existing Corps of Engineers low-flow channel located on the west side of the river has not been altered and will continue to function as it does at the present time. A recently excavated channel downstream of the stilling basin (see Figure 3.4-6) on the east side of the river supplies makeup water to the screen house during normal conditions. This channel can be fed by a 42-inch diameter pipe connected with John Redmond Dam during times the stilling basin is under repair.

The screen house bar grill, located at the inlet of the intake bays, is composed of 1-inch vertical bars spaced at 3-inch intervals. Each intake bay is approximately 11 feet 2 inches wide. Each screen is 10 feet wide. The intake structure floor is located at an elevation of 995 feet MSL.

The vertical screens, operated intermittently, are backwashed with water drawn from the Neosho River. This screen wash system is activated normally by a timer or automatically from a high-differential pressure switch. Screen mesh size is 0.375 inch. Trash collected on the traveling screens is backwashed to a trash basket where it is strained and collected. The trash is manually disposed of offsite. There are no provisions for returning fish that survive impingement to the Neosho River, but the intake velocity of 0.5 feet per second at the low water-level minimizes fish impingement.

Makeup water from the screen house is pumped through a 54-inch diameter pipe and discharges into the Wolf Creek cooling lake at the makeup water discharge structure located on the western shore of the cooling lake (see Figure 2.1-5). A plan and section view of the discharge structure is shown on Figure 3.4-7. Two raw water pumps located in this discharge structure supply water to the steam cycle makeup system and the potable water system.

3.4.3.2 Circulating Water

The location of the circulating water screen house at the WCGS is shown on Figure 2.1-5. Plan and elevation drawings of this structure are shown on Figures 3.4-8 and 3.4-9.

The circulating water screen house structure for Unit 1 houses three circulating water pumps. Under normal conditions all three pumps will be operating at a total capacity of 1114 cfs.

Three service water pumps are also housed in the circulating water screen house structure. Normally, two service water pumps will be operating at a total capacity of 90 cfs, with one pump serving as a standby. A low-flow and startup pump with a capacity of 14.5 cfs is also provided for the service water system.

The Circulating Water Screenhouse sump floor is located at an elevation fo 1058 feet MSL. A steel plate is provided at the sump inlet of the Screenhouse as a weather protection device (Figure 3.4-9). This steel plate extends from elevation 1075 feet MSL, upwards to the operating floor, 1092 feet MSL. The velocities of circulating water and service water flow downstream of the steel plate are essentially independent of cooling lake water level.

Based on a total (circulating water and service water combined) flow rate of 1204 cfs for one unit, the average inlet water velocities are calculated to be:

Approach velocity to the Screenhouse:	0.87 feet per second
Velocity through the bar grill:	1.06 feet per second
Approach velocity to the traveling screens:	1.06 feet per second
Velocity through the traveling screens:	1.95 feet per second

The circulating water screen house contains a bar grill, conventional traveling screens, strainers, and fire pumps (one diesel and one electric motor driven). The traveling screens will operate the same as the makeup water screen house traveling screens described in Section 3.4.3.1.

After passing through the condenser, the circulating water discharges into the cooling lake from the circulating water discharge structure, shown on Figure 3.4-10. The water takes approximately 38 days to travel from the discharge to the intake, based on an effective cooling volume of 91,000 acre-feet and a total flow rate of 1204 cfs (the total volume of circulating water and service water required for one-unit operation at 100 percent average annual load factor).

There are two essential service water pumps for Unit 1, each of which has a capacity of 33.5 cfs. One of the two pumps serves as the redundant backup pump. The pumps are located in a seismic Category I structure that is separate from the circulating water screen house.

3.4.4 THERMAL CONSIDERATIONS

The temperature rise across the condenser for each 1150 MWe unit is 31.5 F based on the circulating water heat rejection rate of 7.87×10^9 Btu/hr and circulating water flow rate of 1114 cfs at 100 percent average annual load factor. The condenser has three sections: low pressure, intermediate pressure, and high pressure. Total effective tube length for the three sections in series is approximately 140 feet. With a tube flow velocity of 8.0 feet per second, the travel time for water across the condenser is about 18 seconds.

Sargent & Lundy's LAKET computer model has been used to calculate the cooling lake temperature distribution. This model simulates the effects of varying weather conditions and plant heated-water discharge on the surface temperature and evaporation rates of a lake. The time-varying temperature distribution along the water body's central axis is computed against time, and the natural and forced evaporation rates and the variation in the lake level are also computed.

At the normal operating pool elevation of 1087 feet MSL, the gross surface area of the cooling lake is 5090 acres, and the effective cooling area is 4330 acres. Elevation/area-capacity information for the Wolf Creek cooling lake is shown on Figure 3.3-2.

Hydraulic and thermal balances are used together with the energy budget method to determine evaporation from the lake. The energy budget method takes into account such factors as solar radiation, reflected solar radiation, and energy transferred from the lake to the atmosphere.

Maximum temperatures at various locations in the cooling lake with one unit operating at 100 and two units operating at 88.5 percent average annual load factor are shown in Figures 3.4-11 and 3.4-12. The location points are shown in Figure 3.4-13 along with the distances from the plant discharge point along the circulating water flow path line to each location point. These maximum temperatures correspond to lake temperatures that occurred less than 1 percent of the time during the 16 years of analysis (1949-1964).

A cumulative profile of temperature distribution for various locations in the cooling lake is presented in Table 3.4-1. For each location, the table gives the maximum temperature and the temperatures that occurred at a frequency of 1, 5 and 50 percent of the time based on the 16 years of calculated data. The temperature provided at N percent (where N is 1, 5, or 50) frequency is interpreted as a base temperature where N percent of all temperatures calculated were higher than this temperature. (For example, at 5 percent occurrence, 5 percent of all temperatures calculated were higher than the base temperature.) Conversely, 95 percent of all temperatures recorded were lower than the base temperature. Seasonal upper 1 percentile and 50 percentile temperature distributions in the cooling lake at the locations identified in Figure 3.4-13 are given in Tables 3.4-2 and 3.4-3.

Table 3.4-1 shows that the maximum plant inlet temperatures for one-unit operation at 100 percent average annual load factor do not exceed the design maximum plant inlet temperature of 95 F established by essential service water intake requirements. Table 3.4-1 also shows the same result for two-unit operation at 38.5 percent average annual load factor.

The maximum natural cooling lake temperature simulated for the 16-year data period is 87.2 F for one-unit operation and 87.4 F for two-unit operation. Natural temperatures are the cooling lake temperatures that would exist at zero load and are assumed to be constant throughout the cooling lake. They differ for one- and two-unit operation because the water mass following 16 years of operation differs. Because natural temperatures are dependent on the total mass of water in the cooling lake, the natural temperatures on an aggregate time basis are indirectly dependent on load, and the recorded maximum natural lake temperatures for one- and two-unit operation are not identical. Figure 3.4-14 presents the simulated natural temperature variation in the cooling lake for one-unit operation.

The total dissolved solids (TDS) concentration in the cooling lake increases as the water evaporates. Tables 3.4-4 and 3.4-5 show the evaporation rates for one- and two-unit operation. A balance between consumptive water losses (such as evaporation) and replenishment sources (such as makeup, rainfall, and runoff), which vary with seasonal and operational characteristics, determines the extent of the TDS buildup and reduction. A complete discussion of total dissolved solids is presented in Section 3.6.

TABLE 3.5-1 (Sheet 3)

Class 6	Reactor Coolant μCi/gm	Secondary Coolant[2] μCi/gm
Ce-141	7.00E-5	1.81E-9
Ce-143	4.00E-5	4.79E-10
Ce-144	3.30E-5	9.03E-10
Pr-143	5.00E-5	9.08E-10
Pr-144	3.30E-5	1.97E-9
	2.90E-1	5.78E-6[3]

(1) Refer to Table 3A-1 for assumptions.

(2) For the secondary side, the noble gas activities are for the steam phase; all other activities are for steam generator water activities.

(3) Lower blowdown rates result in higher secondary system activities. A 60-gpm blowdown will result in a total of 5.35E-5 μCi/gm (excluding noble gases, N-16, and tritium) in the steam generator. A maximum blowdown rate was used in this table.

TABLE 3.5-2

ANNUAL EFFLUENT RELEASES (1)
LIQUID

Nuclide	Half-life (Days)	Boron Recycle (Curies)	Misc. Wastes (Curies)	Secondary (Curies)	Turb. Bldg. (Curies)	Total LWS (Curies)	Adjusted Total(2) (Ci/yr)	Detergent Wastes (Ci/yr)	Total (Ci/yr)
Corrosion & activation products									
CR-51	2.78+001	.00001	.00000	.00000	.00000	.00001	.00007	.00000	.00007
MN-54	3.03+002	.00000	.00000	.00000	.00000	.00000	.00001	.00010	.00011
FE-55	9.50+002	.00001	.00000	.00000	.00000	.00001	.00006	.00000	.00006
FE-59	4.50+001	.00000	.00000	.00000	.00000	.00001	.00004	.00000	.00004
CO-58	7.13+001	.00007	.00002	.00000	.00000	.00009	.00059	.00040	.00099
CO-60	1.92+003	.00001	.00000	.00000	.00000	.00001	.00007	.00087	.00094
ZR-95	6.50+001	.00000	.00000	.00000	.00000	.00000	.00000	.00014	.00014
NB-95	3.50+001	.00000	.00000	.00000	.00000	.00000	.00000	.00020	.00020
NP-239	2.35+000	.00001	.00000	.00000	.00000	.00001	.00004	.00000	.00004
Fission products									
BR-83	1.00-001	.00000	.00006	.00000	.00000	.00006	.00038	.00000	.00038
BR-84	2.21-002	.00000	.00003	.00000	.00000	.00003	.00020	.00000	.00020
BR-85	2.08-003	.00000	.00000	.00000	.00000	.00000	.00002	.00000	.00002
RB-86	1.87+001	.00000	.00000	.00000	.00000	.00000	.00003	.00000	.00003
RB-88	1.24-002	.01050	.00024	.00000	.00000	.01074	.06768	.00000	.06800
SR-89	5.20+001	.00000	.00000	.00000	.00000	.00000	.00001	.00000	.00001
SR-91	4.03-001	.00000	.00000	.00000	.00000	.00000	.00002	.00000	.00002
Y-91M	3.47-002	.00000	.00000	.00000	.00000	.00000	.00001	.00000	.00001
MO-99	2.79+000	.00037	.00010	.00000	.00002	.00049	.00307	.00000	.00310
TC-99M	2.50-001	.00021	.00006	.00000	.00002	.00028	.00179	.00000	.00180
RU-103	3.96+001	.00000	.00000	.00000	.00000	.00000	.00000	.00001	.00002
RU-106	3.67+002	.00000	.00000	.00000	.00000	.00000	.00000	.00024	.00024
AG-110M	2.53+002	.00000	.00000	.00000	.00000	.00000	.00000	.00004	.00004
TE-127M	1.09+002	.00000	.00000	.00000	.00000	.00000	.00001	.00000	.00001
TE-127	3.92-001	.00000	.00000	.00000	.00000	.00000	.00003	.00000	.00003
TE-129M	3.40+001	.00001	.00000	.00000	.00000	.00001	.00005	.00000	.00005
TE-129	4.79-002	.00001	.00000	.00000	.00000	.00001	.00006	.00000	.00006
I-130	5.17-001	.00000	.00002	.00000	.00000	.00003	.00018	.00000	.00018
TE-131M	1.25+000	.00001	.00000	.00000	.00000	.00001	.00009	.00000	.00009
TE-131	1.74-002	.00000	.00000	.00000	.00000	.00001	.00004	.00000	.00004
I-131	8.05+000	.00012	.00321	.00000	.00040	.00373	.02349	.00006	.02400
TE-132	3.25+000	.00012	.00003	.00000	.00000	.00016	.00098	.00000	.00098
I-132	9.58-002	.00004	.00119	.00000	.00003	.00126	.00795	.00000	.00790
I-133	8.75-001	.00017	.00452	.00000	.00045	.00514	.03238	.00000	.03200
I-134	3.67-002	.00002	.00056	.00000	.00000	.00058	.00366	.00000	.00370
CS-134	7.49+002	.00131	.00003	.00000	.00001	.00135	.00850	.00130	.00980
I-135	2.79-001	.00008	.00226	.00000	.00013	.00248	.01562	.00000	.01600
CS-136	1.30+001	.00068	.00002	.00000	.00000	.00070	.00442	.00000	.00440
CS-137	1.10+004	.00095	.00002	.00000	.00000	.00097	.00612	.00240	.00850
BA-137M	1.77-003	.00007	.00002	.00000	.00000	.00009	.00059	.00000	.00059
CE-144	2.84+002	.00000	.00000	.00000	.00000	.00000	.00000	.00052	.00052
All Others		.00000	.00000	.00000	.00000	.00001	.00003	.00000	.00003
Total (Except Tritium)		.01481	.01242	.00000	.00107	.02830	.17830	.00629	.19000
Tritium Release		410 curies per year							

(1) Releases are based on assumptions given in Appendix 3A.

(2) Adjustment is 0.15 Ci/yr based on Regulatory Guide 1.112

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TABLE 3.5-6

LIQUID PROCESS AND EFFLUENT RADIOACTIVITY MONITORS

LIQUID PROCESS RADIOACTIVITY MONITORS

Monitor Number	Description	Type (continuous)	Detection	Range (μCi/cc)	MDC (1) (μCi/cc)	Controlling Isotope	Alert Alarm (μCi/cc)	Hi Alarm (μCi/cc)	Sample Flow Rate (gpm)	Monitor Control Function
O-EG-RE-9 O-EG-RE-10	Component cooling water monitor	Liquid	NaI (Tl) gamma scintillation	10^{-7} to 10^{-2}	1×10^{-6}	Cs-137	1×10^{-5}(3)	1×10^{-4}(4)	1-5	Isolates air vents on component cooling water surge tanks on hi alarms
O-SJ-RE-2	Steam generator liquid radioactivity monitor	Liquid (2)	NaI (Tl) gamma scintillation	10^{-7} to 10^{-2}	1×10^{-6}	Cs-137	1×10^{-5}(3)	1×10^{-4}(4)	1-5	Closes blowdown isolation valves on hi alarm
O-BM-RE-25	Steam generator blowdown processing system monitor	Liquid (2)	NaI (Tl) gamma scintillation	10^{-7} to 10^{-2}	1×10^{-6}	Cs-137	1×10^{-5}(3)	1×10^{-4}(4)	1-5	Closes blowdown isolation valve on hi alarms
O-EA-RE-4A O-EA-RE-4B	Service water monitor	Liquid	NaI (Tl) gamma scintillation	10^{-7} to 10^{-2}	1×10^{-6}	Cs-137	1×10^{-5}(3)	1×10^{-4}(4)	1-5	Alarms
O-HE-RE-16	Boron recycle system distillate monitor	Liquid (2)	NaI (Tl) gamma scintillation	10^{-7} to 10^{-2}	1×10^{-6}	Cs-137	1×10^{-5}(5)	1×10^{-2}(6)	1-5	Alert alarm diverts flow to recycle holdup tank
O-SJ-RE-01	Chemical and volume control system letdown monitor	Liquid	NaI (Tl) gamma scintillation	10^{-5} to 1	NA	—	10^{-1}(7)	1 (8)	.2-1	Alarms
O-EF-RE-35 O-EF-RE-36	Essential service water system monitor	Liquid	NaI (Tl) gamma scintillation	10^{-7} to 10^{-2}	1×10^{-6}	Cs-137	1×10^{-5}(3)	1×10^{-4}(4)	1-5	Alarms
O-FB-RE-50	Auxiliary steam system condensate recovery monitor	Liquid (2)	NaI (Tl) gamma scintillation	10^{-7} to 10^{-2}	1×10^{-6}	Cs-137	1×10^{-5}(3)	1×10^{-4}(4)	1-5	Hi alarm isolates auxiliary steam supply to radwaste building and trips auxiliary steam condensate transfer pumps
O-HC-RE-1 O-HC-RE-2	Radwaste lidificat system monitor	Liquid	NaI (Tl) gamma scintillation	0.1 - 10^{3}r/hr	0.1 r/hr	NA	NA	NA	NA	NA

(1) MDC - minimum detectable concentration.
(2) When in operation.
(3) One order of magnitude above MDC to avoid spurious alarms and to indicate the leakage of radioactivity into an otherwise nonradioactive system.
(4) Two orders of magnitude above MDC to indicate significant inleakage of radioactivity.
(5) Only water cleaner than this will be sent to the reactor makeup water storage tank.
(6) High activity may indicate evaporator operating problem.
(7) High activity may indicate a crud burst or iodine spiking.
(8) High activity may indicate a crud burst, iodine spiking, or failed fuel. Laboratory analyses will be performed to determine cause.

TABLE 3.5-6 (Sheet 2)

LIQUID PROCESS AND EFFLUENT RADIOACTIVITY MONITORS

LIQUID EFFLUENT RADIOACTIVITY MONITORS

Monitor Number	Description	Type (continuous)	Detection	Range (μCi/cc)	MDC (1) (μCi/cc)	Controlling Isotope	Alert Alarm (μCi/cc)	Hi Alarm (μCi/cc)	Sample Flow Rate (gpm)	Monitor Control Function
O-HF-RE-45	Secondary liquid waste system monitor	Liquid (4)	NaI (Tl) gamma scintillation	10^{-7} to 10^{-2}	1×10^{-6}	Cs-137	(3)	(2)	1-5	Closes discharge valves on hi alarm
O-HB-RE-18	Liquid radwaste discharge monitor	Liquid (4)	NaI (Tl) gamma scintillation	10^{-7} to 10^{-2}	1×10^{-6}	Cs-137	(3)	(2)	1-5	Closes discharge valve on hi alarm
O-LE-RE-59	Turbine building drain monitor	Liquid (5)	NaI (Tl) gamma scintillation	10^{-7} to 10^{-2}	1×10^{-6}	Cs-137	(3)	(2)	1-5	Closes discharge valve on Hi alarm
O-BM-RE-52	Steam generator blowdown discharge monitor	Liquid (4)	NaI (Tl) gamma scintillation	10^{-7} to 10^{-2}	1×10^{-6}	Cs-137	(3)	(2)	1-5	Closes discharge and blowdown isolation valves on hi alarm

(1) MDC = minimum detectable concentration.
(2) High alarm is set to ensure that Technical Specification limits (the 10 CFR 20 general population MPCs for the controlling isotope at the boundary of the restricted area) are not exceeded and to initiate isolation before the limit can be exceeded.
(3) Alert alarm is set one order of magnitude below the Technical Specification limits to alert operators of alert radioactivity levels.
(4) Normally, all of this liquid will be recycled. The monitor is to prevent inadvertent discharge valve opening and to ensure that any releases that might become necessary are within limits. In accordance with the Technical Specifications, batch analyses will be performed before any releases are made.
(5) Normally, not radioactive since potentially radioactive drains are segregated from this and recycled.

TABLE 3.5-7

AIRBORNE PROCESS AND EFFLUENT RADIOACTIVITY MONITORS

AIRBORNE PROCESS RADIOACTIVITY MONITORS

Monitor	Type (continuous)	Range ($\mu Ci/cc$)	MDC (1) ($\mu Ci/cc$)	Controlling Isotope	Alert Alarm ($\mu Ci/cc$)	Hi Alarm ($\mu Ci/cc$)	Total Ventilation Flow (cfm)	Minimum Required Sensitivity ($\mu Ci/cc$)	Monitor Control Function
O-GT-RE-31 O-GT-RE-32 Containment atmosphere monitors	Particulate (3)	10^{-12} to 10^{-7}	1×10^{-11}	Cs-137	1×10^{-8}(8)	1×10^{-7}(7)	420,000	1×10^{-7}(7)	Isolates containment purge, deenergizes purge fans on high gaseous activity via the ESFAS
	Iodine (4)	10^{-11} to 10^{-6}	1×10^{-10}	I-131	9×10^{-9}(8)	9×10^{-8}(7)	420,000	9×10^{-8}(7)	
	Gaseous (3)	10^{-7} to 10^{-2}	2×10^{-7}	Kr-85	1×10^{-5}(8)	1×10^{-4}(7)	420,000	1×10^{-4}(7)	
O-GT-RE-22 O-GT-RE-33 Containment purge system monitors	Particulate (3)	10^{-12} to 10^{-7}	1×10^{-11}	Cs-137	1×10^{-8}(8)	1×10^{-7}(7)	20,000/4000	1×10^{-7}(7)	Isolates containment purge, deenergizes purge fans on high gaseous activity via the ESFAS
	Iodine (4)	10^{-11} to 10^{-6}	1×10^{-10}	I-131	9×10^{-9}(8)	9×10^{-8}(7)	20,000/4000	9×10^{-8}(7)	
	Gaseous (3)	10^{-7} to 10^{-2}	2×10^{-7}	Kr-85	1×10^{-5}(8)	1×10^{-4}(7)	20,0000/4000	1×10^{-4}(7)	
O-SH-RE-3 O-SH-RE-4 Containment High Activity Monitors	Gamma (5)	1 to 10^{8} rads/hr	1 rad/hr	NA	NA	NA	NA	NA	NA
O-GE-RE-92 Condenser air discharge monitor	Gaseous (continuous) (3), (6)	10^{-7} to 10^{-2}	2×10^{-7}	Kr-85	2×10^{-6}(9)	2×10^{-5}(10)	1000	NA	Closes blowdown isolation valve on hi alarms
	Particulate (lab analysis) (6)								
	Iodine (lab analysis) (6)								
O-GG-RE-27 O-GG-RE-28 Fuel building exhaust monitors (2)	Particulate (3)	10^{-12} to 10^{-7}	1×10^{-11}	Cs-137	1×10^{-8}(8)	1×10^{-7}(7)	20,000	1×10^{-7}(7)	Initiates switch to fuel building emergency ventilation on high gaseous activity via the ESFAS
	Iodine (4)	10^{-11} to 10^{-6}	1×10^{-10}	I-131	9×10^{-9}(8)	9×10^{-8}(7)	20,000	9×10^{-8}(7)	
	Gaseous (3)	10^{-7} to 10^{-2}	2×10^{-7}	Kr-85	1×10^{-5}(8)	1×10^{-4}(7)	20,000	1×10^{-4}(7)	
O-GK-RE-04 O-GK-RE-05 Control room air supply monitors	Particulate (3)	10^{-12} to 10^{-7}	1×10^{-11}	Cs-137	1×10^{-8}(8)	1×10^{-7}(7)	1950	1×10^{-7}(7)	Initiates switch to control room emergency ventilation on high gaseous activity via the ESF S
	Iodine (4)	10^{-11} to 10^{-6}	1×10^{-10}	I-131	9×10^{-9}(8)	9×10^{-8}(7)	1950	9×10^{-8}(7)	
	Gaseous (3)	10^{-7} to 10^{-2}	2×10^{-7}	Kr-85	1×10^{-5}(8)	1×10^{-4}(7)	1950	1×10^{-4}(7)	

Sample flow for each channel is 3 cfm.
(1) MDC = minimum detectable concentration.
(2) When fuel is in the building.
(3) Beta scintillation detector.
(4) Gamma scintillation detector.
(5) Gamma sensitive ion chamber.
(6) When in operation.
(7) 10 MPC.
(8) MPC.
(9) One order of magnitude above MDC to avoid spurious alarms and to indicate primary to secondary leakage.
(10) Two orders of magnitude above MDC to indicate significant inleakage of radioactivity.

TABLE 3.5-7 (Sheet 2)

AIRBORNE PROCESS AND EFFLUENT RADIOACTIVITY MONITORS

AIRBORNE EFFLUENT RADIOACTIVITY MONITORS

Monitor	Type (continuous)	Range (μCi/cc)	MDC (1) (μCi/cc)	Controlling Isotope	Alert Alarm (μCi/cc)	Hi Alarm (μCi/cc)	Total Ventilation Flow (cfm)	Dilution Factor	Minimum Required Sensitivity (μCi/cc)	Monitor Control Function
O-GT-RE-21 Plant unit vent monitor	Particulate (2)	10^{-12} to 10^{-7}	1×10^{-11}	Cs-137	(8)	(7)	66,000	(4)	(5)	Alarms
	Iodine (3)	10^{-11} to 10^{-6}	1×10^{-10}	I-131	(8)	(7)	66,000	(4)	(5) (6)	
	Gaseous (2)	10^{-7} to 10^{-2}	2×10^{-7}	Kr-85	(8)	(7)	66,000	(4)	(5)	
O-GH-RE-10 Radwaste building exhaust monitor	Particulate (2)	10^{-12} to 10^{-7}	1×10^{-11}	Cs-137	(8)	(7)	12,000	(4)	(5)	High alarm isolates the waste gas decay tank discharge line
	Iodine (3)	10^{-11} to 10^{-6}	1×10^{-10}	I-131	(8)	(7)	12,000	(4)	(5)	
	Gaseous (2)	10^{-7} to 10^{-2}	2×10^{-7}	Kr-85	(8)	(7)	12,000	(4)	(5)	
O-GL-RE-60 Auxiliary Ventilation Exhaust Monitor	Particulate (3)	10^{-12} to 10^{-7}	1×10^{-11}	Cs-137	(8)	(7)	20,000	(4)	(7)	Alarms
O-GK-RE-41 Access Control Area Ventilation Exhaust Monitor	Particulate (3)	10^{-12} to 10^{-7}	1×10^{-11}	Cs-137	(8)	(7)	1950	(4)	(7)	Alarms

Sample flow for each channel is 3 cfm.

(1) MDC = minimum detectable concentration.

(2) Beta scintillation detector.

(3) Gamma scintillation detector.

(4) Dilution factor = vent flow rate in $m^3/sec\ \frac{X}{Q}$ (annual average).

(5) Minimum required sensitivity of monitor in μCi/cc at maximum allowable annual average concentration of controlling isotope at monitor which will result in annual average Appendix I dose at the site boundary = population MPC for controlling isotope $\times \frac{1}{100} \times \frac{1}{\text{bioaccumulation factor}} \times \frac{1}{\text{dilution factor}}$ where the bioaccumulation factor is 1 for noble gases and 1,000 for iodines and particulates. See Offsite Dose Calculation Manual.

(6) Grab samples will be analyzed in the laboratory, and low iodine concentrations will be calculated, using previously established ratios.

(7) High alarm is set to ensure that Technical Specification limits (the 10 CFR 20 general population MPCs for the controlling isotopes at the boundary of the restricted area) are not exceeded.

(8) Alert alarm is set to alert operators to that average concentration which, if maintained for a full year, would result in the 10 CFR 50 Appendix I annual dose guidelines being reached. See Offsite Dose Calculation Manual.

plant. Pretreated water (11.6 gpm/unit) is further processed through weak base, strong base, strong acid, and mixed bed ion exchangers and then pumped to a cycled condensate storage tank where it is added to the condensate feed as required. The following sections discuss the chemicals used in these water treatment systems.

3.6.3.1 Pretreatment System

The pretreatment system for the potable water and demineralized water systems consists of one chlorinator, a chlorine retention tank, two ferric sulfate pre-mix tanks, two lime softeners (one a spare), one acid feed (pH adjustment) system, one clear well, three sand filters (one a spare), three carbon filters (one a spare), and one filtered water storage tank. During normal plant operation, the system operates intermittently.

The chlorinator, lime softener, and acid feed system operate at 1000 gpm for approximately 30 min/day. The two carbon filters (one a spare) and two sand filters (one a spare) each operate at 167 to 250 gpm for approximately 80 min/day. Blowdown from the lime softener and the carbon and sand filter produces all of the waste generated in the pretreatment system.

The lime softener blowdown rate is 50 gpm for 4 minutes for each 20 minutes of operation. Blowdown consists of 3 percent solids by weight. Solids are composed of 97.8 percent calcium carbonate ($CaCO_3$), 0.36 percent magnesium hydroxide ($Mg[OH]_2$), and 1.8 percent ferric hydroxide ($Fe[OH]_2$). The blowdown is discharged into the lime sludge pond, which is sized to contain all the influent for one-unit operation.

The carbon and sand filters are backflushed for about 10 minutes once every 7 days. Each carbon filter requires 5660 gallons of backwash water, and each sand filter requires 3410 gallons of backwash water. The backwash is discharged into the lime sludge pond.

3.6.3.2 Demineralizer System

The demineralizer system consists of two parallel demineralizer trains (one a spare), each designed to produce a minimum of 216,000 gallons of demineralized water in a 24-hour period. Each train operates at 150 gpm and requires regeneration every 13 days. During normal operation, one train is used approximately 2 hr/day.

Each demineralizer train consists of a strong acid cation unit, weak base and strong base anion units, and a mixed bed polisher. The mixed bed polisher requires one regeneration for every 14 regenerations of the train. The chemicals used to regenerate a train and a mixed bed polisher are given in Table 3.6-2. The amount of water used to regenerate the primary units is 35,600 gallons per regeneration. The mixed bed units require 7,523 gallons per regeneration. Impurities removed by the demineralizers are listed in Table 3.6-6. Waste produced during regeneration (regenerates and impurities) is discharged to the lime sludge pond.

3.6.4 SERVICE WATER SYSTEM

Service water used to cool plant equipment is withdrawn from the cooling lake at a flow rate of 90 cfs per unit. Of the total flow, 83 cfs is circulated through the plant, and returned to the cooling lake; the remaining 7 cfs is used as backwash water for traveling screens and strainers and is also returned to the cooling lake.

The service water is chlorinated in the same manner and for the same reasons as the circulating water (see Section 3.6.2.1). The feed rate is carefully monitored so that the amount of chlorine added is only slightly greater than the chlorine demand of the water. The free chlorine residual concentration is maintained between 0.1 and 0.5 mg/liter at the service water discharge. Free chlorine residual dissipates rapidly when discharged to the cooling lake and will therefore have little effect on the lake.

The predicted chlorine usage for the service water system is approximately 100 lb/day per unit

3.6.5 ESSENTIAL SERVICE WATER SYSTEM

Essential service water is withdrawn from the cooling lake at a flow rate of 33.5 cfs per unit, circulated through the plant, and returned to the cooling lake. There is no chemical treatment of the essential service water.

3.6.6 SANITARY WATER SYSTEM

Water used for plant sanitary purposes is treated in a sewage treatment system, and the effluent is treated with sodium hypochlorite. The sodium hypochlorite is added as a 15% solution with water with a maximum free chlorine residual of 1 mg/liter.

3.6.7 AUXILIARY STEAM SYSTEM

Blowdown from the auxiliary steam system is discharged to the oily waste system sump. The typical chemicals added for boiler water treatment of the auxiliary steam system are described in Table 3.6-3.

3.6.8 PLANT DECONTAMINATION SYSTEM

Chemically treated water in the plant decontamination system is not directly discharged to the lake but treated in the radwaste system and then discharged. Typical chemicals used in the decontamination system are Turco Decon 4521, and Turco Decon 4502 (see Table 3.6-3) The resulting decontamination solutions are sent to the chemical waste tank. These wastes are then transferred to the solid radwaste system and solidified for burial.

3.6.9 RADWASTE SYSTEM

Waste systems such as those from floor drains, power block equipment drains, laundry wastes, steam generator blowdown, and other wastes are processed through the radwaste system (see Section 3.5).

3.6.10 OTHER WASTE STREAMS

3.6.10.1 Oily Wastes

Wastes leaving the power block, collectively known as the oily waste system effluent, are discharges to the site oil separator. These wastes consist of a mixture of the following liquids:

a. HVAC condensates;

b. lube oil (vapor extractors);

c. radiation monitor effluent (circulating water);

d. miscellaneous sources (valve stem leakoffs, compressed air condensate, equipment seal leakage);

e. domestic water (washdown);

f. fire protection; and

g. auxiliary boiler blowdown.

The actual amount of effluent from any one liquid source is dependent on equipment condition (seals, packing, etc.) and power block operation phase (plant shutdown, normal operation, maintenance, etc.). These effluents are discharged from power block sumps to the oil separator via centrifugal sump pumps. They have a batch flow rate of approximately 100 gpm. The average duration and frequency of discharge is 1 minute, 9 times per hour during normal operation and 15 times per hour during plant shutdown. The effluent could consist of all, a combination of, or a single component of these liquids. The oily waste separator receives these effluents, along with drainage frcm various yard and equipment drains. The oily waste separator separates the oils from the water using their density difference.

The condensate/feedwater leakage is normally routed to the secondary liquid radwaste system for internal processing and recycling.

In the event of a fire and subsequent fire protection system actuation, the sprinkler discharge water and a condensate/feedwater mixture will be discharged to the site collection system, but 10 hours of flow (approximately 2000 gpm) can be held if it is not possible to discharge to the site collection system immediately. The fire protection water discharged during a fire will contain an increased amount of contaminants (solids and dissolved products of combustion), the composition and quantity of which are generally undeterminable.

The domestic water source (washdown) is normally zero but may increase to as much as 10 to 50 gpm during power block shutdown-maintenance operations. Closed cooling water has not been included because all pumps have mechanical seals (zero leakage anticipated) and all drains are capped. Any closed cooling water maintenance drainage is collected in portable containers for recycling or disposal. The amounts of effluents during normal, design, and worst conditions are indicated in Table 3.6-7. Worst condition refers to occurrences such as tank overflows.

The miscellaneous sources previously mentioned are approximately 75% circulating water and 25% domestic water. To prevent corrosion in the power block system, potassium chromate is added to the component cooling water and closed cooling water systems. A similar inhibitor is added to the chilled water system. With good maintenance and housekeeping, none of the corrosion inhibitor fluid will be discharged (see Table 3.6-3).

3.6.10.2 Transformer Vault Effluents

Transformer effluents could be discharged from the service station and engineered safety feature (ESF) transformer, the main and unit auxiliary transformer, and the start-up transformer. Normally, effluent release will be due to rainwater accumulation in the vaults and is controlled by normally closing a manual valve. Should an oil spill occur, the oil can be pumped out with a portable pump in lieu of draining it out through the valve. The amounts of effluents during normal, design, and worst conditions are indicated in Table 3.6-7.

TABLE 3.6-1

WATER ANALYSES

(All Values in mg/liter as Substance Except Where Noted)

SUBSTANCE	JOHN REDMOND RESERVOIR		COOLING LAKE TWO UNITS (88.5 percent load)		COOLING LAKE ONE UNIT (100 percent load)	
	NORMAL	DROUGHT	NORMAL[a]	DROUGHT[b]	NORMAL	DROUGHT[b]
Calcium	89	125	214	389	172	218
Magnesium	22	31	53	96	43	54
Sodium	24	34	58	106	46	59
Bicarbonate (as $CaCO_3$)	233	326	80	52	129	74
Sulfates	89	125	674	1329	480	701
Chlorides	28	40	67	124	54	70
TDS[c]	400	560	1133	2089	888	1153
pH	8.0	8.0	7.7	7.1	7.5	7.3

[a]Average values during the post drought years.

[b]Maximum values.

[c]Adjusted for acid addition.

TABLE 3.6-2

CHEMICALS USED AT WOLF CREEK GENERATING STATION SITE - UNIT 1

FORMULA	GENERIC NAME	TRADE NAME	PURPOSE	DOSAGE	FREQUENCY OF USE	ANNUAL QUANTITY (pounds)
NaOH	Sodium Hydroxide (100%)	Caustic	Used to regenerate primary bed demineralizers.	625 lb/regen	once every 13 days	17,548
NaOH	Sodium Hydroxide (100%)	Caustic	Used to regenerate mixed bed demineralizers.	240 lb/regen	once every 182 days	480
H_2SO_4	Sulfuric Acid (100%)	66° Be	Used to regenerate primary bed demineralizers.	1,125 lb/regen	once every 13 days	31,590
H_2SO_4	Sulfuric Acid (100%)	66° Be	Used to regenerate mixed bed demineralizers.	320 lb/regen	once every 182 days	650
H_2SO_4	Sulfuric Acid (100%)	66° Be	Reduce scaling tendency of circulating water.	6.15×10^4 lb/day 9.63×10^4 lb/day 6.46×10^4 lb/day 7.06×10^4 lb/day	Continuous	One Unit Normal - 2.24×10^7 Two Unit Normal - 3.51×10^7 One Unit Drought - 2.36×10^7 Two Unit Drought - 2.58×10^7
Cl_2	Chlorine Gas		Prevent biological fouling of condenser.	412 lb/dose	3/day for 30 minutes	4.51×10^5/unit
Cl_2	Chlorine Gas		Prevent biological fouling of non-essential service water system.	33.3 lb/dose	3/day for 30 minutes	3.64×10^4/unit
$Ca(OH)_2$	Calcium Hydroxide (93%)	Lime	Used to soften influent to the demineralized and potable water systems.	2.4 lb/1000 gallon	28 minutes/day	24,230
H_2SO_4	Sulfuric Acid (100%)	66° Be	pH Adjustment of the lime softened water.	3.00 lb/day	Intermittent	1,100
Cl_2	Chlorine Gas		Prevent biological fouling of pretreatment system.	2.30 lb/day	Intermittent	840
$Fe_2(SO_4)_3$	Ferric Sulfate	Coagulant Aid	Used to soften influent to the demineralized and potable water systems.	4.6 lb/day	28 minutes/day	1,680
NaOCl	Sodium Hypochlorite (15%)		Tertiary sewage treatment.	0.26 gallons per day	Continuous	960
NaOCl	Sodium Hypochlorite (15%)		Potable water disinfection.	0.085 gallons per day	Continuous	315

POOR ORIGINAL

TABLE 3.6-3

CHEMICALS USED IN POWER BLOCK ONLY

GENERIC NAME	TRADE NAME	CONTENTS	FORMULA	PURPOSE	COMMENTS
Ammonia			NH_3	Adjust pH of auxiliary boiler water.	
Hydrazine			NH_2NH_2	Remove oxygen from boiler water.	
	Turco Decon 4521	Oxalate, citrate, ammonium ions, inhibitors, surfactant, and a foam suppressant.		For decontamination of equipment and plant facilities.	Disposed of in radwaste system.
	Turco Decon 4502	Potassium permanganate, potassium hydroxide, and a wetting agent.		Pre-decontamination oxidizer and conditioner.	Disposed of in radwaste system.
Potassium Chromate			K_2CrO_4	Corrosion inhibitor for the component cooling water and closed cooling water systems.	No liquid discharge to environment is anticipated.

TABLE 3.6-4

WOLF CREEK COOLING LAKE

PREDICTED MONTHLY TDS CONCENTRATIONS (1949-1964) FOR TWO-UNIT OPERATION

(All Values in mg/liter)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1949	385.8	384.6	387.3	394.0	401.0	408.5	415.3	428.0	437.7	447.3	457.5	466.0
1950	470.6	476.0	482.8	492.0	500.3	505.7	508.9	511.7	519.5	532.4	545.6	553.6
1951	558.5	562.3	565.8	570.0	573.2	575.6	552.8	549.7[a]	549.2	561.3	571.9	577.6
1952	581.7	586.2	588.5	592.3	601.7	616.2	633.0	651.9	675.9	702.0	721.1	727.2
1953	733.3	739.6	743.2	756.3	763.6	786.6	808.8	846.2	882.8	918.6	934.7	944.9
1954	955.5	962.9	977.5	990.4	980.2	999.4	1047.5	1103.7	1157.0	1179.2	1193.0	1207.6
1955	1204.1	1199.7	1200.1	1207.0	1220.5	1226.6	1253.8	1309.2	1355.1	1358.0	1390.2	1399.2
1956	1401.3	1393.3	1409.1	1434.4	1452.6[b]	1458.9	1504.6	1564.7	1643.3	1710.6	1726.3	1735.2
1957	1737.0	1721.8	1724.2	1711.1	1680.5	1574.7	1518.1	1506.6	1479.1	1427.2	1357.4	1300.3
1958	1245.2	1199.3	1138.0	1085.9	1057.9	1034.0	1000.9	992.8	990.4	990.4	990.1	985.3
1959	978.2	972.6	969.6	966.6	965.1	965.7	963.7	969.4	978.2	967.5	970.0	967.2
1960	961.5	953.5	945.3	938.1	933.4	932.1	935.1	937.0	943.2	941.2	936.4	934.1
1961	929.5	925.0	920.8	914.6	893.6	898.3	907.7	916.4	908.7	908.2	909.6	906.9
1962	900.9	891.7	885.0	880.0	881.1	873.5	872.0	875.3	868.0	862.4	859.5	852.3
1963	844.8	837.7	829.7	827.6	828.4	828.0	833.9	841.9	847.5	855.3	855.9	849.3
1964	845.5	841.7	839.6	835.7	832.8	826.3	830.7	839.3	834.5	836.8	835.8	832.8

WCGS-ER(OLS)

Note: Values are based on two units operating at 88.5 percent average annual load factor.

[a] Start of design drought period.

[b] End of design drought period.

3.9 TRANSMISSION FACILITIES

3.9.1 GENERAL DESCRIPTION

Except for minor modifications noted in the following discussions, the routes, structures and clearing methods are as originally described in Section 3.9 of the Environmental Report - Construction Permit Stage (ER(CPS)). The transmission lines described herein are the preferred routes defined in that original document.

The WCGS required construction of transmission line interconnections to the KG&E and KCPL systems (Figures 3.9-1 and 3.9-2). The connection to the KG&E system is a 345-kV line extending 97.6 miles in a west-southwest direction from the generating station substation to the existing KG&E Rose Hill Substation. The interconnection to the KCPL system is a 345-kV line extending northeast 49.2 miles to where it enters an existing transmission line corridor which was widened to accomodate the additional line. The transmission line then continues along this dual corridor for 7.2 miles to West Gardner Substation.

The KEPCo system will continue to be served by existing interconnections at KG&E and KCPL substations with the exception of the construction by the Coffey County REC of a 69-kV line from WCGS to the Phillips Petroleum Company pipeline pumping station near Sharpe, Kansas.

KG&E constructed a four mile long 69-kV tap from the Athens-Burlington line to the WCGS.

3.9.2 DESCRIPTION OF TRANSMISSION RIGHTS-OF-WAY

3.9.2.1 Wolf Creek-Rose Hill Transmission Line

The right-of-way for the Wolf Creek-Rose Hill transmission line shown in Figure 3.9-1 extends 97.6 miles from the Wolf Creek Substation to the Rose Hill Substation. The 345-kV single circuit line is carried for the majority of the transmission route on wooden H frame structures. Transmission line structures are discussed in more detail in Section 3.9.3. The width of the Wolf Creek-Rose Hill right-of-way required to accomodate the 345-kV line is 150 feet. To construct the Wolf Creek-Rose Hill line, right-of-way agreements for access to 1775 acres are required. The total acreage required for the Wolf Creek Substation is 10.3 acres.

3.9.2.2 Wolf Creek-West Gardner Transmission Line

The right-of-way for the Wolf Creek-West Gardner transmission line shown in Figure 3.9-1 extends 49.2 miles from Wolf Creek Substation in a 160 foot wide right-of-way corridor where it enters a dual transmission line corridor 260 feet wide with the LaCygne-Craig 345-kV transmission line for 7.2 miles. The 7.2 mile dual transmission line corridor was widened from 160 feet to accommodate the additional line. The 345-kV single circuit line will be carried on wooden H frame structures for the majority of the transmission route. Transmission line structures are discussed in more detail in Section 3.9.3. To construct the 56.4 mile Wolf Creek-West Gardner transmission line, right-of-way agreements for access to 1041 acres are required.

3.9.2.3 Wolf Creek Tap of Athens-Burlington Transmission Line

The right-of-way for the 69-kV Wolf Creek tap of the Athens-Burlington line (Figure 3.9-2) extends east out of the Wolf Creek Substation, then south and east along the cooling lake to connect to the existing Athens-Burlington line. The total length of this line is 4.05 miles. The width of the right-of-way to accommodate the 69-kV line is 50 feet. Only one-quarter mile of the line is outside the site property boundary requiring right-of-way agreements for access to 1.51 acres.

3.9.2.4 Wolf Creek to Coffey County REC Transmission Line

The right-of-way for the 69-kV line from Wolf Creek to the Coffey County REC extends east out of the Wolf Creek Substation, then north to connect with the Phillips Petroleum Company pipeline pumping station near Sharpe, Kansas. The total length of this line is approximately three miles. The width of the right-of-way for the 69-kV line is 100 feet. Right-of-way agreements were obtained with KG&E and other property owners along the line right-of-way.

3.9.2.5 Land Use Classifications

The land classification types crossed by the transmission lines are those described in the ER(CPS). Additional land classification has been accomplished since then by the United States Department of Agriculture Soil Conservation Service (SCS) for the national program of inventorying prime and unique farmland (SCS, 1979).

Transmission lines from WCGS pass through seven counties of Kansas. Soil types classified as prime farmland by the

SCS are found within the transmission line corridors. Table 3.9-1 provides a quantification of the percentage of the transmission line corridor which is prime farmland. The percentage of prime farmland which is within the Wolf Creek-Rose Hill transmission line right-of-way is 47% and 68% for the Wolf Creek-West Gardner right-of-way.

Only land that is required for the foundations of the transmission towers will be removed from production. Therefore, the majority of the transmission corridor will continue to be used for agricultural purposes and no significant removal of prime farmland from production will result.

3.9.3 GENERAL DESIGN AND SELECTION OF STRUCTURES

Transmission tower structures are planned for use as described in the ER(CPS) Section 3.9.3. The wooden H frame structures are used to support nearly all of the transmission lines and are treated with pentachlorophenol oil in lieu of cellon as described in the ER(CPS). The oil treated structures age less rapidly. Thus, the potential for environmental disturbance is reduced due to less required tower repair and replacement after the lines are initially put into service. Cellon was originally chosen because it was felt that the structures treated with cellon, which age to a natural gray, would more readily blend into the skyline. However, the actual difference in the ability of either pole to blend into the environment is not markedly different. The visible impact of the transmission lines has, however, been reduced where feasible by routing the lines so that they are screened by trees and hills.

3.9.4 GENERAL TREATMENT OF RIGHTS-OF-WAY

Access, treatments at highway and river crossings and maintenance practices for the transmission lines are as discussed in the ER(CPS) Section 3.9.3 except as noted below.

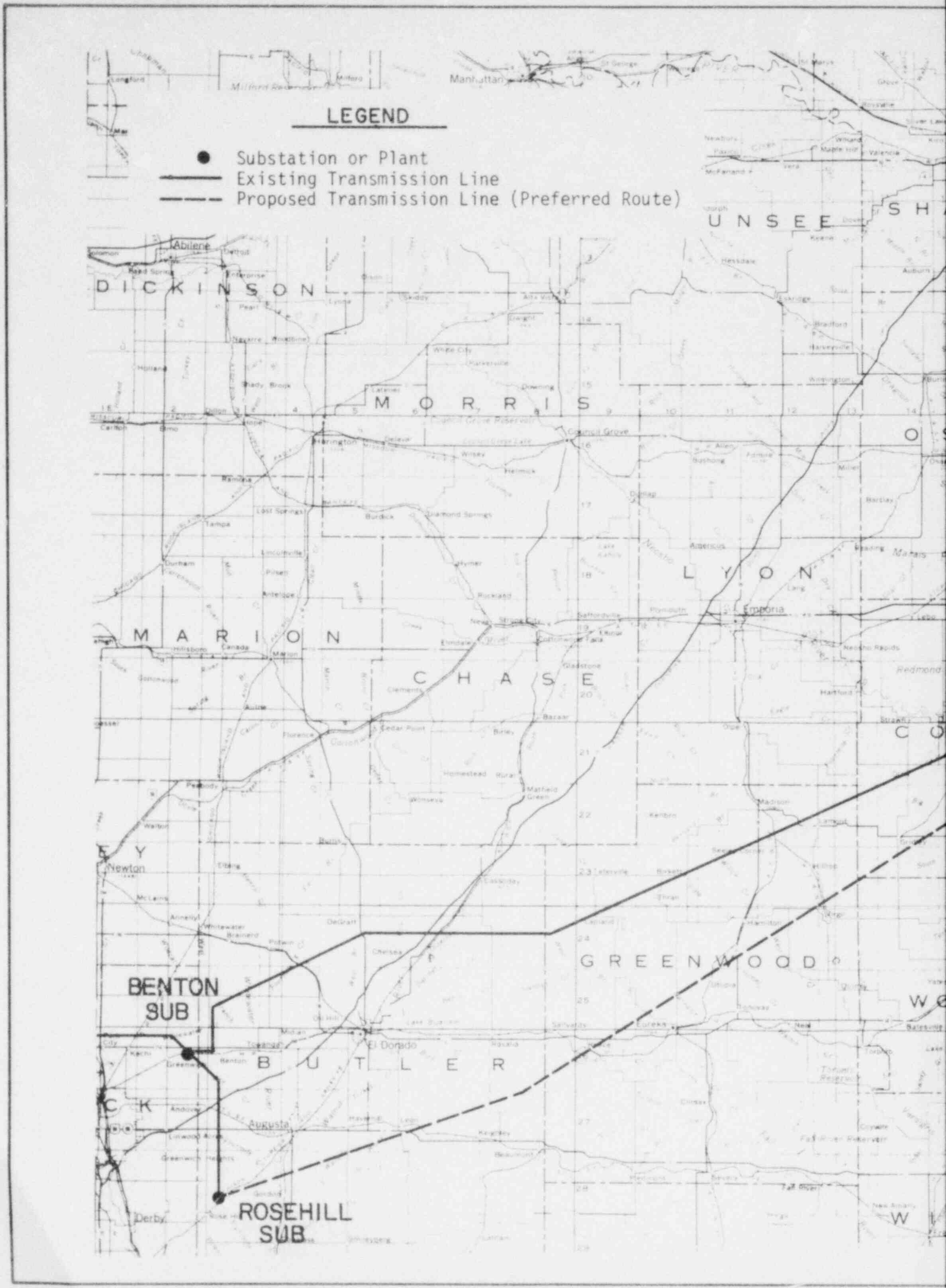
Herbicides used to maintain transmission rights-of-way will be only those herbicides approved for use at the time of such maintenance by the EPA and the Kansas Weed and Pesticide Division of the Kansas State Department of Agriculture.

TABLE 3.9-1

PRIME FARMLAND CROSSED BY TRANSMISSION LINES*

	Wolf Creek-Rose Hill			Wolf Creek-West Gardner		
County	Total Miles	Miles Prime Farmland	Percent Prime Farmland	Total Miles	Miles Prime Farmland	Percent Prime Farmland
Butler	35	15	43	--	--	--
Greenwood	38	12	32	--	--	--
Coffey	25	19	76	11.9	7	59
Anderson	--	--	--	7	6	86
Franklin**	--	--	--	24	14	58
Miami	--	--	--	10	8	80
Johnson	--	--	--	3.5	3.3	94
Total	98	46	47	56.4	38.3	68

*Source: US Soil Conservation Service data, 1979.
**Partially estimated.


LEGEND
Substation or Plant
Existing Transmission Line
Proposed Transmission Line (Preferred Route)
DICKINSON
MORRIS
MARION
CHASE
LYON
GREENWOOD
BUTLER
BENTON SUB
ROSEHILL SUB
Abilene
Manhattan
Council Grove
Emporia
El Dorado
Augusta
Newton
Derby

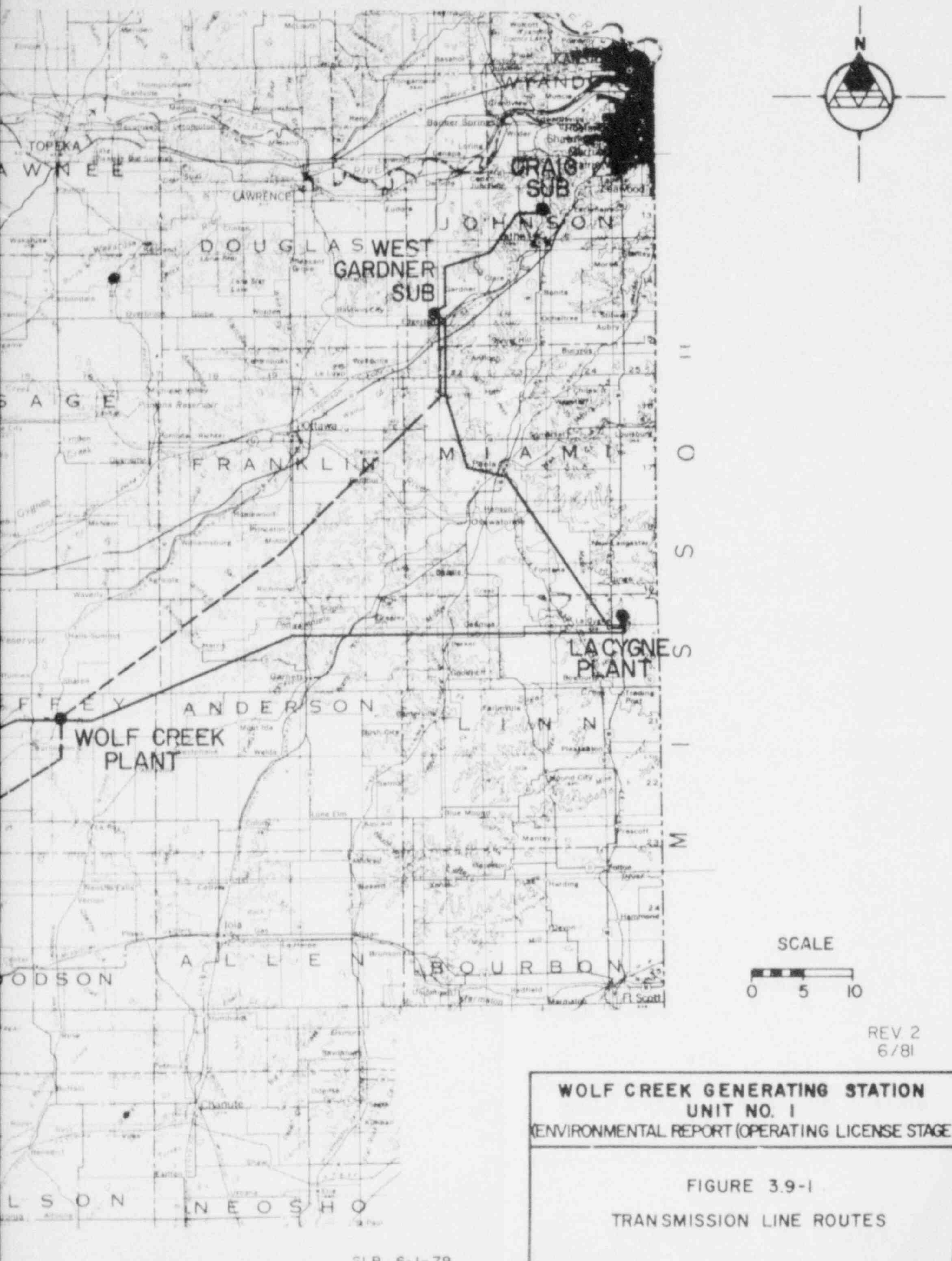


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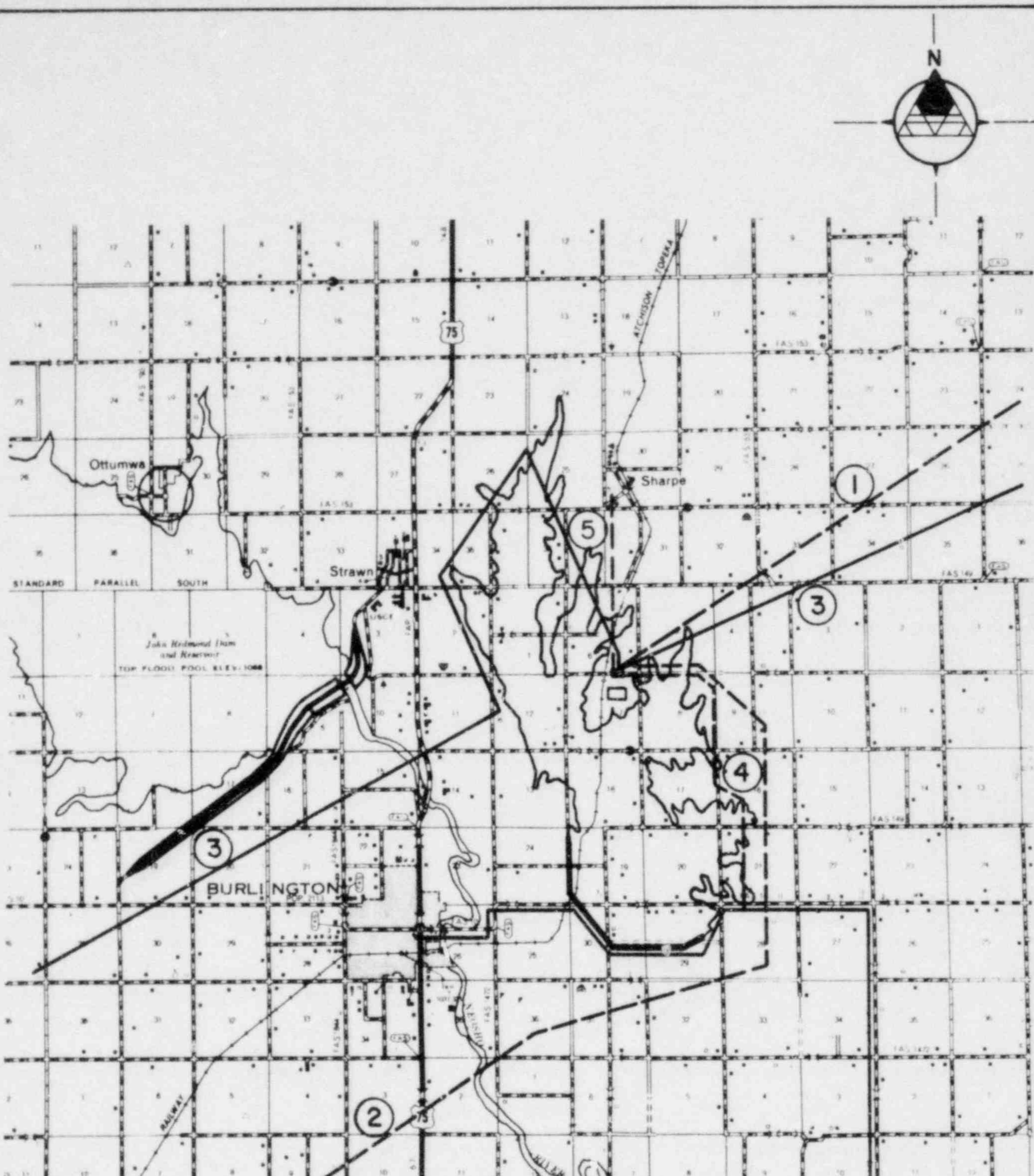
FIGURE 3.9-1

TRANSMISSION LINE ROUTES

SLB 6-1-79



(1) Wolf Creek-West Gardner 345 KV Line

(2) Wolf Creek-Rose Hill 345 KV Line.

(3) LaCygne-Benton 345 KV Line

(4) Athens- Burlington 69 KV Line Wolf Creek Tap

(5) Wolf Creek-Sharpe 69 KV Line

Scale: 1/2" = 1 Mile

Dr. GLS Date 1-3-75

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WOLF CREEK GENERATING STATION
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FIGURE 3.9-2
TRANSMISSION LINE
RIGHT-OF-WAY ALIGNMENT

TABLE 3A-1

PLANT DATA FOR SOURCE TERM CALCULATIONS

A.	General	
1.	The maximum core thermal power evaluated for safety considerations in the SAR (ultimate rating), MW(t)	3,565
2.	Plant capacity factor, percent	80
3.	Core properties	
(a)	The total mass of uranium in an equilibrium core, lb	196,000
(b)	The total mass of plutonium in an equilibrium core, lb	N/A
(c)	Enrichment of uranium in reload fuel (max.), percent	3.5
(d)	Fissile plutonium in reload fuel (max.), percent	0.0
(e)	Fuel cladding defects number of rods, percent	0.12
(f)	Cladding material	Zircaloy-4
(g)	Escape rate coefficients	Same as R.G. 1.112
B.	Reactor Coolant System Properties	
1.	Mass of primary coolant, x 10^5 lb(1)	5.3
2.	Mass of primary coolant less pressurizer volume, x 10^5 lb	5.04
3.	Mass of primary coolant in reactor, x 10^5 lb	2.1
4.	Primary coolant flowrate, x 10^6 lb/hr	142
5.	Number of loops	4

TABLE 3A-1 (Sheet 2)

6.	Average primary letdown rate to CVCS, gpm	75
7.	Average primary letdown rate to CVCS cation demineralizer, gpm	7.5
8.	Average shim bleed flowrate, gpm	1.3
9.	Chemical and volume control system parameter	See Figure 3A-2 (Sheet 1) and Table 3A-2.
10.	Boron recycle system parameters	See Figure 3A-2 (Sheet 2) and Table 3A-2.
11.	Reactor coolant degassing	Continuous in VCT (CVCS) or recycle evaporator (BRS)
12.	Reactor coolant leakage to containment, percent of inventory per day	
	Noble gases	1.0
	Iodine	0.001
C.	Secondary System	
1.	Steam Generator	
	Number	4
	Type	Recirculation U-tube
	Carryover, percent	0.25
	Iodine partition factor	0.01
	Nonvolatile partition factor	0.001
	Type of chemistry	AVT
	Operating temperature, F	554.6
	Operating pressure, psia	1000
	Mass of steam each, (2) lb	8000
	Mass of liquid each, (2) lb	104,000

TABLE 3A-2

PARAMETERS USED IN THE CALCULATION OF ESTIMATED ACTIVITY IN LIQUID WASTES

Collector Tank With Sources	Volume of Liquid Wastes	Specific Activity	Basis	Collection & Decay Period Assumed Before Discharge	Comments
A. Reactor coolant drain tank	300 gal/day	1.0 PCA(1)	0.05 gpm/R.C. pump #2 seal leak and other miscellaneous leakage	None	10 percent assumed discharged. Balance recycled to BRS.
B. Letdown shim bleed	1,840 gal/day	1.0 PCA(1)	CVCS inventory control	None	10 percent assumed discharged. Balance recycled to BRS.
C. Waste holdup tank	400 gal/day	0.5 PCA(1)		None	Recycled to RMWST
1. Equipment drains			Tank drains, filter drains, heat exchanger drains, demineralizer drains		
2. Excess samples			Miscellaneous pre-purges sample		
D. Floor drain tank	1,140 gal/day	0.06 PCA(1)		None	Recycled to RMWST or discharged
1. Decontamination water			Fuel cask, vessel head system component flushing, floor washdown, etc.		Nominal discharge will be 5,000 gallons at 35 gpm, approximately twice a week. Annual release is given in FSAR Table 11.1-2.
2. Laboratory equipment			Washing and rinsing of laboratory equipment. Reactor grade drains which are aerated. Maintenance drains for filters, H. Ex., demineralizers, etc.		
E. Chemical drain tanks	7,000 gal/yr		Samples plus sample rinse water	90 days	Drummed

TABLE 3A-2 (Sheet 2)

Collector Tank With Sources	Volume of Liquid Wastes	Specific Activity	Basis	Collection & Decay Period Assumed Before Discharge	Comments
F. Laundry and hot shower tank	450 gal/day		NUREG-0017	None	Recycled within closed laundry system or discharged. Nominal discharge will be 5,000 gallons at 35 gpm, approximately twice per month. Annual release is given in FSAR Table 11.1-2.
G. Steam generator	86,400-518,400 gal/day	1.0 SCA (2)	Continuous blowdown of 60-360 gpm	None	Normally recycled to condensate/feedwater system
H. Secondary liquid waste drain collector tank	7,200 gal/day	(3)	Floor drains and equipment drains	None	Discharged or recycled to condensate storage tank. Annual release is given in FSAR Table 11.1-2.
I. Condensate demineralizer regeneration waste	4,286 gal/day	(3)	15,000 gal/high TDS regeneration waste - per regeneration	None	Processing options are: 1. Neutralize and discharge 2. Process and recycle to condenser 3. Evaporate and discharge
	12,857 gal/day	(3)	45,000 gal/low TDS regeneration waste - per regeneration		Recycled to secondary cycle or discharge

(1) PCA - Primary coolant specific activity
(2) SCA - Secondary coolant specific activity
(3) Fraction of SCA internally calculated by GALE Code.

TABLE 3A-4 (Sheet 2)

Source	Building Free Volume (cu. ft.)	Point of Release (1)	Filters(2)	Shape of Exhaust Vent	Type	Physical Characteristics of Effluent Streams: Flow rate (cfm)	Temperature (F)	Velocity (fpm)
H. Access control area	208,000	Unit vent	Exhaust P-H-C-H	-	Continuous	6,000	104 max.	-
I. Main steam enclosure	166,000	Unit vent	None	-	Continuous	23,000	120 max.	-

(1) Grade elevation is 2000'-0"
(2) P = prefilter or roughing filter, H = HEPA filter, C = charcoal adsorber

TABLE 3A-5

GALE CODE INPUT DATA

SNUPPS Nuclear Unit Parameters	PWR Value
Thermal power level (megawatts)	3565.000
Plant capacity factor	0.800
Mass of primary coolant (thousands lbs)	530.000
Percent fuel with cladding defects	0.120
Primary system letdown rate (gpm)	75.000
Letdown cation demineralizer flow (gpm)	7.500
Number of steam generators	4.000
Total steam flow (millions lbs/hr)	15.850
Mass of steam in each steam generator (thousands lbs)	8.000
Mass of liquid in each steam generator (thousands lbs)	104.000
Mass of water in steam generators (thousands lbs)	416.000
Total mass of secondary coolant (thousands lbs)	3570.000
Steam generator blowdown rate (thousands lbs/hr)	176.000
Primary to secondary leak rate (lbs/day)	100.000
Condensate demineralizer regeneration time (days)	17.500
Fission product carry-over fraction	0.001
Halogen carry-over fraction	0.010
Condensate demineralizer flow fraction	0.684
Radwaste dilution flow (thousands gpm)	5.000

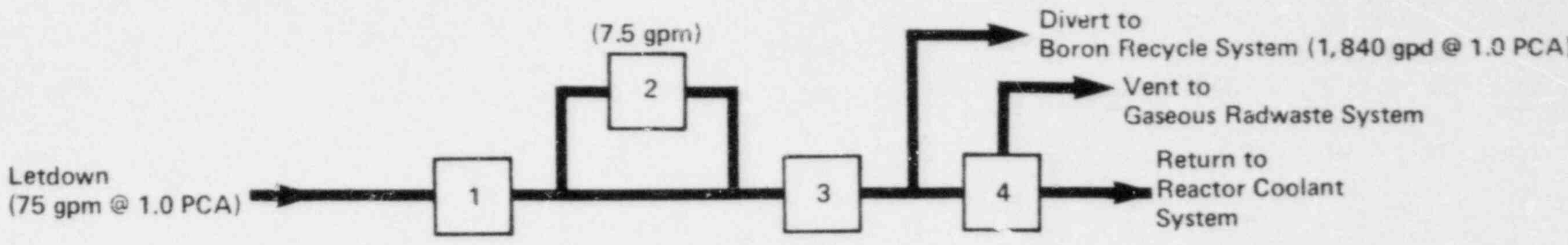
Liquid Waste Inputs

Steam	Flow Rate (gal/day)	Fraction of PCA	Fraction Discharged	Collection Time (days)	Decay Time (days)	Decontamination Factors I	Decontamination Factors CS	Decontamination Factors Others
Shim bleed rate	1.84E+03	1.000	.1	0.0	0.0	1.00E+06	4.00E+03	1.00E+05
Equipment drains	3.00E+02	1.000	.1	0.0	0.0	1.00E+05	2.00E+03	1.00E+04
Clean waste input	4.00E+02	.500	.1	0.0	0.0	1.00E+04	1.00E+05	1.00E+05
Dirty waste input	1.14E+03	.058	1.0	0.0	0.0	1.00E+04	1.00E+05	1.00E+05
S.G. blowdown	3.80E+05	(1)	.0	.0	.000	1.00E+03	1.00E+02	1.00E+03
Untreated blowdown	1.27E+05	(1)	1.0	0.0	.000	1.00E+00	1.00E+00	1.00E+00
Regenerant solutions	4.71E+04	(1)	.0	.0	0.0	1.33E+02	2.67E+02	1.33E+02

(1) Fraction of SCA internally calculated by GALE Code

Gaseous Waste Inputs

There is continuous low vol. purge of vol. control tk	
Holdup time for xenon (days)	9.0E+1
Holdup time for krypton (days)	9.0E+1
Fill time of decay tanks for the gas stripper (days)	0.0E+0



DECONTAMINATION FACTORS

		Iodine	Cesium & Rubidium	Other Nuclides
1.	Mixed Bed Demineralizers	10	2	10
2.	Cation Bed Demineralizer	1	10	10
3.	Reactor Coolant Filter	1	1	1
4.	Volume Control Tank [(a)]	—	—	—
	System DF	10	20	10^2

(a) For noble gases, a value of 0.25 is built into the GALE code for the y parameter for the case of continuous VCT purging.

Chemical and Volume Control System

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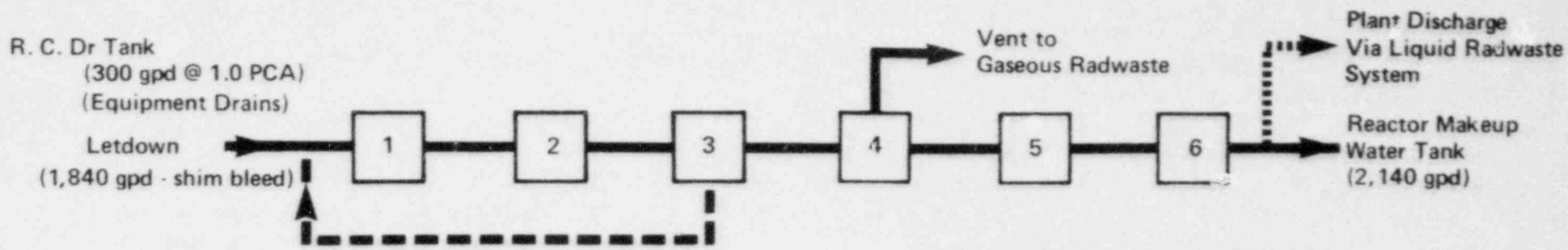
Figure 3A-2
(Sheet 1)

System Decontamination Factors



DECONTAMINATION FACTORS

	Iodine	Cesium & Rubidium	Other Nuclides
1. Recycle Evaporator Demineralizer [(a)]	10	2	10
2. Recycle Evaporator Feed Filter	1	1	1
3. Recycle Holdup Tank	—	—	—
4. Recycle Evaporator	10^2	10^3	10^3
5. Recycle Evaporator Condensate Demineralizer [(b)]	10^2	1	1
6. Recycle Evaporator Condensate Filter	1	1	1
System DF	10^5	2×10^3	10^4

Boron Recycle System

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a. Mixed Bed
b. Anion Bed

WOLF CREEK GENERATING STATION
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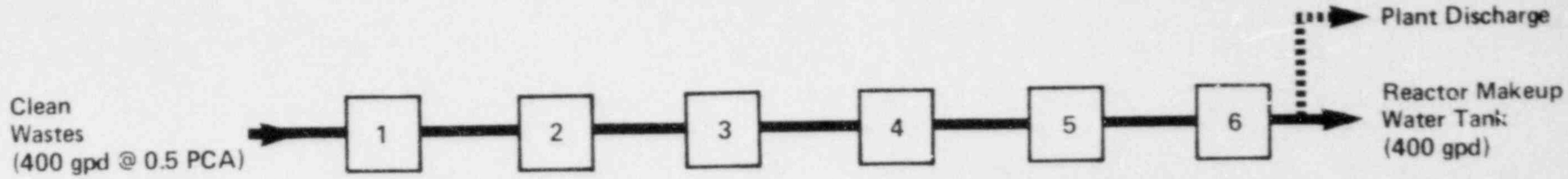
Figure 3A-2
(Sheet 2)

System Decontamination Factors



		DECONTAMINATION FACTORS		
		Iodine	Cesium & Rubidium	Other Nuclides
1.	Waste Holdup Tank			
2.	Waste Evaporator Feed Filter	1	1	1
3.	Waste Evaporator	10^3	10^4	10^4
4.	Liquid Waste Charcoal Adsorber	1	1	1
5.	Waste Evaporator Condensate Demineralizer	10	10	10
6.	Waste Evaporator Condensate Filter	1	1	1
	System DF	10^4	10^5	10^5

Liquid Radwaste
Train "A" - Clear Waste

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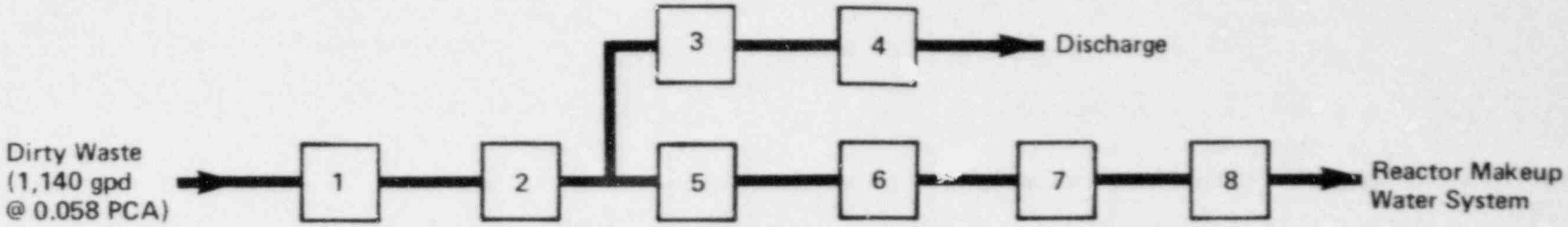
Figure 3A-2
(Sheet 3)

System Decontamination Factors



DECONTAMINATION FACTORS

		Iodine	Cesium & Rubidium	Other Nuclides
1.	Floor Drain Tank	—	—	—
2.	Floor Drain Tank Filter	1	1	1
3.	Waste Monitor Tank Demineralizer [(a)]	—	—	—
4.	Waste Monitor Tank Filter [(a)]	1	1	1
5.	Waste Evaporator [(b)]	10^3	10^4	10^4
6.	Liquid Waste Charcoal Adsorber	1	1	1
7.	Waste Evaporator Condensate Demineralizer	10	10	10
8.	Waste Evaporator Condensate Filter	1	1	1
	System DF [(c)]	10^4	10^5	10^5

Liquid Radwaste
Train "B" - Dirty Waste

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Figure 3A-2
(Sheet 4)

System Decontamination Factors

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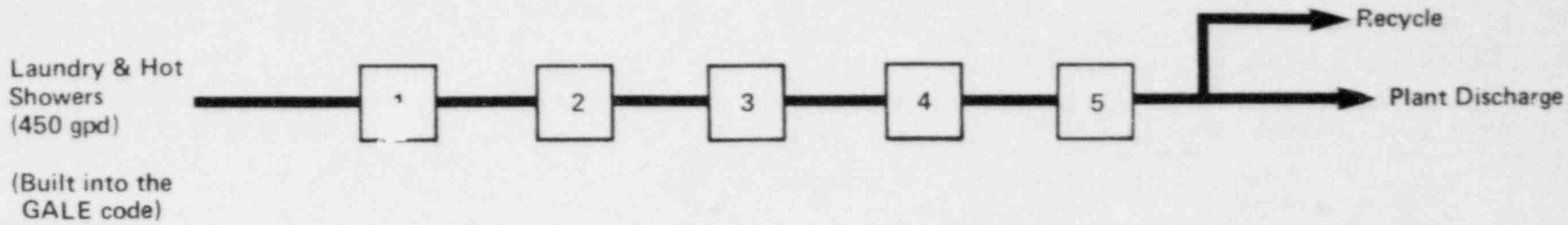
a) Used only when influent activity < 10^{-5} μCi/cc
b) Used when influent activity ≥ 10^{-5} μCi/cc
c) Assumes evaporator path



DECONTAMINATION FACTORS

		Iodine	Cesium & Rubidium	Other Nuclides
1.	Laundry and Hot Shower Tank			
2.	Laundry and Hot Shower Filter	1	1	1
3.	Laundry and Hot Shower Reverse Osmosis	10	10	10
4.	Laundry and Hot Shower Charcoal Adsorber	1	1	1
5.	Laundry and Hot Shower Storage Tank			
	System DF	10	10	10

Liquid Radwaste -
Laundry Train

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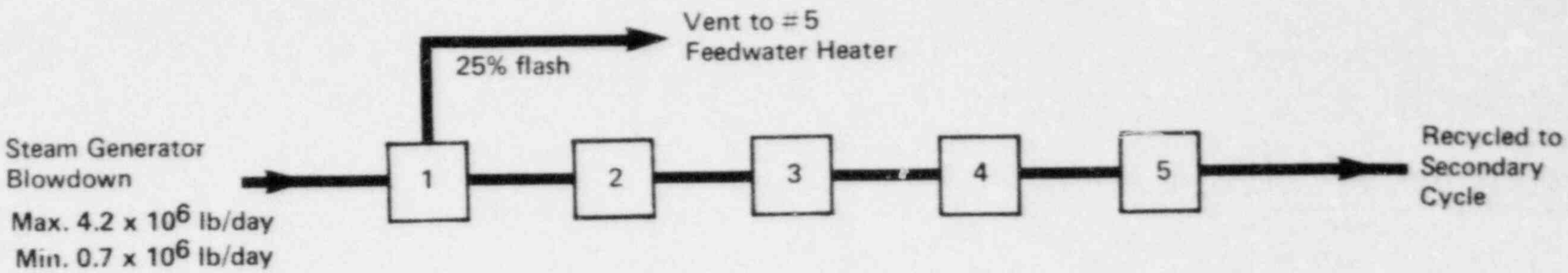
Figure 3A-2
(Sheet 5)

System Decontamination Factors



DECONTAMINATION FACTORS

		Iodine	Cesium & Rubidium	Other Nuclides
1.	Steam Generator Blowdown Flashtank	—	—	—
2.	Steam Generator Blowdown Regenerative Heat Exchanger	—	—	—
3.	S.G. Blowdown Nonregenerative Heat Exchanger	—	—	—
4.	S.G. Blowdown Filters	1	1	1
5.	S.G. Blowdown Demineralizers	10^2(10)	10(10)	10^2(10)
	System DF	10^3	10^2	10^3

Steam Generator
Blowdown

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Figure 3A-2
(Sheet 6)

System Decontamination Factors

TABLE OF CONTENTS

CHAPTER 5.0

ENVIRONMENTAL EFFECTS OF STATION OPERATION

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LIST OF FIGURES

to dissipate the excess heat (1.29 F). The Kansas Water Quality Criteria for absolute temperature is also met, as illustrated on Figures 5.1-1 and 5.1-2, since the blowdown temperature is calculated to be cooler than the river during the warm months of the year and elevates the river temperature to less than 90 F.

Since the monthly Neosho River flow varies substantially from year to year, monitoring the Neosho River flow and temperature and regulating the blowdown flow are used to ensure that the Kansas Water Quality Criteria are not exceeded during any operating conditions.

5.1.2.5 Conclusion

The Wolf Creek blowdown complies with the Kansas Water Quality Criteria under all conditions. During post-drought conditions with a maximum blowdown of 40 cfs for one- and two-unit operation, the monthly average blowdown temperature difference between the blowdown and the natural Neosho River temperature at the confluence of Wolf Creek and the Neosho River is sufficiently small that (1) the resultant river temperature is less than 90 F and (2) the increase in temperature is less than 5 F except during February when both units are operating at 88.5 percent average annual load factor. A negligible mixing zone may be required during this February discharge condition to comply with the Kansas Water Quality Criteria.

5.1.3 BIOLOGICAL EFFECTS

5.1.3.1 Introduction

The effects of station operation on aquatic biota in the vicinity of the WCGS site were discussed in Section 5.1 of the Environmental Report Construction Permit State (ER(CPS)). That discussion was based on the limited amount of baseline data available then and projected cooling lake inundation effects based on that limited data. Substantially more biological data are available now from our aquatic ecology monitoring programs (Section 2.2.2) to evaluate what biota will inhabit the cooling lake. The effects of station operation discussed in Section 5.1 of the ER (CPS) were reexamined because the cooling lake temperature distributions presented in Section 3.4.4 of this report vary from temperatures presented in the ER (CPS). The new temperature distributions resulted from higher plant capacity factors used in Sargent & Lundy's LAKET computer program (Section 3.4.4).

The following sections discuss the effects of various operational features of the heat dissipation system on aquatic biota in the cooling lake, Wolf Creek, and the Neosho River. The effects of biocide and chemical discharges are discussed in Section 5.3. The discussions are based on current literature and available information on the biological composition of the cooling lake, Wolf Creek, and the Neosho River.

5.1.3.2 Effects of Released Heat

5.1.3.2.1 Cooling Lake

The cooling lake will have an area of 5,090 acres of which 4,330 acres will be thermally altered. Temperatures at the plant inlet, discharge, and at various locations in the cooling lake are discussed in Section 3.4. The predicted temperatures represent a range from the maximum to 50 percentile occurrence. Maximum temperatures will occur less than 1 percent of the time, or on an average of approximately four days per year, and are not indicative of normal conditions in the cooling lake. Fifty percentile, or median temperatures approximate what may actually be observed. The following discussions were based on two temperature values, those at the 50 percentile level, as indicative of average conditions in the cooling lake, and maximum temperatures, as worst case.

The cooling lake should provide suitable habitat for aquatic biota during operation of WCGS. An area near the immediate discharge zone will be most affected by thermal input since the predicted 1 percentile temperatures during spring, summer, and fall (104.1 - 116.5 F) will exclude most aquatic organisms. The extent of the area/volume of the cooling lake affected by the thermal input will vary depending on meteorological factors (Section 3.4). Thermal stratification in the cooling lake to dissipate the excess heat (1.29 F). The Kansas Water Quality Criteria for absolute temperature is also met, as illustrated on Figures 5.1-1 and 5.1-2, since the blowdown temperature is calculated to be cooler than the river during the warm months of the year and elevates the river temperature to less than 90 F.

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5.2 RADIOLOGICAL IMPACT FROM ROUTINE OPERATION

Normal operation of the Wolf Creek Generating Station (WCGS) will result in the release of only very low level liquid and gaseous radioactive discharges. In order to evaluate any potential impact from these releases, the dose contribution of the radioactive materials in the environment was predicted on the basis of terrestrial and aquatic pathways discussed in this section and in Sections 5.2 and 5.3 of the Environmental Report-Construction Permit Stage (ER(CPS)). In summary, negligible radiological impact is expected on man and the aquatic biota or terrestrial mammals as a result of the quantity of radionuclides to be released from the WCGS.

A detailed discussion of important dose pathways and resultant exposure rates was presented in Sections 5.2 and 5.3 of the ER(CPS) and is updated below. An update of this section was necessitated to reevaluate the potential impact from liquid and gaseous radioactive effluent discharges using the NRC computer codes GASPAR and LADTAP II. This update is based on a full three years of meteorological data collected at WCGS and a revised set of liquid source terms which are being incorporated into Section 3.5 at this time. The NRC computer codes used in this revision are based on the methods and models outlined in Regulatory Guides 1.109, 1.111 and 1.113.

5.2.1 EXPOSURE PATHWAYS

5.2.1.1 Exposure Pathways for Radiation Exposure of Biota Other Than Man

Dose rate estimates to biota as herein presented should be considered extremely conservative since they are predicated on the following assumptions:

1. Liquid discharges are diluted only by the circulating cooling water. No credit was taken for further reduction of radionuclide concentrations in the cooling lake;

2. Buildup of the radionuclides in the cooling lake over the period of the life of the plant;

3. Aquatic organisms are continuously submerged at the point of discharge to the cooling lake;

4. Predatory species obtain their entire diet from primary organisms in equilibrium with water at effluent concentrations.

Liquid and gaseous releases will result in radiation doses to aquatic and terrestrial biota through pathways summarized in Figure 5.2-1. Many of the pathways of exposure for biota are similar to those for man. These pathways include ingestion of water and aquatic foods, submersion in air, immersion in water and exposure to sediments and shorelines. Other pathways such as inhalation and direct radiation from air deposition of radionuclides on soils are not considered significant for inclusion in the total dose to such organisms. Pathways of exposure from liquid effluents are generally the most significant contributors to radiation dose to organisms other than man. Because aquatic organisms can actively concentrate some radionuclides, these food chain components are potentially the most important contributors to radiation dose to terrestrial animals. The impact through the food chain pathway is expected to reach a maximum in predatory species such as muskrats, raccoons and herons which could conceivably obtain their total diet from aquatic organisms in equilibrium with water at effluent concentrations. The dose rate estimates for biota other than man are discussed in Section 5.2.3.

5.2.1.2 Exposure Pathways to Man

Radioactive effluents from the WCGS will become distributed throughout the terrestrial ecosystem by dispersion of gaseous releases, deposition of radioactive particulates and dilution of liquid radioactive discharges. Liquid and gaseous releases will result in radiation doses to man through pathways summarized in Figure 5.2-2.

Gaseous exposure pathways to man include:

1. Submersion in the cloud of gaseous effluents;
2. Inhalation of gaseous effluents;
3. Direct radiation exposure from radionuclide deposition on vegetation, soil and exposed surfaces; and
4. Ingestion of contaminated food chain components.

The annual individual dose from noble gases was evaluated in each of the 16 directional sectors around the plant at the Exclusion-Restricted Area Boundary (.75 miles), to evaluate cloud submersion and air dose from beta and gamma radiations. Also the calculated population dose rates from submersion in gaseous effluents were evaluated within a 50 mile radius of the plant. Radioactive iodine and particulate gaseous pathway doses were evaluated for a hypothetical worst case and for the controlling existing resident in the prevailing X/Q sector which is north. The hypothetical worst case assumes a resident lives in the north sector at the Exclusion-Restricted Area Boundary (.75 miles) with members of each age group present and all pathways present. The controlling existing resident lives 1.4 miles north of the plant and was evaluated as the maximum existing case. The dose rate estimates for man are presented in Section 5.2.4.

Liquid exposure pathways to man include:

1. Internal exposure from ingestion of water or contaminated food chain components;

2. External exposure from contaminated water or shoreline sediment.

Dose rate estimates to maximum individuals from liquid effluent concentrations were evaluated at the circulating water discharge point.

Water is not available for public consumption at the plant site and no population or individual exposure is expected from this pathway. Although recreational uses of the cooling lake are not planned it is conservatively assumed that individual exposures from swimming, boating, fishing or ingestion of fish could result.

Discharge water concentrations, bioaccumulation factors, and ingestion rates were used to estimate internal dose rates. Although such activities may not be allowed on the lake, external dose rates were estimated for individuals boating or swimming in the vicinity of the discharge. The exposure rate from contaminated shoreline sediments was also calculated.

Evaluation of each pathway is based on maximizing conditions. No credit was taken for dilution of the effluents in the cooling lake; buildup of the radionuclides in the lake over the life of the plant is assumed; all interactions are assumed to occur with radionuclide concentrations as they will occur at the point of discharge. Aquatic food chain elements are assumed to be in equilibrium with discharge concentrations prior to consumption. Since any swimming, boating, or fishing activities, if allowed, would be expected to be conducted in places in the cooling lake other than at the discharge point, evaluation of this pathway provides an upper estimate of the potential dose.

Dose rate estimates to maximum individuals and the population of the town of Le Roy were also evaluated for exposure from liquid effluent concentrations.

Important aquatic pathways for consideration are summarized in Figure 5.2-2.

5.2.2 RADIOACTIVITY IN THE ENVIRONMENT

Estimated gaseous and liquid effluents from the WCGS are presented in Section 3.5.

On-site meteorological data collected over three full years was used to predict gaseous effluent distribution in the environment. Both the PUFF and straight-line Gaussian dispersion models, described in Regulatory Guide 1.111, were used for determination of ground level and mixed mode annual average diffusion estimates. Resultant CHI/Q values are summarized for each sector in Table 5.2-1. For estimation of effluent dispersion a combination of both a mixed mode and ground-level release was assumed. The meteorological data indicates that maximum concentrations would be expected to occur in the north sector. Gaseous dose calculations were done using GASPAR computer code. Dose calculation models used in GASPAR are outlined in Regulatory Guides 1.109 and 1.111. Assumptions used were either site specific or default values taken from the Regulatory Guides. These assumptions are presented in Appendix 5A.

Liquid dose calculations were done using LADTAP II computer code. Dose calculation models used in LADTAP II are outlined in Regulatory Guides 1.109 and 1.113 for doses to man and USAEC Report WASH-1258 for doses to biota other than man. Site specific values were used when available. Default values used were either recommended in Regulatory Guide 1.109 or taken from HERMES USAEC Report HEDL-TME-71-168. The assumptions used in LADTAP II are presented in Appendix 5A.

Liquid radioactive releases will be diluted by cooling water with a flow rate of 1114 cfs and service water with a flow rate of 90 cfs for a total discharge of 1204 cfs. This is the only dilution assumed for dose calculations to the maximum individual interacting with the cooling lake environment. Buildup or reconcentration of the radionuclides in the cooling lake and at the circulating water discharge is taken into consideration over a 40 year plant life expectancy. The last five of these years are considered to be during a drought. The model used for calculating buildup of the radionuclides in the lake is presented in Appendix 5A. The models were taken from Regulatory Guide 1.113 and USEPA EPA-520 Radionuclide Accumulation in a Reactor Cooling Lake. The town of Le Roy, Kansas, is the nearest downstream water user intake from WCGS. Dose rates to an individual residing in Le Roy and to the population at Le Roy have been evaluated. These dose rates take into consideration a 40 year buildup of radionuclides in the lake and then a further dilution in the Neosho River. No credit is taken for the radionuclides decay during transition from the lake to

Le Roy. Estimated radionuclide concentrations in the effluent water at the discharge to the cooling lake and at Le Roy are listed in Table 5.2-2. Bioaccumulation factors used to predict uptake of radionuclides by fish and invertebrates are listed in Table 5.2-3.

5.2.3 DOSE RATE ESTIMATES FOR BIOTA OTHER THAN MAN

The pathways for radiation exposure of biota other than man were discussed in Section 5.2.1.1. For calculation of these dose rates it was assumed that aquatic organisms and terrestrial species live at the circulating water discharge point. Buildup of radionuclides was considered over the 40 year plant life. All food consumed has been grown or has lived in the liquid effluent at discharge concentrations. Internal and external dose rates to biota are summarized in Table 5.2-4. The primary aquatic organism, fish, receive an estimated maximum internal exposure of 13.6 mrad/yr and a maximum external exposure of 9.41 mrad/yr. The muskrat is a terrestrial animal which could receive an estimated maximum internal exposure of 51.6 mrad/yr and a maximum external exposure of 6.42 mrad/yr.

According to information presented in USAEC report WASH-1258 doses to biota at WCGS are well within expected annual doses when assuming the organisms live at the discharge point in effluent concentrations.

While these doses may be experienced by a few organisms which live at the discharge point of the station, the doses received by an entire population of aquatic or terrestrial organisms would be significantly less.

5.2.4 DOSE RATE ESTIMATES FOR MAN

5.2.4.1 Liquid Pathways

Radionuclide concentrations in the discharge water were calculated based on a total discharge of 1204 cfs. Release rates and resultant radionuclide concentrations are listed in Table 5.2-2. Dose rate estimates to maximum individuals from liquid effluent concentrations were evaluated at the circulating water discharge point. No credit was taken for dilution of the effluents in the cooling lake; buildup of the radionuclides in the lake over a 40 year life expectancy are assumed to occur with radionuclide concentrations as they will occur at the discharge point. Pathways to man are discussed in Section 5.2.1.2. Assumptions used in dose calculations are given in Appendix 5A.

Dose rate estimates were calculated for maximum individuals and to the population residing at Le Roy. No credit was taken for the radionuclides decay during transition between discharge from the lake and Le Roy.

Dose rates to maximum individuals from liquid effluents are listed in Tables 5.2-5 and 5.2-6. Population doses at Le Roy are listed in Table 5.2-7.

The maximum organ and total body doses to individuals residing in Le Roy were calculated to be 1.96E-001 mrem/yr to the liver of a child and 1.49E-001 mrem/yr to the total body of an adult, Table 5.2-5. The most significant internal doses will be from eating fish (1.29E-001 mrem/yr to the liver of a teenager and 8.92E-002 mrem/yr to the total body of an adult). The most significant external dose rate will be to the skin of a teenager from exposure to radionuclide deposits in shoreline sediments 5.19E-004 mrem/yr.

Estimated dose from liquid effluents to the population of Le Roy are presented in Table 5.2-7.

The maximum organ and total body doses to individuals at the circulating water discharge point were calculated to be 4.27 mrem/yr to the liver of a teenager and 2.95 mrem/yr to the total body of an adult, Table 5.2-6. The most significant internal doses will be from eating fish (4.19 mrem/yr to the liver of a teenager and 2.90 mrem/yr to the total body of an adult). The most significant external dose rate will be to the skin of a teenager from exposure to radionuclide deposits in shoreline sediments 2.52E-002 mrem/yr.

5.2.4.2 Gaseous Pathways

The doses from gaseous effluents were calculated assuming intermittent purge operation. Intermittent purge mode release rates were taken from Table 3.5-3. The values of the dispersion and deposition coefficients, X/Q (non-decayed), X/Q (depleted and non-decayed) and D/Q used in the calculations are listed in Table 5.2-1.

The north sector was determined to be the prevailing X/Q sector for calculating annual dose from noble gases as well as from particulates and iodines. Exposure pathways to man are discussed in Section 5.2.1.2. Assumptions used in these dose calculations are given in Appendix 5A.

The annual doses due to normal gaseous effluents from WCGS are listed in Tables 5.2-9a, b and 5.2-10. Doses attributable to radioactive iodines and particulates at the controlling sector Exclusion-Restricted Area Boundary are contained within Table 5.2-9a (Hypothetical Worst Case). Doses from iodines and particulates at the controlling residence are contained within Table 5.2-9b (Controlling Existing Resident). Table 5.2-10 contains doses from noble gases at the Exclusion-Restricted Area Boundary.

Results of noble gas calculations at the Exclusion-Restricted Area Boundary (.75 miles) show the cloud submersion dose to the total body to be 2.2E-002 mrem/yr and 7.24E-002 mrem/yr to the skin in the north sector. The air dose resulted in exposure rates of 3.55E-002 mrad/yr gamma and 1.00E-001 mrad/yr from beta.

Doses attributable to radioactive particulates and iodines were evaluated at the north sector Exclusion-Restricted Area Boundary. A hypothetical worst case assumed members of each age group were present and all pathways were present at the boundary. Members of each age group were assumed to ingest goat milk rather than cow milk to consider the worst case milk ingestion pathway. The maximum organ and total body dose was 6.51 mrem/yr to the thyroid of an infant and 4.66E-001 mrem/yr to the total body of a child. Doses attributable to the actual controlling existing resident (1.4 miles north sector) for the maximum organ and total body dose were 3.07 mrem/yr to an infants thyroid and 1.94E-001 to the total body of an adult.

Calculated population dose rates from submersion in gaseous effluents were predicted based on the population in the year 2000 The results of these calculations are presented in Table 5.2-8.

5.2.4.3 Direct Radiation From Facility

This subject was discussed in Section 5.3.4 of the ER(CPS). Although the source strengths involved have changed slightly, the conclusion reached-that negligible annual population exposure would be received in direct radiation from WCGS-has not changed.

5.2.4.4 Annual Population Doses

Population dose rates at radial distances are summarized in Table 5.2-8. From these calculations, the average person within 50 miles of the site would receive an annual dose of 2.9×10^{-4} mrem. The actual doses would be much lower due to shielding effects of housing.

5.2.5 SUMMARY OF ANNUAL RADIATION DOSES

The design of the WCGS will assure that gaseous and liquid effluent concentrations are within the guidelines stated in 10 CFR 20. During reactor operation, actual radionuclide concentrations in the environment will be determined by continuous environmental monitoring.

A series of previously discussed tables from Sections 5.2.3 and 5.2.4 estimate individual, population and biota annual doses from liquid and gaseous effluents. A brief summary of calculated total body and thyroid dose rates from liquid and gaseous effluents is presented in Table 5.2-11 for maximum individual exposures and population exposures.

The exposure pathways considered for calculation of doses to man and biota are outlined in Sections 5.2.1.1 and 5.2.1.2.

A conformance summary with 10 CFR 50, Appendix I, is outlined in Table 5.2-12.

5.2.6 REFERENCES

Attachment to Concluding Statement of Position of the Regulatory Staff. Public Rule-making Hearing on: Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low As Practicable" for Radioactive Material in Light-Water-Cooled Nuclear Power Stations, USAEC, Docket No. RM-50-2, February 20, 1974.

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Fletcher, J. F., and Dotson, W. L. (compilers), HERMES-A Digital Computer Code for Estimating Regional Radiological Effects from the Nuclear Power Industry, USAEC Report HEDL-TME-71-168, Hanford Engineering Development Laboratory, 1971.

Lyon, R. J., Shearin, R. L., 1976, EPA-520 Radionuclide Accumulation in a Reactor Cooling Lake: USEPA, Office of Radiation Programs.

Regulatory Guide 1.109, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50, Appendix I, Office of Standards Development.

Regulatory Guide 1.111, Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors, Office of Standards Development.

Regulatory Guide 1.113, Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I, Office of Standards Development.

Simpson, D. B., McGill, B. L., 1980, NUREG/CR-1276 User's Manual for LADTAP II Computer Program: U.S.N.R.C. and Oak Ridge National Laboratory.

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TABLE 5.2-1 Sheet 1 of 3

AVERAGE METEOROLOGICAL RELATIVE CONCENTRATION ANALYSIS

Data Period 3 years:
(6/1/73 - 5/31/75,
3/5/79 - 3/4/80)

Dames and Moore 7699-062-07
7/12/80 (Ground)
7/19/80 (Mixed Mode)

Sector	Nearest Plant Boundary	MIXED MODE X/Q Rel.	MIXED MODE X/Q Depl.	MIXED MODE X/Q Depos.	GROUND X/Q Rel.	GROUND X/Q Depl.	GROUND X/Q Depos.
NNE	1.1	2.8E-07	2.5E-07	4.1E-09	5.9E-07	5.1E-07	5.1E-09
NE	1.3	9.3E-08	8.2E-08	1.1E-09	2.4E-07	2.0E-07	1.5E-09
ENE	1.5	5.4E-08	4.8E-08	4.3E-10	1.7E-07	1.5E-07	7.3E-10
E	1.2	8.0E-08	7.1E-08	7.5E-10	2.8E-07	2.4E-07	1.4E-09
ESE	1.2	1.2E-07	1.1E-07	1.1E-09	3.3E-07	2.9E-07	1.7E-09
SE	1.2	1.5E-07	1.3E-07	1.6E-09	3.8E-07	3.3E-07	2.3E-09
SSE	3.0	4.8E-08	4.0E-08	4.7E-10	1.0E-07	7.9E-08	6.3E-10
S	3.3	4.6E-08	3.8E-08	3.9E-10	8.5E-08	6.6E-08	4.9E-10
SSW	1.7	1.0E-07	8.9E-08	1.0E-09	2.5E-07	2.1E-07	1.5E-09
SW	1.5	8.1E-08	7.2E-08	6.3E-10	2.5E-07	2.1E-07	1.2E-09
WSW	1.5	8.3E-08	7.3E-08	6.5E-10	2.6E-07	2.2E-07	1.2E-09
W	1.8	9.0E-08	7.8E-08	5.9E-10	2.3E-07	1.9E-07	1.0E-09
WNW	2.1	7.5E-08	6.4E-08	4.9E-10	1.8E-07	1.5E-07	8.5E-10
NW	2.6	8.5E-08	7.0E-08	4.1E-10	2.0E-07	1.5E-07	7.0E-10
NNW	1.5	2.5E-07	2.1E-07	1.6E-09	6.3E-07	5.3E-07	3.0E-09
N	1.1	5.6E-07	4.9E-07	6.4E-09	1.0E-06	8.8E-07	8.0E-09
	Nearest Residence						
NNE	3.1*	7.9E-08	6.6E-08	7.7E-10	1.4E-07	1.1E-07	9.3E-10
NE	1.8	5.8E-08	5.0E-08	6.1E-10	1.5E-07	1.2E-07	8.6E-10
ENE	2.0	3.7E-08	3.2E-08	2.7E-10	1.1E-07	9.0E-08	4.3E-10
E	1.8	4.7E-08	4.1E-08	3.9E-10	1.6E-07	1.3E-07	7.1E-10
ESE	1.7*	9.4E-08	8.1E-08	7.7E-10	2.4E-07	2.0E-07	1.2E-09
SE	1.4	1.1E-07	9.8E-08	1.2E-09	3.1E-07	2.6E-07	1.8E-09
SSE	3.0	4.8E-08	4.0E-08	4.7E-10	1.0E-07	7.9E-08	6.3E-10
S	3.5	4.3E-08	3.5E-08	3.5E-10	7.8E-08	6.1E-08	4.4E-10
SSW	2.5*	6.2E-08	5.3E-08	5.3E-10	1.5E-07	1.2E-07	7.6E-10
SW	2.1	5.0E-08	4.4E-08	3.5E-10	1.5E-07	1.2E-07	6.5E-10
WSW	2.7*	5.3E-08	5.5E-08	3.4E-10	1.6E-07	1.3E-07	7.3E-10
W	2.2	7.3E-08	6.2E-08	4.5E-10	1.7E-07	1.4E-07	7.1E-10
WNW	2.9	5.2E-08	4.4E-08	3.0E-10	1.2E-07	9.2E-08	4.8E-10
NW	1.3*	2.9E-07	3.3E-07	1.9E-09	8.3E-07	7.3E-07	3.7E-09
NNW	2.2*	1.7E-07	1.9E-07	1.0E-09	4.3E-07	3.6E-07	1.9E-09
N	1.4	4.1E-07	3.5E-07	4.4E-09	7.3E-07	6.2E-07	5.5E-09
	Nearest Veg. Garden						
NNE	3.6*	6.3E-08	5.2E-08	5.7E-10	1.2E-07	9.2E-08	7.6E-10
NE	2.1*	5.1E-08	4.4E-08	5.1E-10	1.3E-07	1.0E-07	7.3E-10
ENE	2.2*	3.8E-08	3.3E-08	2.7E-10	1.1E-07	9.2E-08	4.4E-10
E	1.8	4.7E-08	4.1E-08	3.9E-10	1.6E-07	1.3E-07	7.1E-10
ESE	1.7*	9.4E-08	8.1E-08	7.7E-10	2.4E-07	2.0E-07	1.2E-09
SE	1.4	1.1E-07	9.8E-08	1.2E-09	3.1E-07	2.6E-07	1.8E-09
SSE	3.2*	4.8E-08	4.0E-08	4.7E-10	1.0E-07	8.0E-08	6.4E-10
S	3.5	4.3E-08	3.5E-08	3.5E-10	7.8E-08	6.1E-08	4.4E-10
SSW	4.6*	2.5E-08	2.0E-08	1.7E-10	6.2E-08	4.6E-08	2.6E-10
SW	3.0*	3.3E-08	2.8E-08	1.9E-10	8.9E-08	7.0E-08	3.5E-10
WSW	2.7*	5.3E-08	5.5E-08	3.4E-10	1.4E-07	1.1E-07	5.8E-10
W	2.2	7.3E-08	6.2E-08	4.5E-10	1.7E-07	1.4E-07	7.1E-10
WNW	2.9	5.2E-08	4.4E-08	3.0E-10	1.2E-07	9.2E-08	4.8E-10
NW	1.4*	2.9E-07	3.3E-07	1.9E-09	8.3E-07	7.3E-07	3.7E-09
NNW	2.2	1.5E-07	1.3E-07	8.4E-10	3.8E-07	3.1E-07	1.6E-09
N	1.4	4.1E-07	3.5E-07	4.4E-09	7.3E-07	6.2E-07	5.5E-09

* The closest conservative distance X/QS were used for these distances.

TABLE 5.2-1 Sheet 2 of 3

AVERAGE METEOROLOGICAL RELATIVE CONCENTRATION ANALYSIS

Data Period 3 years:
(6/1/73 - 5/31/75,
3/5/79 - 3/4/80)

Dames and Moore 7699-062-07
7/12/80 (Ground)
7/19/80 (Mixed Mode)

Sector	Exclusion-Restricted Area Boundary	MIXED MODE X/Q Rel.	MIXED MODE X/Q Depl.	MIXED MODE X/Q Depos.	GROUND X/Q Rel.	GROUND X/Q Depl.	GROUND X/Q Depos.
NNE	.75	4.7E-07	4.2E-07	7.5E-09	1.0E-06	8.9E-07	9.1E-09
NE	.75	1.9E-07	1.7E-07	2.8E-09	5.2E-07	4.7E-07	3.6E-09
ENE	.75	9.2E-08	8.3E-08	8.6E-10	4.5E-07	4.0E-07	2.1E-09
E	.75	1.6E-07	1.5E-07	1.6E-09	5.8E-07	5.2E-07	3.0E-09
ESE	.75	2.2E-07	2.0E-07	2.1E-09	7.1E-07	6.4E-07	3.8E-09
SE	.75	2.5E-07	2.3E-07	3.0E-09	7.5E-07	6.6E-07	4.7E-09
SSE	.75	2.9E-07	2.6E-07	4.2E-09	7.6E-07	6.8E-07	6.3E-09
S	.75	3.4E-07	3.0E-07	4.4E-09	7.5E-07	6.7E-07	5.8E-09
SSW	.75	2.9E-07	2.6E-07	3.4E-09	8.4E-07	7.5E-07	5.4E-09
SW	.75	2.2E-07	2.0E-07	2.0E-09	7.0E-07	6.2E-07	3.7E-09
WSW	.75	2.0E-07	1.8E-07	1.8E-09	8.0E-07	7.1E-07	4.2E-09
W	.75	3.0E-07	2.7E-07	2.4E-09	1.0E-06	9.0E-07	5.2E-09
WNW	.75	2.5E-07	2.2E-07	2.1E-09	7.6E-07	6.8E-07	4.2E-09
NW	.75	4.2E-07	3.8E-07	2.8E-09	1.3E-06	1.2E-06	5.9E-09
NNW	.75	6.2E-07	5.5E-07	4.4E-09	1.8E-06	1.6E-06	9.7E-09
N	.75	9.2E-07	8.2E-07	1.1E-08	1.9E-06	1.7E-06	1.6E-08
	L.P. Zone						
NNE	2.5	1.0E-07	8.6E-08	1.1E-09	1.8E-07	1.5E-07	1.3E-09
NE	2.5	3.6E-08	3.1E-08	3.2E-10	8.5E-08	6.8E-08	4.6E-10
ENE	2.5	2.8E-08	2.4E-08	1.8E-10	7.8E-08	6.2E-08	2.8E-10
E	2.5	3.3E-08	2.8E-08	2.3E-10	9.6E-08	7.7E-08	4.0E-10
ESE	2.5	4.8E-08	4.0E-08	3.3E-10	1.3E-07	1.0E-07	5.3E-10
SE	2.5	6.0E-08	5.0E-08	5.2E-10	1.3E-07	1.0E-07	6.3E-10
SSE	2.5	6.1E-08	5.1E-08	6.4E-10	1.4E-07	1.1E-07	9.3E-10
S	2.5	6.4E-08	5.4E-08	6.1E-10	1.3E-07	1.0E-07	7.9E-10
SSW	2.5	6.1E-08	5.2E-08	5.2E-10	1.5E-07	1.2E-07	7.9E-10
SW	2.5	3.9E-08	3.4E-08	2.5E-10	1.2E-07	9.4E-08	4.9E-10
WSW	2.5	5.2E-08	4.4E-08	3.4E-10	1.4E-07	1.1E-07	5.7E-10
W	2.5	6.4E-08	5.4E-08	3.7E-10	1.4E-07	1.1E-07	5.5E-10
WNW	2.5	6.0E-08	5.0E-08	3.7E-10	1.5E-07	1.2E-07	6.4E-10
NW	2.5	9.0E-08	7.5E-08	4.4E-10	2.1E-07	1.7E-07	7.5E-10
NNW	2.5	1.3E-07	1.1E-07	6.8E-10	3.2E-07	2.6E-07	1.3E-09
N	2.5	1.9E-07	1.6E-07	1.6E-09	3.2E-07	2.6E-07	2.1E-09
	Nearest Meat Animal						
NNE	.8	4.3E-07	3.9E-07	6.8E-09	9.1E-07	8.1E-07	8.2E-09
NE	.8	1.7E-07	1.5E-07	2.4E-09	4.8E-07	4.3E-07	3.3E-09
ENE	.8	9.5E-08	8.5E-08	8.8E-10	4.1E-07	3.6E-07	1.9E-09
E	1.2	8.0E-08	7.1E-08	7.5E-10	2.8E-07	2.4E-07	1.4E-09
ESE	1.2	1.2E-07	1.1E-07	1.1E-09	3.3E-07	2.9E-07	1.7E-09
SE	1.2	1.5E-07	1.3E-07	1.6E-09	3.8E-07	3.3E-07	2.3E-09
SSE	3.2	4.5E-08	3.7E-08	4.2E-10	9.3E-08	7.2E-08	5.7E-10
S	3.3	4.6E-08	3.8E-08	3.9E-10	8.5E-08	6.6E-08	4.9E-10
SSW	3.3	3.8E-08	3.2E-08	2.9E-10	1.1E-07	8.2E-08	5.0E-10
SW	1.6	7.4E-08	6.6E-08	5.6E-10	2.2E-07	1.8E-07	1.0E-09
WSW	1.5	8.3E-08	7.3E-08	6.5E-10	2.6E-07	2.2E-07	1.2E-09
W	1.7	9.5E-08	8.2E-08	6.4E-10	2.6E-07	2.2E-07	1.2E-09
WNW	3.0*	5.1E-08	5.2E-08	2.9E-10	1.1E-07	8.9E-08	4.6E-10
NW	2.3*	1.2E-07	1.3E-07	6.5E-10	3.0E-07	2.5E-07	1.1E-09
NNW	2.0	1.7E-07	1.4E-07	9.9E-10	4.3E-07	3.5E-07	1.9E-09
N	1.1	5.6E-07	4.9E-07	6.4E-09	1.0E-06	8.8E-07	8.0E-09

* The closest conservative distance X/QS were used for these distances.

TABLE 5.2-1 Sheet 3 of 3

AVERAGE METEOROLOGICAL RELATIVE CONCENTRATION ANALYSIS

Data Period 3 years:
(6/1/73 - 5/31/75,
3/5/79 - 3/4/80)

Dames and Moore 7699-062-07
7/12/80 (Ground)
7/19/80 (Mixed Mode)

		MIXED MODE			GROUND		
Sector	Nearest Dairy Goat	X/Q Rel.	X/Q Depl.	X/Q Depos.	X/Q Rel.	X/Q Depl.	X/Q Depos.
NNE	5.0	3.6E-08	2.9E-08	2.8E-10	6.7E-08	5.0E-08	3.8E-10
NE	5.0	1.6E-08	1.3E-08	9.6E-11	2.8E-08	2.0E-08	1.2E-10
ENE	5.0	9.0E-09	7.5E-09	4.0E-11	2.1E-08	1.5E-08	5.8E-11
E	5.0	1.4E-08	1.1E-08	7.0E-11	2.8E-08	2.0E-08	8.8E-11
ESE	5.0	1.8E-08	1.4E-08	9.0E-11	4.6E-08	3.4E-08	1.5E-10
SE	5.0	2.2E-08	1.7E-08	1.4E-10	4.0E-08	2.9E-08	1.5E-10
SSE	[illegible].0	2.2E-08	1.8E-08	1.8E-10	4.5E-08	3.4E-08	2.4E-10
S	5.0	2.9E-08	2.3E-08	2.1E-10	4.8E-08	3.5E-08	2.4E-10
SSW	5.0*	2.1E-08	1.7E-08	1.3E-10	5.1E-08	3.8E-08	2.1E-10
SW	5.0*	1.8E-08	1.5E-08	8.2E-11	4.3E-08	3.2E-08	1.4E-10
WSW	5.0	2.2E-08	1.8E-08	1.0E-10	5.2E-08	3.8E-08	1.7E-10
W	5.0	2.4E-08	1.9E-08	1.0E-10	5.7E-08	4.2E-08	1.8E-10
WNW	5.0	2.3E-08	1.8E-08	1.0E-10	5.5E-08	4.0E-08	1.8E-10
NW	5.0	3.4E-08	2.7E-08	1.2E-10	8.1E-08	6.0E-08	2.2E-10
NNW	5.0	6.1E-08	4.7E-08	2.4E-10	1.3E-07	9.4E-08	4.0E-10
N	5.0	7.4E-08	5.8E-08	4.9E-10	1.1E-07	8.2E-08	5.7E-10
[illegible]	1.1	5.[illegible]E-07	4.9E-07	6.4E-09	1.0E-06	8.8E-07	8.0E-09

Sector	Nearest Dairy Cow	X/Q Rel.	X/Q Depl.	X/Q Depos.	X/Q Rel.	X/Q Depl.	X/Q Depos.
NNE	4.7	3.9E-08	3.2E-08	3.2E-10	7.3E-08	5.5E-08	4.2E-10
NE	3.0*	2.8E-08	2.4E-08	2.3E-10	5.8E-08	4.6E-08	3.0E-10
ENE	5.0/None	9.0E-09	7.5E-09	4.0E-11	2.1E-08	1.5E-08	5.8E-11
E	1.8	4.7E-08	4.1E-08	3.9E-10	1.6E-07	1.3E-07	7.1E-10
ESE	1.3*	1.5E-07	1.4E-07	1.4E-09	4.5E-07	4.0E-07	2.3E-09
SE	1.2*	1.8E-07	1.6E-07	2.0E-09	5.0E-07	4.3E-07	3.1E-09
SSE	4.0*	3.3E-08	2.6E-08	2.8E-10	6.5E-08	5.0E-08	3.7E-10
S	5.0/None	2.9E-08	2.3E-08	2.1E-10	4.8E-08	3.5E-08	2.4E-10
SSW	5.0/None	2.1E-08	1.7E-08	1.4E-10	5.1E-[illegible]	3.8E-08	2.1E-10
SW	5.0*/None	1.8E-08	1.5E-08	8.2E-11	4.3E-08	[illegible].2E-08	1.4E-10
WSW	4.7	2.4E-08	2.0E-08	1.2E-10	5.7E-08	4.3E-08	1.9E-10
W	5.0/None	2.4E-08	1.9E-08	1.0E-10	5.7E-08	4.3E-08	1.8E-10
WNW	5.0/None	2.3E-08	1.8E-08	1.0E-10	5.5E-08	4.0E-08	1.8E-10
NW	3.5*	5.9E-08	6.0E-08	2.4E-10	1.3E-07	1.0E-07	4.2E-10
NNW	2.0*	1.7E-07	1.9E-07	1.0E-09	4.3E-07	3.6E-07	1.9E-09
N	5.0*/None	7.7E-08	6.1E-08	4.7E-10	1.1E-07	8.3E-08	5.8E-10
N	1.1	5.6E-07	4.9E-07	6.4E-09	1.0E-06	8.8E-07	8.0E-09

* The closest conservative distance X/QS were used for these distances.

TABLE 5.2-2

CALCULATED LIQUID EFFLUENT
DISCHARGE CONCENTRATIONS
FROM ROUTINE OPERATION

Isotope	Release Ci/yr	pCi/l Circulating Water[b]	Cooling Lake[c]	LeRoy[d]
H-3	4.10E+002	2.38E+004	2.34E+004	7.38E+002
Cr-51	7.00E-005	1.26E-004	6.09E-005	1.92E-006
Mn-54	1.10E-004	1.12E-003	1.01E-003	3.19E-005
Fe-55	6.00E-005	1.59E-003	1.53E-003	4.82E-005
Fe-59	4.00E-005	9.34E-005	5.62E-005	1.77E-006
Co-58	9.90E-004	3.11E-003	2.19E-003	6.91E-005
Co-60	9.40E-004	3.91E-002	3.82E-002	1.21E-003
Br-83	3.80E-004	3.53E-004	1.19E-006	3.76E-008
Mo-99	3.10E-003	3.17E-003	2.88E-004	9.09E-006
Tc-99M[a]	1.80E-003	1.69E-003	1.41E-005	4.45E-007
TE-129M	5.00E-005	9.95E-005	5.30E-005	1.67E-006
I-131	2.40E-002	2.84E-002	6.07E-003	1.92E-004
Te-132	9.80E-004	1.01E-003	9.94E-005	3.14E-006
I-132	7.90E-003	7.35E-003	2.37E-005	7.48E-007
I-133	3.20E-002	3.07E-002	8.78E-004	2.77E-005
Cs-134	9.80E-003	2.16E-001	2.07E-001	6.53E-003
I-135	1.60E-002	1.50E-002	1.40E-004	4.42E-006
Cs-136	4.40E-003	5.89E-003	1.79E-003	5.65E-005
Cs-137	8.50E-003	5.85E-001	5.77E-001	1.82E-002
Zr-95	1.40E-004	4.14E-004	2.84E-004	8.98E-006
Nb-95	2.00E-004	4.06E-004	2.20E-004	6.94E-006
Rb-86	3.00E-005	4.55E-005	1.76E-005	5.55E-007
Ru-103	2.00E-005	4.35E-005	2.49E-005	7.86E-007
Ru-106	2.40E-004	2.90E-003	2.68E-003	8.46E-005
Ag-110M	4.00E-005	3.46E-004	3.09E-004	9.75E-006
Ce-144	5.20E-004	4.98E-003	4.50E-003	1.42E-004
Br-84	2.00E-004	1.86E-004	1.39E-007	4.39E-009
Sr-89	1.00E-005	2.56E-005	1.63E-005	5.14E-007
Te-127M	1.00E-005	4.32E-005	3.39E-005	1.07E-006
Te-127	3.00E-005	2.82E-005	3.68E-007	1.16E-008
Te-129	6.00E-005	5.58E-005	8.99E-008	2.84E-009
I-130	1.80E-004	1.71E-004	2.93E-006	9.25E-008
Te-131M	9.00E-005	8.71E-005	3.53E-006	1.11E-007
Br-85	2.00E-005	1.86E-005	1.30E-009	4.10E-011
Rb-88	6.80E-002	6.33E-002	2.64E-005	8.33E-007
Sr-91	2.00E-005	1.88E-005	2.51E-007	7.92E-009
Y-91M	1.00E-005	9.30E-006	1.09E-008	3.44E-010
Te-131	4.00E-005	3.72E-005	2.18E-008	6.88E-010
I-134	3.70E-003	3.44E-003	4.27E-006	1.35E-007
All Others	3.00E-005	-	-	-

[a] M = metastable

[b] Based solely on dilution by the circulating water discharge and buildup of radionuclides over 40 year plant life.

[c] Based on dilution by the circulating water discharge and build-up of radionuclides in the cooling lake over 40 year plant life.

[d] Concentration of radionuclides at the LeRoy water works intake. Based on dilution by circulating water discharge and build-up of radionuclides in the cooling lake over 40 year plant life and additional dilution in the Neosho River.

TABLE 5.2-3

BIOACCUMULATION FACTORS*
(pCi/kg per pCi/liter)

ELEMENT	FRESHWATER FISH	FRESHWATER INVERTEBRATE	SALTWATER FISH	SALTWATER INVERTEBRATE
H	9.0E-01	9.0E-01	9.0E-01	9.3E-01
C	4.6E 03	9.1E 03	1.8E 03	1.4E 03
NA	1.0E 02	2.0E 02	6.7E-02	1.9E-01
P	1.0E 05	2.0E 04	2.9E 04	3.0E 04
CR	2.0E 02	2.0E 03	4.0E 02	2.0E 03
MN	4.0E 02	9.0E 04	5.5E 02	4.0E 02
FE	1.0E 02	3.2E 03	3.0E 03	2.0E 04
CO	5.0E 01	2.0E 02	1.0E 02	1.0E 03
NI	1.0E 02	1.0E 02	1.0E 02	2.5E 02
CU	5.0E 01	4.0E 02	6.7E 02	1.7E 03
ZN	2.0E 03	1.0E 04	2.0E 03	5.0E 04
BR	4.2E 02	3.3E 02	1.5E-02	3.1E 00
RB	2.0E 03	1.0E 03	8.3E 00	1.7E 01
SR	3.0E 01	1.0E 02	2.0E 00	2.0E 01
Y	2.5E 01	1.0E 03	2.5E 01	1.0E 03
ZR	3.3E 00	6.7E 00	2.0E 02	8.0E 01
NB	3.0E 04	1.0E 02	3.0E 04	1.0E 02
MO	1.0E 01	1.0E 01	1.0E 01	1.0E 01
TC	1.5E 01	5.0E 00	1.0E 01	5.0E 01
RU	1.0E 01	3.0E 02	3.0E 00	1.0E 03
RH	1.0E 01	3.0E 02	1.0E 01	2.0E 03
TE	4.0E 02	6.1E 03	1.0E 01	1.0E 02
I	1.5E 01	5.0E 00	1.0E 01	5.0E 01
CS	2.0E 03	1.0E 03	4.0E 01	2.5E 01
BA	4.0E 00	2.0E 02	1.0E 01	1.0E 02
LA	2.5E 01	1.0E 03	2.5E 01	1.0E 03
CE	1.0E 00	1.0E 03	1.0E 01	6.0E 02
PR	2.5E 01	1.0E 03	2.5E 01	1.0E 03
ND	2.5E 01	1.0E 03	2.5E 01	1.0E 03
W	1.2E 03	1.0E 01	3.0E 01	3.0E 01
NP	1.0E 01	4.0E 02	1.0E 01	1.0E 01

*Regulatory Guide 1.109

TABLE 5.2-4

MAXIMUM INTERNAL AND EXTERNAL DOSE RATES TO BIOTA OTHER THAN MAN AT THE CIRCULATING WATER DISCHARGE POINT

Biotic Type	Dose Rate (mrad/yr)		
Primary Organisms	Internal	External	Total
Fish	1.36E+001	9.41E+000	2.30E+001
Invertebrate	5.12E+000	1.88E+001	2.39E+001
Algae	5.72E+000	1.37E-002	5.73E+000
Secondary Organisms			
Muskrat	5.16E+001	6.42E+000	5.80E+001
Raccoon	2.80E+000	4.84E+000	7.64E+000
Heron	2.84E+002	6.41E+000	2.90E+002
Duck	4.64E+001	9.55E+000	5.60E+001

Assumes aquatic and terrestrial organisms and species live at the circulating water discharge point. Build-up of radionuclides is considered over the 40 year plant life. All food consumed is considered to be in equilibrium with water at effluent concentrations.

TABLE 5.2-5

ESTIMATED DOSE RATES TO MAXIMUM INDIVIDUALS FROM LIQUID EFFLUENTS RESIDING IN THE TOWN OF LEROY

MREM PER YEAR

ADULT

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
Fish		7.80-002	1.25-001	8.92-002	1.57-003	4.29-002	1.52-002	3.94-003
Invertebrate		9.47-004	1.90-003	1.42-003	3.63-004	9.36-004	5.13-004	9.29-004
Drinking		1.36-003	5.87-002	5.80-002	5.68-002	5.72-002	5.67-002	5.66-002
Shoreline	9.30-005	7.97-005	7.97-005	7.97-005	7.97-005	7.97-005	7.97-005	7.97-005
Swimming	.00	3.38-007	3.38-007	3.38-007	3.38-007	3.38-007	3.38-007	3.38-007
Boating	.00	1.13-006	1.13-006	1.13-006	1.13-006	1.13-006	1.13-006	1.13-006
Total	9.30-005	8.03-002	1.86-001	1.49-001	5.88-002	1.01-001	7.25-002	6.16-002

TEENAGER

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
Fish		8.27-002	1.29-001	5.05-002	1.23-003	4.37-002	1.76-002	2.98-003
Invertebrate		1.00-003	1.86-003	8.76-004	2.82-004	8.72-004	4.64-004	6.87-004
Drinking		1.32-003	4.1[illegible]-002	4.06-002	4.01-002	4.05-002	4.01-002	3.99-002
Shoreline	5.19-004	4.45-004	4.45-004	4.45-004	4.45-004	4.45-004	4.45-004	4.45-004
Swimming	.00	1.95-006	1.95-006	1.95-006	1.95-006	1.95-006	1.95-006	1.95-006
Boating	.00	1.13-006	1.13-006	1.13-006	1.13-006	1.13-006	1.13-006	1.13-006
Total	5.19-004	8.55-002	1.73-001	9.24-002	4.20-002	8.56-002	5.86-002	4.40-002

CHILD

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
Fish		1.03-001	1.14-001	1.99-002	1.03-003	3.73-002	1.4[illegible]-002	1.65-003
Invertebrate		1.30-003	1.69-003	4.88-004	2.46-004	7.65-004	3.91-004	3.84-004
Drinking		3.82-003	8.05-002	7.70-002	7.69-002	7.77-002	7.68-002	7.64-002
Shoreline	1.09-004	9.29-005	9.29-005	9.29-005	9.29-005	9.29-005	9.29-005	9.29-005
Swimming	.00	1.21-006	1.21-006	1.21-006	1.21-006	1.21-006	1.21-006	1.21-006
Boating	.00	6.28-007	6.28-007	6.28-007	6.28-007	6.28-007	6.28-007	6.28-007
Total	1.09-004	1.08-001	1.96-001	9.75-002	7.82-002	1.16-001	9.13-002	7.85-002

INFANT[1]

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
Fish		.00	.00	.00	.00	.00	.00	.00
Drinking		3.95-003	8.01-002	7.53-002	7.58-002	7.63-002	7.55-002	7.50-002
Shoreline	.00	.00	.00	.00	.00	.00	.00	.00
Total	.00	3.95-003	8.01-002	7.53-002	7.58-002	7.63-002	7.55-002	7.50-002

(1) Assumes drinking water is the only liquid pathway an infant would receive exposure from.

TABLE 5.2-6

ESTIMATED DOSE RATES TO MAXIMUM INDIVIDUALS FROM LIQUID EFFLUENT CONCENTRATIONS AT THE CIRCULATING WATER DISCHARGE POINT[2]

ADULT

MREM PER YEAR

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
Fish		2.52+000	4.07+000	2.90+000	6.47-002	1.39+000	4.94-001	1.31-001
Invertebrate		3.19-002	6.25-002	4.66-002	1.36-002	3.75-002	1.66-002	6.27-002
Drinking[1]		.00	.00	.00	.00	.00	.00	.00
Shoreline	4.51-003	3.86-003	3.86-003	3.86-003	3.86-003	3.86-003	3.86-003	3.86-003
Swimming	.00	1.22-005	1.22-005	1.22-005	1.22-005	1.22-005	1.22-005	1.22-005
Boating	.00	4.08-005	4.08-005	4.08-005	4.08-005	4.08-005	4.08-005	4.08-005
Total	4.51-003	2.56+000	4.14+000	2.95+000	8.22-002	1.43+000	5.14-001	1.98-001

TEENAGER

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
Fish		2.67+000	4.19+000	1.64+000	5.28-002	1.42+000	5.70-001	9.88-002
Invertebrate		3.38-002	6.13-002	2.91-002	1.09-002	3.57-002	1.50-002	4.53-002
Drinking		.00	.00	.00	.00	.00	.00	.00
Shoreline	2.52-002	2.16-002	2.16-002	2.16-002	2.16-002	2.16-002	2.16-002	2.16-002
Swimming	.00	7.06-005	7.06-005	7.06-005	7.06-005	7.06-005	7.06-005	7.06-005
Boating	.00	4.08-005	4.08-005	4.08-005	4.08-005	4.08-005	4.08-005	4.08-005
Total	2.52-002	2.73+000	4.27+000	1.69+000	8.53-002	1.48+000	6.07-001	1.66-001

CHILD

PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-
Fish		3.34+000	3.70+000	6.47-001	4.73-002	1.21+000	4.53-001	5.40-00[illegible]
Invertebrate		4.37-002	5.55-002	1.66-002	1.01-002	3.14-002	1.26-002	1.96-002
Drinking		.00	.00	.00	.00	.00	.00	.00
Shoreline	5.26-003	4.51-003	4.51-003	4.51-003	4.51-003	4.51-003	4.51-003	4.51-003
Swimming	.00	4.39-005	4.39-005	4.39-005	4.39-005	4.39-005	4.39-005	4.39-005
Boating	.00	2.27-005	2.27-005	2.27-005	2.27-005	2.27-005	2.27-005	2.27-005
Total	5.26-003	3.38+000	3.76+000	6.68-001	6.19-002	1.25+000	4.71-001	7.82-002

1 Assumes the lake is not a source of drinking water.
2 Assumes an infant would not be exposed to the existing pathways.

TABLE 5.2-7

ESTIMATED DOSE FROM LIQUID EFFLUENTS
TO POPULATION OF LEROY

	POPULATION DOSE (person-rem/yr)							
	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
INGESTION								
Fish		3.06E-003	4.56E-003	2.68E-003	5.15E-005	1.55E-003	5.62E-004	1.26E-004
Invertebrate		2.27E-005	4.16E-005	2.67E-005	7.36E-006	1.97E-005	1.09E-005	1.65E-005
Drinking Water		5.69E-004	1.92E-002	1.88E-002	1.85E-002	1.87E-002	1.85E-002	1.85E-002
EXTERNAL EXPOSURE								
Shoreline	6.19E-005	5.30E-005	5.30E-005	5.30E-005	5.30E-005	5.30E-005	5.35E-005	5.35E-005
Swimming		1.81E-007	1.81E-007	1.81E-007	1.81E-007	1.81E-007	1.81E-007	1.81E-007
Boating		3.62E-007	3.62E-007	3.62E-007	3.62E-007	3.62E-007	3.62E-007	3.62E-007
Totals	6.19E-005	3.71E-003	2.39E-002	2.16E-002	1.86E-002	2.03E-002	1.91E-002	1.87E-002

TABLE 5.2-8

CALCULATED POPULATION DOSE RATES
FROM SUBMERSION IN GASEOUS EFFLUENTS

Cumulative Radius (miles)	Cumulative 2000 Population[a]	Cumulative Dose (person-rem/yr)	Average Annual Dose (mrem/yr)
1	20	0.0024	0.12
2	100	0.0055	0.055
3	260	0.0076	0.029
4	2,750	0.021	0.008
5	4,870	0.026	0.0054
10	6,180	0.026	0.0043
20	12,100	0.026	0.0021
30	72,020	0.041	0.00058
40	114,630	0.046	0.0004
50	184,[illegible]70	0.054	0.00029

[a]Demographic data are presented in Section 2.1.2. Since population in the vicinity of the site will be reduced, the calculated doses are conservative.

TABLE 5.2-9a
CALCULATED RADIOACTIVE IODINE AND PARTICULATE GASEOUS PATHWAY DOSES (Hypothetical Worst Case)[1, 2, 3]

Location	Age Group	Pathway	Critical Organ Dose Contributions (mRem/yr)			
	Adult		Skin	Thyroid	Bone	Total Body
Controlling Sector Exclusion-Restricted Area Boundary .75 miles North Sector		Ground Contamination	1.26 E-02*	1.08 E-02	1.08 E-02	1.08 E-02
		Air Inhalation	3.69 E-02	6.13 E-02*	9.63 E-05	3.69 E-02
		Vegetable Ingestion	8.92 E-02	3.97 E-01*	1.78 E-01	9.35 E-02
		Cow Milk Ingestion	---------	---------	---------	---------
		Goat Milk Ingestion	5.35 E-02	8.68 E-01*	7.98 E-02	6.13 E-02
		Meat Ingestion	2.15 E-02	4.60 E-02	6.69 E-02*	2.18 E-02
		Total Dose (mRem/yr)	2.14 E-01	1.38 E+00	3.36 E-01	2.24 E-01
	Teen		Skin	Thyroid	Bone	Total Body
		Ground Contamination	1.26 E-02*	1.08 E-02	1.08 E-02	1.08 E-02
		Air Inhalation	3.71 E-02	6.75 E-02*	1.29 E-04	3.71 E-02
		Vegetable Ingestion	1.20 E-01	3.78 E-01*	2.92 E-01	1.24 E-01
		Cow Milk Ingestion	---------	---------	---------	---------
		Goat Milk Ingestion	7.76 E-02	1.37 E+00*	1.47 E-01	8.60 E-02
		Meat Ingestion	1.61 E-02	3.38 E-02	5.65 E-02*	1.63 E-02
		Total Dose (mRem/yr)	2.63 E-01	1.86 E+00	5.06 E-01	2.74 E-01
	Child		Skin	Thyroid	Bone	Total Body
		Ground Contamination	1.26 E-02*	1.08 E-02	1.08 E-02	1.08 E-02
		Air Inhalation	3.28 E-02	6.73 E-02*	1.65 E-04	3.29 E-02
		Vegetable Ingestion	2.37 E-01	6.30 E-01	7.05 E-01*	2.40 E-01
		Cow Milk Ingestion	---------	---------	---------	---------
		Goat Milk Ingestion	1.46 E-01	2.69 E+00*	3.60 E-01	1.55 E-01
		Meat Ingestion	2.70 E-02	5.38 E-02	1.06 E-01*	2.71 E-02
		Total Dose (mRem/yr)	4.55 E-01	3.45 E+00	1.18 E+00	4.66 E-01
	Infant		Skin	Thyroid	Bone	Total Body
		Ground Contamination	1.26 E-02*	1.08 E-02	1.08 E-02	1.08 E-02
		Air Inhalation	1.89 E-02	5.05 E-02*	1.16 E-04	1.89 E-02
		Vegetable Ingestion	---------	---------	---------	---------
		Cow Milk Ingestion	---------	---------	---------	---------
		Goat Milk Ingestion	2.60 E-01	6.45 E+00*	6.98 E-01	2.72 E-01
		Meat Ingestion	---------	---------	---------	---------
		Total Dose (mRem/yr)	2.92 E-01	6.51 E+00	7.09 E-01	3.02 E-01
		Appendix I Limit (mRem/yr)	15.00 E+00	15.00 E+00	15.00 E+00	15.00 E+00

Note: (1) Assumes members of each age group are present and all pathways are present at the Controlling Exclusion-Restricted Area Boundary.

(2) Assumes members of each age group ingest goat milk rather than cow milk to consider the worst case milk ingestion pathway.

(3) Assumes no vegetable or meat ingestion by infants.

* Identifies the critical organ dose for each given pathway.

TABLE 5.2-9b
CALCULATED RADIOACTIVE IODINE AND PARTICULATE GASEOUS PATHWAY DOSES (Controlling Existing Resident)[1, 2]

Location	Age Group	Pathway	Critical Organ Dose Contributions (mRem/yr)			
	Adult		Skin	Thyroid	Bone	Total Body
1.4 miles N		Ground Contamination	4.78 E-03*	4.08 E-03	4.08 E-03	4.08 E-03
1.4 miles N		Air Inhalation	1.64 E-02	2.67 E-02*	3.96 E-05	1.64 E-02
1.4 miles N		Vegetable Ingestion	3.77 E-02	1.58 E-01*	6.91 E-02	3.94 E-02
1.1 miles N		Cow Milk Ingestion	1.94 E-02	4.05 E-01*	4.04 E-02	2.12 E-02
1.1 miles N		Meat Ingestion	1.20 E-02	2.60 E-02	3.55 E-02*	1.22 E-02
		Total Dose (mRem/yr)	9.03 E-02	6.20 E-01	1.49 E-01	9.33 E-02
	Teen		Skin	Thyroid	Bone	Total Body
1.4 miles N		Ground Contamination	4.78 E-03*	4.08 E-03	4.08 E-03	4.08 E-03
1.4 miles N		Air Inhalation	1.65 E-02	2.94 E-02*	5.30 E-05	1.66 E-02
1.4 miles N		Vegetable Ingestion	5.04 E-02	1.51 E-01*	1.13 E-01	5.19 E-02
1.1 miles N		Cow Milk Ingestion	2.94 E-02	6.39 E-01*	7.45 E-02	3.17 E-02
1.1 miles N		Meat Ingestion	8.93 E-03	1.90 E-02	3.00 E-02*	9.03 E-03
		Total Dose (mRem/yr)	1.10 E-01	8.42 E-01	2.22 E-01	1.13 E-01
	Child		Skin	Thyroid	Bone	Total Body
1.4 miles N		Ground Contamination	4.78 E-03*	4.08 E-03	4.08 E-03	4.08 E-03
1.4 miles N		Air Inhalation	1.46 E-02	2.92 E-02*	6.80 E-05	1.46 E-02
1.4 miles N		Vegetable Ingestion	9.76 E-02	2.51 E-01	2.74 E-01*	9.91 E-02
1.1 miles N		Cow Milk Ingestion	5.89 E-02	1.27 E+00*	1.83 E-01	6.18 E-02
1.1 miles N		Meat Ingestion	1.48 E-02	3.00 E-02	5.64 E-02*	1.49 E-02
		Total Dose (mRem/yr)	1.91 E-01	1.58 E+00	5.18 E-01	1.94 E-01
	Infant		Skin	Thyroid	Bone	Total Body
1.4 miles N		Ground Contamination	4.78 E-03*	4.08 E-03	4.08 E-03	4.08 E-03
1.4 miles N		Air Inhalation	8.41 E-03	2.17 E-02*	4.81 E-05	8.42 E-03
1.4 miles N		Vegetable Ingestion	----------	----------	----------	----------
1.1 miles N		Cow Milk Ingestion	1.10 E-01	3.04 E+00*	3.57 E-01	1.14 E-01
1.1 miles N		Meat Ingestion	----------	----------	----------	----------
		Total Dose (mRem/yr)	1.23 E-01	3.07 E+00	3.61 E-01	1.27 E-01
		Appendix I Limit (mRem/yr)	15.00 E+00	15.00 E+00	15.00 E+00	15.00 E+00

Note: (1) All pathways actually exist for this resident except the cow milk ingestion pathway which is assumed.

(2) Assumes members of each age group are present and that there is no vegetable or meat ingestion by infants.

* Identifies the critical organ dose for each given pathway.

TABLE 5.2-10
ANNUAL DOSE FROM NOBLE GASES

Sector	Exclusion-Restricted Area Boundary (miles)	Cloud Submersion Total Body (mrem/yr)	Cloud Submersion Skin (mrem/yr)	Air Dose Gamma (mrad/yr)	Air Dose Beta (mrad/yr)
NNE	.75	1.12 E-02	3.74 E-02	1.83 E-02	5.17 E-02
NE	.75	4.71 E-03	1.67 E-02	7.62 E-03	2.30 E-02
ENE	.75	2.57 E-03	1.08 E-02	4.13 E-03	1.48 E-02
E	.75	4.17 E-03	1.60 E-02	6.73 E-03	2.20 E-02
ESE	.75	5.61 E-03	2.08 E-02	9.07 E-03	2.87 E-02
SE	.75	6.30 E-03	2.28 E-02	1.02 E-02	3.16 E-02
SSE	.75	7.14 E-03	2.51 E-02	1.16 E-02	3.45 E-02
S	.75	8.17 E-03	2.74 E-02	1.32 E-02	3.79 E-02
SSW	.75	7.26 E-03	2.62 E-02	1.17 E-02	3.60 E-02
SW	.75	5.60 E-03	2.07 E-02	9.04 E-03	2.85 E-02
WSW	.75	5.32 E-03	2.10 E-02	8.59 E-03	2.89 E-02
W	.75	7.70 E-03	2.89 E-02	1.25 E-02	3.97 E-02
WNW	.75	6.31 E-03	2.30 E-02	1.02 E-02	3.17 E-02
NW	.75	1.06 E-02	3.90 E-02	1.72 E-02	5.37 E-02
NNW	.75	1.55 E-02	5.59 E-02	2.52 E-02	7.71 E-02
N	.75	2.20 E-02	7.24 E-02	3.55 E-02	1.00 E-01
Appendix I Limit		5.00 E+0	15.00 E+0	10.00 E+0	20.00 E+0

TABLE 5.2-11

SUMMARY OF CALCULATED TOTAL-BODY AND THYROID DOSE RATES FROM LIQUID AND GASEOUS EFFLUENTS

Pathway	Dose Rate	
	Total Body	Thyroid
Maximum Individual Exposures:		
Liquid effluents[a]		
Ingestion		
fish	2.90E+000 mrem/yr	5.28E-002 mrem/yr
invertebrate	4.66E-002 mrem/yr	1.09E-002 mrem/yr
drinking water	0.0 mrem/yr	0.0 mrem/yr
External exposure		
shoreline	3.86E-003 mrem/yr	2.16E-002 mrem/yr
swimming	1.22E-005 mrem/yr	7.06E-005 mrem/yr
boating	4.08E-005 mrem/yr	4.08E-005 mrem/yr
Subtotal	2.95E+000 mrem/yr	8.53E-002 mrem/yr
Gaseous effluents[b]		
noble gas submersion	2.20E-002 mrem/yr	--
particulate and iodine gases	1.27E-001 mrem/yr	3.07E+000 mrem/yr
Subtotal	1.49E-001 mrem/yr	3.07E+000 mrem/yr
Population Exposures:		
Liquid effluents[c]		
Ingestion		
fish	2.68E-003 person-rem/yr	5.15E-005 person-rem/yr
invertebrate	2.67E-005 person-rem/yr	7.36E-006 person-rem/yr
drinking water	1.88E-002 person-rem/yr	1.85E-002 person-rem/yr
External exposure		
shoreline	5.30E-005 person-rem/yr	5.30E-005 person-rem/yr
swimming	1.81E-007 person-rem/yr	1.81E-007 person-rem/yr
boating	3.62E-007 person-rem/yr	3.62E-007 person-rem/yr
Subtotal	2.16E-002 person-rem/yr	1.86E-002 person-rem/yr
Gaseous effluents[d]		
submersion	5.4E-002 person-rem/yr	--
direct radiation	1.0E-003 person-rem/yr	--
Subtotal	5.5E-002 person-rem/yr	--

[a]Doses were calculated at the circulating water discharge for maximum individual exposures. Total body doses were for an adult and thyroid doses were to a teen

[b]Doses were calculated at a point 1.4 miles from the vent in the maximally exposed sector for an infant.

[c]To the population in the town of Le Roy.

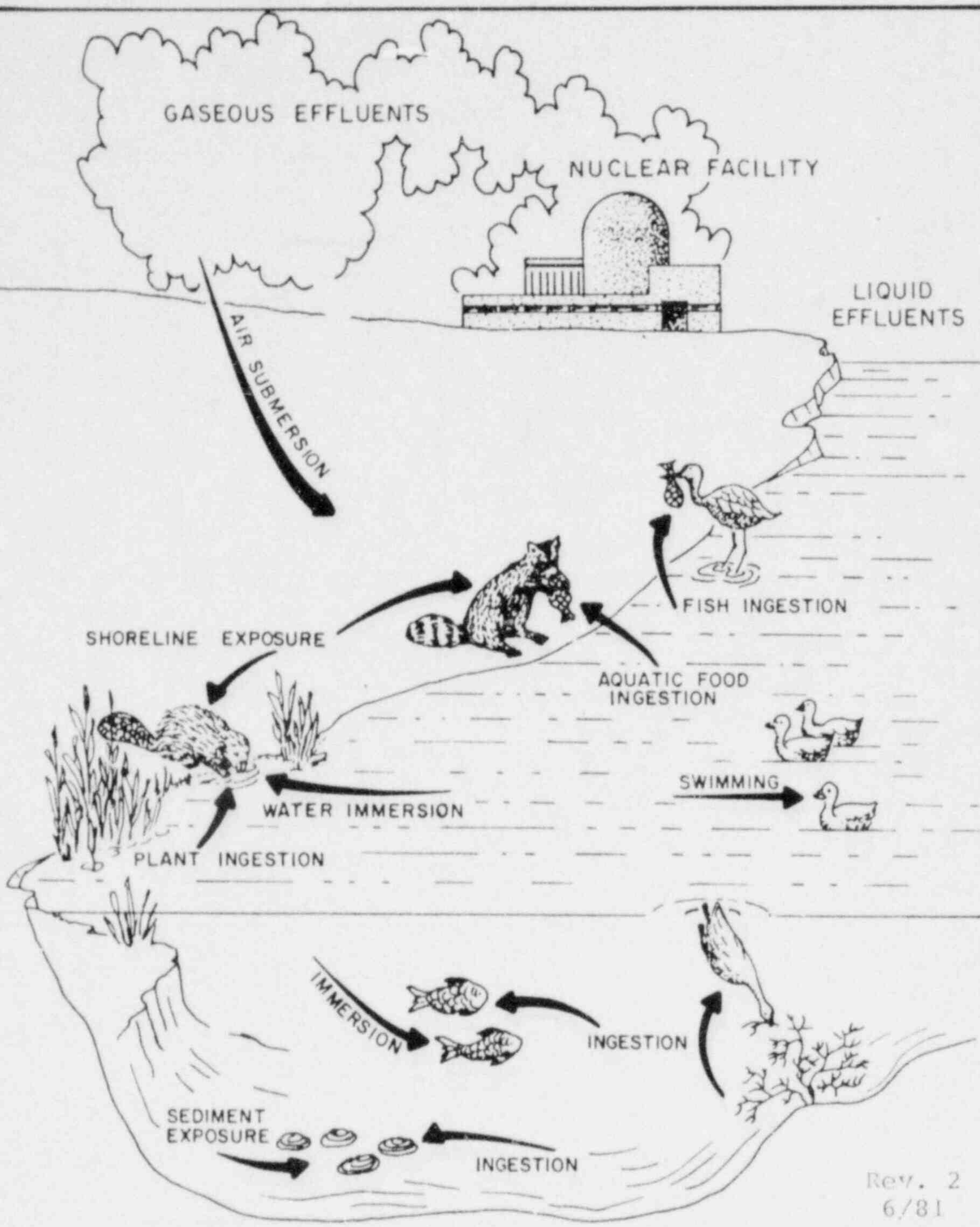
[d]To the population within a 50 mile radius.

TABLE 5.2-12

APPENDIX I CONFORMANCE SUMMARY TABLE FOR LIQUID AND GASEOUS EFFLUENTS

Type of Dose	Design Objective[a]	Calculated Dose[b]	Point of Dose Evaluation
Liquid Effluents			
Dose to total body from all pathways	5 mrem/yr per site	2.95 mrem/yr[b]	Point of Discharge Cooling Lake
Dose to any organ from all pathways	5 mrem/yr per site	4.27 mrem/yr[c]	Same as above
Gaseous Effluents			
Dose to total body of an individual	5 mrem/yr per site	0.0220 mrem/yr	.75 mi N of stack vent[d]
Dose to skin of an individual	15 mrem/yr per site	0.0724 mrem/yr	.75 mi N of stack vent
Radioiodine and Particulates			
Dose to any organ from all pathways	15 mrem/yr per site	3.07 mrem/yr[e]	Residence, 1.4 mi. N of stack vent. Milk cow 1.1 mi. N of stack.
I-131 releases	1 Ci/yr per unit	0.0577 Ci/yr 0.0240 Ci/yr	gaseous liquid
	Total	0.0817 Ci/yr	

[a] Design objective as specified in the Commission's Appendix I Conformance Option, 40 FR, 40816, September 4, 1975, RM-50-2.
[b] Maximum dose to an individual from all liquid pathways.
[c] Maximum dose to a teen liver from all liquid pathways.
[d] Maximally exposed sector.
[e] Dose to an infant thyroid.



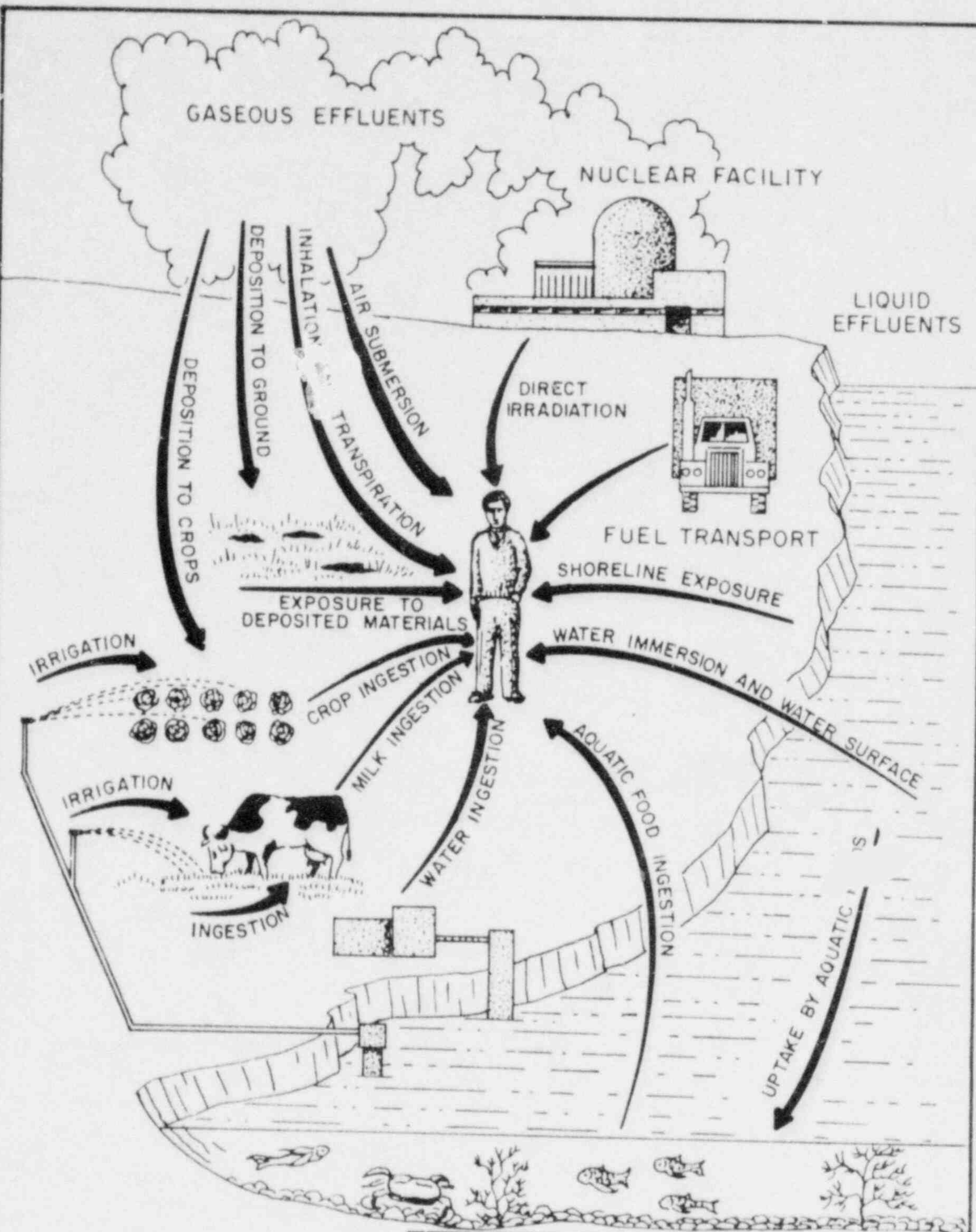
Rev. 2
6/81

REFERENCE:
U.S. Atomic Energy Commission, 1973

WOLF CREEK GENERATING STATION
UNIT NO. 1
ENVIRONMENTAL REPORT (OPERATING LICENSE STAGE)

FIGURE 5.2-1

EXPOSURE PATHWAYS TO ORGANISMS OTHER THAN HUMANS



WOLF CREEK GENERATING STATION
UNIT NO. 1
ENVIRONMENTAL REPORT (OPERATING LICENSE STAGE)

FIGURE 5.2-2

EXPOSURE PATHWAYS FOR HUMANS

REFERENCE:
U.S. Atomic Energy Commission, 1973

5.7 RESOURCES COMMITTED

5.7.1 URANIUM RESOURCES

With the exception of uranium ore as fuel, operation of Wolf Creek Generating Station (WCGS) is not expected to cause an irreversible commitment of resources beyond that resulting from construction of the plant. Loss of habitat and effects on the terrestrial community are detailed in Section 4.3 of the Environmental Report-Construction Permit Stage (ER(CPS)) and the impact of thermal and chemical discharges on fish and other forms of aquatic biota is discussed in Section 5.1 and 5.3.

Operation of the WCGS will involve irreversible consumption of a certain amount of uranium ore which represents a small fraction of the current reserves and potential resources of the United States. Fuel consumption for Unit No. 1 of WCGS (operating at a 75 percent load factor) will total approximately 7328 tons of U_3O_8 over the 30-year economic life of the plant. Initial loading and the first year of operation will require 545 tons of U_3O_8. Annual fuel consumption in subsequent years is estimated at approximately 219 to 238 tons of U_3O_8.

As of October 1, 1980, the estimate of the U.S. uranium ore reserves and potential resources recoverable at $50.00 or less per pound of U_3O_8 is as follows (DOE, 1980):

$/lb. U_3O_8 Forward Cost Category	Tons U_3O_8			
			Potential Resources	
	Reserve	Probable	Possible	Speculative
$30	645,000	885,000	346,000	311,000
$50	936,000	1,426,000	641,000	482,000
$100	1,122,000	2,080,000	1,005,000	696,000

This estimate of reserves does not include a possible production of 140,000 tons of U_3O_8 as a byproduct of phosphate and copper production by the year 2000 or other considerations that may also increase the estimates of U_3O_8 resources available. By considering more expensively mined ore the reserves and potential resources of the U.S. are also increased.

The total U.S. and foreign resources at $50.00 per pound or less excluding the Peoples Republic of China, USSR and associated countries, has been estimated by Working Group 1 of the International Nuclear Fuel Cycle Evaluation sponsored jointly by the OCED Nuclear Energy Agency and the International Atomic Energy Agency as of January 1, 1979, as 3,367,000 tons U_3O_8 as Reasonably Assured and 3,185,000 tons U_3O_8 as Estimated Additional.

5.7.2 OTHER RESOURCES

An auxiliary boiler system is installed within the power block to supply building heat and other services during plant outages. When this system is in continuous service at 50 percent load, 325,000 gallons per month of No. 2 distillate fuel oil will be committed. Assuming a 15 percent plant outage rate, the total yearly consumptive use at 50 percent load is not expected to exceed 585,000 gallons.

5.7.3 REFERENCE

DOE, May/June 1979, Update, Nuclear Power Program Information and Data: Division of Nuclear Power Development, U.S. Department of Energy.

APPENDIX 5A

DOSE CALCULATION MODELS AND ASSUMPTIONS

All dose calculations have been revised by means of the NRC computer codes GASPAR and LADTAP II. Computer programs ARRG, CRITR, GRONK, and FOOD developed at the Pacific Northwest Laboratory of Battelle Memorial Institute are no longer being used. The models and assumptions used in LADTAP II and GASPAR are identical or similar to those suggested in NRC Regulatory Guide 1.109. A list of assumptions and parameters used for the Wolf Creek site are presented in Table 5A-1 for liquid effluents and Table 5A-2 for gaseous effluents.

5A.1 INTERNAL DOSES TO AQUATIC ORGANISMS

Doses to aquatic and terrestrial organisms other than man were calculated using NUREG/CR-1276 LADTAP II - "A Computer Program for Calculating Radiation Exposure to Man from Routine Release of Nuclear Reactor Liquid Effluents." The models used by this program are taken from Regulatory Guide 1.113, 1.109 and USAEC publication, WASH-1258.

5A.2 DOSE TO HUMANS

Doses to man from liquid effluents were calculated using NUREG/CR-1276 LADTAP II computer program. The models used by this program are taken from Regulatory Guide 1.113 and 1.109. Doses to man from gaseous effluents were calculated using NUREG-0597 GASPAR - "A Computer Program for the Evaluation of Radiological Impacts Due to the Release of Radioactive Material to the Atmosphere During Normal Operation of Light Water Reactors." The models used by this program are taken from Regulatory Guide 1.111 and 1.109.

5A.3 RECONCENTRATION FORMULA USED TO CALCULATE RECONCENTRATION FACTORS FOR LIQUID EFFLUENTS ACCUMULATING IN A REACTOR COOLING LAKE

Reconcentration models were based on Reg. Guide 1.113 and USEPA EPA-520 - "Radionuclide Accumulation in a Reactor Cooling Lake." Calculated reconcentration factors for the lake and at the circulating water discharge are presented in Table 5A-3. Reconcentration was determined as follows:

$$C = \frac{W}{V_T \ \lambda eff} (1 - e^{-\lambda eff\ t}) + Co\ e^{-\lambda eff\ t}$$ Lake Concentration

C = concentration of radionuclide in the lake at the end of the period

Co = concentration in the lake at the beginning of time period t

W = Ci/yr rate radioactivity is added to the lake

V_T = lake volume ft^3

$$\lambda eff = \lambda + \frac{Q_b}{V_T}$$

λ = the radionuclide decay constant $\frac{.693}{T_{1/2}}$

$T_{1/2}$ = radiological half life

Q_b = lake blowdown rate cfs

t = time

Q_p = plant pumping rate cfs

R = reconcentration of radionuclide in the lake at the end of the period

R_o = reconcentration in the lake at the beginning of time period t

$$R = \frac{C\ Q_p}{W} \qquad C = \frac{W\ R}{Q_p} \text{ therefore}$$

$$R = \frac{Q_p}{V_T\ \lambda eff} (1 - e^{-\lambda eff\ t}) + R_o\ e^{-\lambda eff\ t}$$ Lake Reconcentration

Ccw = concentration at circulating water discharge point

$$Ccw = C + \frac{W}{Q_p} \text{ and } C = \frac{RW}{Q_p}$$

therefore $(R + 1) \frac{W}{Q_p} = Ccw$ Circulating Water Discharge Concentration

R + 1 = reconcentration of radionuclide at the circulating water discharge

5A.4 REFERENCES

Attachment to Concluding Statement of Position of the Regulatory Staff. Public Rule-making Hearing on: Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low As Practicable" for Radioactive Material in Light-Water-Cooled Nuclear Power Stations, USAEC, Docket No. RM-50-2, February 20, 1974.

Eckerman, K. F. and Lash, D. G., 1978 GASPAR version marked "revised 8/19/77": US Nuclear Regulatory Commission, Radiological Assessment Branch.

Eckerman, K. F., Congel, F. J., Roecklein, A. K. and Pasciak, W. J., 1980, NUREG-0597 Users Guide to GASPAR Code: U.S.N.R.C. Radiological Assessment Branch.

Final Environmental Statement Concerning Proposed Rule Making Action: Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low as Practicable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents, USAEC Report WASH-1258, Washington, D.C., July 1973.

Fletcher, J. F., and Dotson, W. L. (compilers). HERMES-A Digital Computer Code for Estimating Regional Radiological Effects from the Nuclear Power Industry, USAEC Report HEDL-TME-71-168, Hanford Engineering Development Laboratory, 1971.

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TABLE 5A-1 (Sheet 1 of 4)

The following assumptions and parameters were used in LADTAP II for estimating doses at the Wolf Creek Generating Station site from liquid effluents:

PARAMETER	INDIVIDUAL	POPULATION	REFERENCE
Cooling Lake volume,			
Normal	4.847E+009 ft^3	4.847E+009 ft^3	WCGS-ER(OLS) page 3.4-3
Pre-drought	4.649E+009 ft^3	4.649E+009 ft^3	
Low-drought	4.451E+009 ft^3	4.451E+009 ft^3	
Seepage	3.5 ft^3/sec	3.5 ft^3/sec	WCGS-ER(OLS) page 3.3-3
Blowdown Discharge			Sargent & Lundy Report SL-3204 Revised March 26, 1976, on Cooling Lake Operation pgs. 10, 11, 13, 14 & 15
Normal-post drought	40.0 ft^3/sec	40.0 ft^3/sec	
Pre-drought	3.5 ft^3/sec	3.5 ft^3/sec	
Drought	0.0 ft^3/sec	0.0 ft^3/sec	
Ave. Neosho River flow rate	1335 ft^3/sec	1335 ft^3/sec	WCGS-ER(OLS) 5.1.2.2 page 5.1-3
Dilution at Le Roy	31.69	31.69	
Population at Le Roy	--	624	1980 Census from Coffey County Clerk Telephone Call Record 4/17/81
Population - 50 mile	--	1980 168,130 2000 184,470	WCGS-ER(OLS) Table 2.1-4
Circulating water discharge flow rate	1204 cfs	1204 cfs	WCGS-ER(OLS) Section 3.3 page 3.3-1 Circulating Water and Service Water

TABLE 5A-1 (Sheet 2 of 4)

PARAMETER	INDIVIDUAL	POPULATION	REFERENCE
Shore width factor, Cooling Lake	.3	.3	Reg. Guide 1.109 p. 15 Table A-2
Shore width factor, Neosho River	.2	.2	Reg. Guide 1.109 p. 15 Table A-2
Drinking Water			Reg. Guide 1.109 pgs. 39 & 40, Tables E-4, E-5
Adult	730 l/yr	370 l/yr	
Teen	510 l/yr	370 l/yr	
Child	510 l/yr	370 l/yr	
Infant	330 l/yr	370 l/yr	
Fish Consumption			Reg. Guide 1.109 Pgs. 39 & 40, Tables E-4 & E-5
Adult	21 Kg/yr	6.9 Kg/yr	
Teen	16 Kg/yr	5.2 Kg/yr	
Child	6.9 Kg/yr	2.2 Kg/yr	
Infant	0.0 Kg/yr	0.0 Kg/yr	
Invertebrate Consumption			Reg. Guide 1.109 Pgs. 39 & 40, Tables E-4 & E-5
Adult	5 Kg/yr	1.0 Kg/yr	
Teen	3.8 Kg/yr	.75 Kg/yr	
Child	1.7 Kg/yr	.33 Kg/yr	
Infant	0.0 Kg/yr	0.0 Kg/yr	
Shoreline Exposure			Reg. Guide 1.109 Pgs. 39 & 40, Tables E-4 & E-5
Adult	12 hr/yr	8.3 hr/yr	
Teen	67 hr/yr	47 hr/yr	
Child	14 hr/yr	9.5 hr/yr	
Swimming	hrs per person		HERMES Pgs. 144 & 145, Tables III-31 & 32
Adult	7.8 hr/yr	3.42 hr/yr	
Teen	45.0 hr/yr	19.2 hr/yr	
Child	28.2 hr/yr	12.0 hr/yr	

TABLE 5A-1 (Sheet 3 of 4)

PARAMETER	INDIVIDUAL	POPULATION	REFERENCE
Boating	hrs per person		HERMES Pgs. 144 & 145, Tables III-31 & 32
Adult	52.2 hr/yr	29 hr/yr	
Teen	52.2 hr/yr	29 hr/yr	
Child	29.0 hr/yr	16.53 hr/yr	
Hold up time	hrs	hrs	Inherent to program
Water	12	24	Reg. Guide 1.109 P. 69
Fish	24	168	Pgs. 12 & 69
Invertebrate	24	168	Pgs. 12 & 69
Shoreline exposure	0	0	P. 69
Swimming	0	0	P. 69
Boating	0	0	P. 69

POPULATION

Fraction of Population		
Adult	71%	Inherent to program
Teen	11%	
Child	18%	

Le Roy Population - 1980		50 Mile Population - 1980		Reference
Adult	443	Adult	119,372	Reference calculated from Le Roy - 1980 Census from Coffey County Clerk. 50 Mile - WCGS-ER(OLS) Table 2.1-4
Teen	69	Teen	18,494	
Child	112	Child	30,263	
Total	624	Total	168,130	

Sport Fish Harvest - Hazleton Lake Use Feasibility Study WCGS-ER(OLS) Appendix 2A
Page 2A-8 Lake Capability 54,000 fishing trips annually 2 lbs per trip from lake.
Page 2A-4 18.4% of Kansas population are fishermen.

Sport Fish Harvest 675 Kg/yr	Fish Harvest 48,990 Kg/yr	Site Specific
Sport Invertebrate Harvest 97.9 Kg/yr	Invertebrate Harvest 26,350 Kg/yr	Site Specific

TABLE 5A-1 (Sheet 4 of 4)

POPULATION		REFERENCE
Le Roy Population - 1980	50 Mile Population - 1980	
Shoreline Recreation 7,984 hrs/yr	Shoreline Recreation 2,147,000 hrs/yr	Site Specific
Swimming 4,184 hrs/yr	Swimming 1,126,500 hrs/yr	Site Specific
Boating 16,700 hrs/yr	Boating 4,498,000 hrs/yr	Site Specific
Nearest Downstream Water Intake Location - Le Roy		
Individual Intake .2678 gal/day	Population Intake 167 gal/day	Reg. Guide 1.109 Site Specific
Annual Liquid Release Source Terms		WCGS-ER(OLS) Table 3.5-2

TABLE 5A-2

The following assumptions and parameters were used in GASPAR for estimating doses at the Wolf Creek Generating Station site from gaseous effluents:

PARAMETER	VALUE ASSIGNED	REFERENCE
Distance from facility to the NE corner of the US (Maine) in miles	1546 miles	Map measurement
Fraction of year leafy vegetables are grown	.75	K-State Extension Service
Fraction of crop from garden	Default value .76	Reg. Guide 1.109-7
Fraction of year cows are on pasture	.5	K-State Extension Service
Fraction of daily intake of cows derived from pasture while on pasture	Default value 1.00	Reg. Guide 1.109-28
Fraction of year goats are on pasture	.5	K-State Extension Service
Fraction of daily intake of goat from pasture while on pasture	Default value 1.00	Reg. Guide 1.109
Fraction of year beef cattle are on pasture	.5	K-State Extension Service
Fraction of daily intake of beef cattle derived from pasture while on pasture	Default value 1.00	Reg. Guide 1.109
Absolute humidity over growing season	63.1%	Table 2.3-3 WCGS-ER(OLS)
Average temperature over growing season	64.4°F	Table 2.3-1 WCGS-ER(OLS)
Total annual release time of intermittent purge operation	1925 hrs/yr	Bechtel letter to SNUPPS BLSE-6610 Oct. 31, 1978
Annual gaseous release source terms	Table 3.5-3	WCGS-ER(OLS)
Average meteorological relative concentrations (X/Qs)	Table 5.2-1 WCGS-ER(OLS)	Dames & Moore X/Q Report 7699-062-07

TABLE 5A-3

40 YR. RECONCENTRATION FACTORS

NUCLIDE	RECONCENTRATION IN LAKE	RECONCENTRATION AT CWD
H-3	6.13E+001	6.23E+001
Cr-51	9.35E-001	1.94E+000
Mn-54	9.90E+000	1.09E+001
Fe-55	2.75E+001	2.85E+001
Fe-59	1.51E+000	2.51E+000
Co-58	2.38E+000	3.38E+000
Co-60	4.37E+001	4.47E+001
Br-83	3.37E-003	1.00E+000
Mo-99	1.00E-001	1.10E+000
Tc-99M	8.42E-003	1.01E+000
Te-129M	1.14E+000	2.14E+000
I-131	2.72E-001	1.27E+000
Te-132	1.09E-001	1.11E+000
I-132	3.23E-003	1.00E+000
I-133	2.95E-002	1.03E+000
Cs-134	2.27E+001	2.37E+001
I-135	9.40E-003	1.01E+000
Cs-136	4.37E-001	1.44E+000
Cs-137	7.30E+001	7.40E+001
Zr-95	2.18E+000	3.18E+000
Nb-95	1.18E+000	2.18E+000
Rb-86	6.29E-001	1.63E+000
Ru-103	1.34E+000	2.34E+000
Ru-106	1.20E+001	1.30E+001
Ag-110M	8.31E+000	9.31E+000
Ce-144	9.30E+000	1.03E+001
Br-84	7.45E-004	1.00E+000
Sr-89	1.75E+000	2.75E+000
Te-127M	3.64E+000	4.64E+000
Te-127	1.32E-002	1.01E+000
Te-129	1.61E-003	1.00E+000
I-130	1.75E-002	1.02E+000
Te-131M	4.22E-002	1.04E+000
Br-85	7.01E-005	1.00E+000
Rb-88	4.18E-004	1.00E+000
Sr-91	1.35E-002	1.01E+000
Y-91M	1.17E-003	1.00E+000
Te-131	5.87E-004	1.00E+000
I-134	1.24E-003	1.00E+000

(1) 40 yrs of reconcentration based on:

	Years	Blowdown	+	Seepage	Lake Level
Normal-post drought	31.59	40 cfs		3.5 cfs	4.847E+009 ft^3
Pre-drought	3.58	3.5 cfs		3.5 cfs	4.650E+009 ft^3
Drought	4.83	0 cfs		3.5 cfs	4.451E+009 ft^3

(2) Drought occurs at the end of the 40 yr period.

7.3 OTHER ACCIDENTS

7.3.1 EXPLOSIVE AND TOXIC MATERIALS

Accidents that do not involve radioactive materials could have consequences that affect the environment. Such accidents include chemical explosions or fires, and leakage or rupture of vessels containing oil or toxic materials. The effects of accidents on the normal operation of the plant are discussed in Section 2.2.3 of the Wolf Creek Generating Station Final Safety Analysis Report (WCGS FSAR). The fire protection system is described in Section 9.5.1 of the FSAR.

The principal criterion established for this facility for the storage of toxic or explosive material is that the impact of accidents involving any significant quantity of materials will be confined within the site boundary.

The effect of chemical explosions or fires on the environment beyond the site boundary is minimized by the fire protection system and the relative isolation of these potential sources of explosions or fires. If an explosion or fire were to occur, the offsite environmental effect would occur from airborne emissions such as sulfur dioxide carbon monoxide, hydrocarbons, nitrogen oxides, and particulates. At worst, the effects from this accident would be short-term. Two examples of combustible materials are as follows:

<u>Heating Fuel Oil</u> - a maximum of 470,000 gallons of No. 2 grade fuel oil is stored at the site approximately 380 feet from the power block. The storage tank is confined by a berm which prevents the release of fuel oil if failure of the tank should occur. The berm has the capacity to hold the entire contents of the tank. Any spillage is handled according to the Spill Prevention Control and Countermeasure Plan and will have no adverse environmental impact. No. 2 grade fuel oil has a relatively low volatility since its vapor pressure is usually less than 0.1 pounds per square inch (psi). At normal storage temperatures explosive mixtures are not formed; thus an explosion hazard should not exist. No. 2 grade fuel oil will sustain combustion if its ignition temperature is reached by an outside heat source. The airborne combustion products from such an event would be diffused at the site boundaries, thereby reducing concentrations.

<u>Hydrogen</u> - a maximum of 120,000 standard cubic feet (scf) of hydrogen is stored on the site. It is stored in modular high pressure (2450 psig) bottles outside and approximately 650 feet from the power block but not near

the site boundaries so that neither the offsite environs nor the power block would be endangered by an explosion involving hydrogen. Any leakage from the hydrogen bottles would be rapidly diluted with atmospheric air thus preventing an explosive mixture from forming in any area other than the immediate area of any postulated leak. Leakage of hydrogen into the atmosphere is not harmful since it merely adds an insignificant quantity to the existing inventory. The hydrogen header serving the power block is provided with a mechanical check valve which would isolate flow in the event of a postulated pipe rupture.

The storage of material which could cause offsite toxic concentrations high enough to have adverse environmental consequences are provided with a confinement barrier. The following are examples of such toxic materials:

Sulfuric Acid (H_2SO_4) - A maximum of 61,000 gallons of a 66° Baume solution of sulfuric acid is stored outdoors at the site. The sulfuric acid is stored in a lined carbon steel tank located above a pit filled with limestone to confine and neutralize releases to the immediate area. The pit has the capacity to hold the entire contents of the tank. A maximum of 11,000 gallons of a 66° Baume solution of sulfuric acid is also stored indoors at the shop building. The acid is stored in a lined carbon steel tank which is confined by a berm. This berm will preclude the possibility of an uncontrolled release of sulfuric acid.

Sodium Hydroxide (NaOH) - A maximum of 16,000 gallons of 50-percent solution of sodium hydroxide is stored in a lined carbon steel tank indoors at the shop building. This tank is confined by the same berm used to confine the sulfuric acid tank. Since the simultaneous rupture of the sodium hydroxide and sulfuric acid tanks is considered highly unlikely, the berm is not designed to hold the entire contents of both tanks. The postulated mode of failure of these tanks is a slow leak condition. A drain is provided within the berm to remove and neutralize any accidentally released material. Each of the tanks can be independently monitored and controlled.

Chlorine (Cl_2 Liquid) - Up to 21 1-ton liquid chlorine containers are onsite either installed in the clorination system in the circulating water screen house, or in the chlorine storage facility located approximately 150 feet north of the circulating water screen house. (See Figure 2.1-4) In addition, four 150-pound storage vessels will be stored near the shop building in the chlorine house. Because potentail accidental releases of chlorine from these containers would be considerably less than those

CHAPTER 10.0

STATION DESIGN ALTERNATIVES

During the construction permit review, a variety of station design alternatives were considered in Chapter 10.0 of the Environmental Report Construction Permit Stage (ER(CPS)). The designs selected were approved by the NRC in the course of granting a construction permit for Wolf Creek Generating Station, Unit No. 1 (WCGS) as discussed in the following sections. In some cases no alternatives were presented in the ER(CPS) when there was only one clear design choice. The implementation of the selected design is discussed in this chapter.

10.1 CIRCULATING WATER SYSTEM

It was concluded by the Applicants in the ER(CPS) and the NRC staff in the Construction Permit Final Environment Statement (CPFES) that a 5090 acre cooling lake was superior to all alternatives considered for the dissipation of heat from WCGS. The cooling lake is described in Section 3.4.

10.2 INTAKE SYSTEM

The preferred design alternative of the intake structure for the WCGS circulating water system as proposed by the Applicants in the ER(CPS) and approved by the NRC in the CPFES utilizes a conventional screenhouse with vertical travelling screens.

The design selected for the WCGS makeup water system by the Applicants in the ER(CPS) and approved by the NRC in the CPFES utilizes a similar screenhouse with travelling screens located on a deadend channel constructed along the east bank of the Neosho River just downstream of the John Redmond Dam. The plant intake systems are described in Section 3.4.

10.3 DISCHARGE SYSTEM

No alternative designs were proposed by the Applicants in the ER(CPS) for the discharge structures in the circulating water and makeup water systems. The NRC concurred with the use of concrete outfall structures for these systems in the CPFES. The discharge structures are described in Section 3.4.

10.4 CHEMICAL WASTE TREATMENT

The chemical waste treatment processes to be implemented for WCGS are those proposed by the Applicants in the ER(CPS). The systems which involve chemicals are the circulating water system, steam cycle system and demineralized water system as described in Sections 3.3 and 3.6.

10.5 BIOCIDE TREATMENT

The alternative chosen by the Applicants in the ER(CPS) to control biological growth and slime buildup in the cooling water which passes through the main condenser and auxiliary heat exchanger tubes at WCGS is an intermittent chlorination program utilizing chlorine gas. A description of the chlorination program is given in Section 3.6. and ER(CPS) Section 3.6.

10.6 SANITARY WASTE SYSTEM

The sanitary waste treatment system implemented for WCGS uses the treatment method proposed by the Applicants in the ER(CPS). The water treatment system is described in Section 3.7. Effluent water quality requirements are imposed on the facility by the State of Kansas under the NPDES permit program.

10.7 LIQUID RADWASTE SYSTEMS

As discussed in Section 5.2, the liquid radwaste systems for WCGS described in Section 3.5 conform to the "as low as reasonably achieveable" (ALARA) criteria of 10 CFR 50 Appendix I. Consequently, no discussion of alternative liquid radwaste systems was presented in the ER(CPS) or is warranted herein.

10.8 GASEOUS RADWASTE SYSTEMS

As discussed in Section 5.2, the gaseous radwaste systems for WCGS described in Section 3.5 conform to the ALARA criteria of 10 CFR 50 Appendix I. Consequently, no discussion of alternative gaseous radwaste systems was presented in the ER(CPS) or is warranted herein.

10.9 TRANSMISSION FACILITIES

The major 345-kV transmission line construction associated with WCGS will be along the preferred routes proposed by the Applicants in the ER(CPS) and concurred with by the NRC in the CPFES with the following exception:

a. The Wolf Creek-Craig transmission line will be shortened by approximately 14 miles and will terminate at the West Gardner Substation becoming the Wolf Creek-West Gardner transmission line (see Section 3.9).

An additional 69-kV transmission line, not identified in the ER(CPS), was constructed by a Kansas Electric Power Cooperatives member between the WCGS substation and the nearby Phillips Petroleum Company pipeline pumping station at Sharpe, Kansas. Because of the shortness of this line (less than three miles) and there being only one practical route for the line, no alternatives are postulated.

See Section 3.9 for a discussion of the WCGS transmission facilities.

10.10 OTHER SYSTEMS

No other systems have been identified for which potential environmental effects warrant consideration of design alternatives.

CHAPTER 12.0

ENVIRONMENTAL APPROVALS AND CONSULTATIONS

The design, construction and operation of Wolf Creek Generating Station, Unit No. 1 (WCGS) is subject to a number of licenses, permits and conditions resulting from the review and approval of numerous local, state and federal agencies. Pursuant to these requirements the Applicants have made contacts with and have secured the appropriate approvals, licenses, permits and certificates from the various governmental agencies as described in the Environmental Report-Construction Permit Stage (ER(CPS)) and as updated below:

12.1 STATUS OF ENVIRONMENTAL REGULATORY REQUIREMENTS AND CONSULTATIONS

12.1.1 FEDERAL AGENCIES

12.1.1.1 Nuclear Regulatory Commission

The Nuclear Regulatory Commission's Atomic Safety and Licensing Board conducted public hearings concerning the WCGS construction permit application. The hearings were held on November 12 and 13, 1975, at Burlington, Kansas, January 26-28, February 2-6, February 23-26, March 2-5, April 26-30, June 24-25, 1976, March 22-23, 1977 at Kansas City, Missouri, and May 4, 1976, at Bethesda, Maryland.

On January 19, 1977, the Board issued a Partial Initial Decision in which it made all the findings required by 10 CFR Part 51 with respect to NEPA matters, and determined that there is reasonable assurance that the proposed site is a suitable location for a nuclear power reactor of the size and type proposed. Subsequently on January 24, 1977, the Nuclear Regulatory Commission granted a Limited Work Authorization permitting certain activities at the site which might be characterized as site construction preparatory activities.

On April 18, 1977, an amendment was granted to the Limited Work Authorization permitting the initiation of construction of specific structures at the site.

On May 17, 1977, the Nuclear Regulatory Commission issued construction permit CPPR-147 authorizing the constructon of WCGS.

12.1.1.2 Environmental Protection Agency

The Environmental Protection Agency (EPA) implements provisions of the Federal Water Pollution Control Act (FWPCA) as amended that requires the licensing and certification of effluent water discharges from federally licensed industrial projects. The EPA has granted the Kansas Department of Health Environment (KDHE) authority to certify activities as provided by FWPCA Section 401 and to issue permits through the National Pollution Discharge Elimination System (NPDES) program as provided by Section 402 of the Federal Water Pollution Control Act.

Kansas Gas and Electric Company (KG&E) has kept the EPA informed of its intentions relating to proposed discharges from WCGS through official meetings, correspondence, and telephone conversations, and has discussed the conditions and standards relating to the NPDES permit which was subsequently issued by the KDHE.

12.1.1.3 U.S. Army Corps of Engineers

Section 404 of the Federal Water Pollution Control Act authorizes the Army Corps of Engineers to regulate the discharge of dredge and fill material, including construction materials in the waters of the United States. In accordance with the provisions of this act the Applicants have secured 404 permits for all applicable structures:

Permit for construction of two highway bridges	issued May 27, 1976
Permit for construction of 8' raw water pipeline.	issued January 29, 1977
Permit for construction of three railroad access bridges	issued January 29, 1977
Permit for construction of cooling water impoundment.	issued May 20, 1977
Dam permit for construction of water intake pumping structure.	issued May 20, 1977

Several meetings were held with the U.S. Army Corps of Engineers, Tulsa District office relative to the location and type of structure to be utilized in pumping water from the John Redmond Reservoir to the Wolf Creek cooling lake

240.0 HYDROLOGICAL AND GEOTECHNICAL ENGINEERING BRANCH

Q240.1 (ER) (3.3) ER-OL, p. 3.3-2, Sec. 3.3.6. Please indicate the makeup water rates used in simulating the Wolf Creek cooling lake drawdown during the 16-year (1948-1964) design weather period.

R240.1 The makeup rate for the 16-year cooling lake analysis was divided into three makeup schedules given as follows:

> For the predrought, January 1, 1949 to July 31, 1952, the makeup rate varied from 0 to 120 cfs; during the drought, August 1, 1952 to May 31, 1957, the makeup rate was fixed at a constant 40 cfs; and for the post drought, June 1, 1957 to December 13, 1964, the makeup rate varied from 0 to 120 cfs.

In the predrought and post drought periods where the makeup varied from 0 to 120 cfs, the LAKET program calculated the amount of makeup required to maintain a constant cooling lake elevation of 1087 feet MSL. The attached tables list the average monthly makeup flow rates for the 16-year cooling lake analysis for Unit 1 and Units 1 and 2 respectively.

TABLE 240.1-1

Monthly Average WCGS Cooling Lake

Makeup Flow Rate, cfs, From 1949 to 1964

WCGS - Unit 1

Month/ Year	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964
JAN	0	26.07	24.37	18.14	40.0	40.0	40.0	40.0	40.0	58.64	62.99	50.03	67.50	38.27	61.44	63.24
FEB	0	23.55	9.18	20.94	40.0	40.0	40.0	40.0	40.0	54.27	59.34	44.75	51.99	43.21	59.20	65.46
MARCH	0	34.67	20.85	.40	40.0	40.0	40.0	40.0	40.0	5.70	69.26	20.66	37.48	40.50	47.76	73.74
APRIL	0	44.57	9.43	0	40.0	40.0	40.0	40.0	40.0	46.27	67.04	52.52	31.33	78.74	96.34	43.85
MAY	0	16.67	0	35.03	40.0	40.0	40.0	40.0	40.0	53.05	43.40	54.56	0	103.56	89.63	79.21
JUNE	0	18.04	0	81.65	40.0	40.0	40.0	40.0	0	52.64	87.42	83.83	36.02	25.74	84.55	46.78
JULY	14.07	0	0	63.25	40.0	40.0	40.0	40.0	57.71	11.28	32.91	79.61	93.95	93.55	108.55	115.02
AUG	62.04	0	0	40.0	40.0	40.0	40.0	40.0	118.33	85.36	96.66	76.76	92.31	108.52	117.54	92.53
SEPT	25.05	0	0	40.0	40.0	40.0	40.0	40.0	79.25	54.96	103.25	115.36	10.72	12.04	102.06	95.69
OCT	33.94	24.40	0	40.0	40.0	40.0	40.0	40.0	63.34	93.90	12.60	48.60	59.44	75.35	107.42	95.0
NOV	48.76	51.54	0	40.0	40.0	40.0	40.0	40.0	54.28	73.87	78.92	75.36	54.08	64.31	80.44	83.68
DEC	23.56	28.83	.94	40.0	40.0	40.0	40.0	40.0	57.71	59.98	58.39	65.89	58.43	66.84	72.53	65.04

TABLE 240.1-2

Monthly Average WCGS Cooling Lake

Makeup Flow Rate, cfs, From 1949 to 1964

WCGS - Units 1 & 2

Month/ Year	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964
JAN	.55	37.58	36.74	29.31	40	40	40	40	40	120	73.68	60.42	78.39	46.46	70.30	74.68
FEB	0	34.70	13.42	34.31	40	40	40	40	40	120	70.45	56.65	53.40	57.92	71.92	78.93
MARCH	0	48.27	39.94	3.45	40	40	40	40	40	120	83.65	31.33	51.64	52.95	62.05	87.15
APRIL	10.82	59.0	24.58	10.62	40	40	40	40	40	120	82.40	69.02	44.16	93.98	112.02	58.21
MAY	24.04	31.51	0	68.84	40	40	40	40	40	120	61.40	71.85	0	115.61	107.94	92.96
JUNE	45.68	39.17	0	100.27	40	40	40	40	120	120	101.67	101.18	74.30	49.97	101.11	68.83
JULY	36.15	4.94	0	84.38	40	40	40	40	120	70.28	56.06	99.02	110.62	111.69	120	120
AUG	82.67	0	0	40	40	40	40	40	120	108.92	116.13	97.21	112.78	113.71	120	120
SEPT	42.37	16.87	0	40	40	40	40	40	120	80.37	119.59	119.33	26.27	42.20	120	118.50
OCT	51.07	75.16	0	40	40	40	40	40	120	110.86	29.33	76.68	78.09	94.83	120	111.58
NOV	61.83	64.67	9.72	40	40	40	40	40	120	87.80	91.89	90.19	67.15	76.10	120	98.74
DEC	35.0	39.48	39.18	40	40	40	40	40	120	70.01	70.34	76.93	69.45	79.59	86.29	74.92

Q240.2 (ER) (3.4) ER-OL, p. 3.4-1, Sec. 3.4.1. For one 1150 MWe unit operating at a 100-percent average annual load factor, will the circulating water heat rejection rate be 8.1×10^9 Btu/hr as stated in Sec. 3.4.1 or 7.87×10^9 Btu/hr as indicated in Sec. 3.4.4?

R240.2 The circulating water heat rejection rate for one 1150 MWe unit operating at 100 percent average annual load factor is 7.87×10^9 Btu/hr.

The 8.1×10^9 Btu/hr heat rejection rate mentioned in Section 3.4.1 should be 8.0×10^9 Btu/hr and represents the heat rejection rate for the circulating water system plus 0.13×10^9 Btu/hr heat rejection rate for the service water system.

Q240.3 (ER) (3.4) ER-OL, p. 3.4-3, Sec. 3.4.3.2. The calculated velocities of the water approaching and within the circulating water intake structure do not seem to be accurate. The staff has presented in the FES-CP, Table 3.1 the various intake velocities for a total flow rate of 1256 cfs. Please prepare the similar table for the modified intake structure and the revised flow rate of 1204 cfs.

R240.3 See revised Section 3.4.3.2, page 3.4-3. The water intake velocities listed in Section 3.4.3.2 replace Table 3.1 of the FES-CP.

Q240.4 (ER) (3.4) ER-OL, p. 3.4-3, Section 3.4.3.2. Please provide an engineering drawing showing the width of the modified circulating water discharge chute, and also indicate the discharge velocity for a total flow rate of 1204 cfs.

R240.4 The width of the modified circulating water discharge chute is 75 feet as shown in the plan view of drawing S-500 provided with formal response.

The discharge velocities below the circulating water discharge chute for a total flow rate of 1204 cfs are calculated to be 1.15 ft/sec and 1.5 ft/sec for the lake levels of 1087.0 ft (normal operating level) and 1085.0 ft (low water level for 1-unit) respectively.

Q240.5 (ER) (3.4) ER-OL, p. 3.4-4, Sec. 3.4.4. Please indicate the service water temperature rise and the combined circulating and service water temperature rise for the station operating at full load.

R240.5 The service water temperature rise and the combined circulating and service water temperature rise for one unit operating at 100% load are given as follows:

Service water temperature rise	= 6.4°F
Plant temperature rise (Combination of circulating and service water)	= 29.6°F
Circulating water temperature rise	= 31.5°F

Q240.6 (ER) (3.4) ER-OL, p.3.4-4, Sec. 3.4.4. Please provide a copy of the manual describing the LAKET computer model used to calculate the cooling lake temperature distribution.

R240.6 The LAKET program is proprietary so that only the LAKET program abstract is attached for your review. The LAKET user's manual is available in Sargent & Lundy offices for NRC's inspection.

R240.6 (continued)

PROGRAM ABSTRACT

TITLE:	LAKET - One-Dimensional Lake Thermal Prediction Program
PROGRAM NO.:	09.5.072-5.0
AUTHOR:	R. J. Slezak
PROGRAM SCOPE:	LAKET analyzes th transient thermal performance of one-dimensional lakes, rivers, and channels. Varying plant flow rate and rise temperature are treated. Lake TDS and turbine back-pressure may be computed. Runs may switch between open and closed cycle, and between constant level and varying level.
INPUT:	Lake configuration, meteorological conditions, and plant operational data.
OUTPUT:	Lake temperatures, elevation, and water balance components. Full statistical monthly, seasonal, yearly, and total summaries for all variables. Computer-generated plots of all calculated variables versus time are available with the LAKPLOT (09.5.115-1.0) post processor.
COMPUTATIONAL APPROACH:	A LaGrangian formulation of the mass and energy conservation equations is implemented. Plug flow is assumed through the channel. A 3-hour time step is used for all variables.
ESTIMATED RUNNING TIME:	One CPU minute per year of simulation.
MACHINE:	UNIVAC 1106 Core size $\cong$ 22k words

Q240.7 (ER) (2.4) Describe the effects of plant consumptive water use on existing and projected downstream water users under low flow conditions up to and including the 2 percent chance drought. The description should include current information on water use and current projections of future use.

R240.7 A discussion of the effects of plant consumptive water use on downstream water users during the period of record drought of 1952-1957 was discussed by the NRC staff in the Supplemental Testimony, dated January 6, 1976, on contention I-1 during the Atomic Safety and Licensing Board hearings. This period-of-record drought is estimated to have a recurrence interval of fifty years (2% chance drought). The NRC staff in their discussion concluded that even if all the water rights, senior to Kansas Water Resources Board's right to John Redmond Reservoir storage, set out in Kansas Department of Agriculture list, are included as downstream users, there is sufficient storage available in John Redmond Reservoir to provide 41 cfs to the WCGS and to satisfy rights of downstream users through the period-of-record drought.

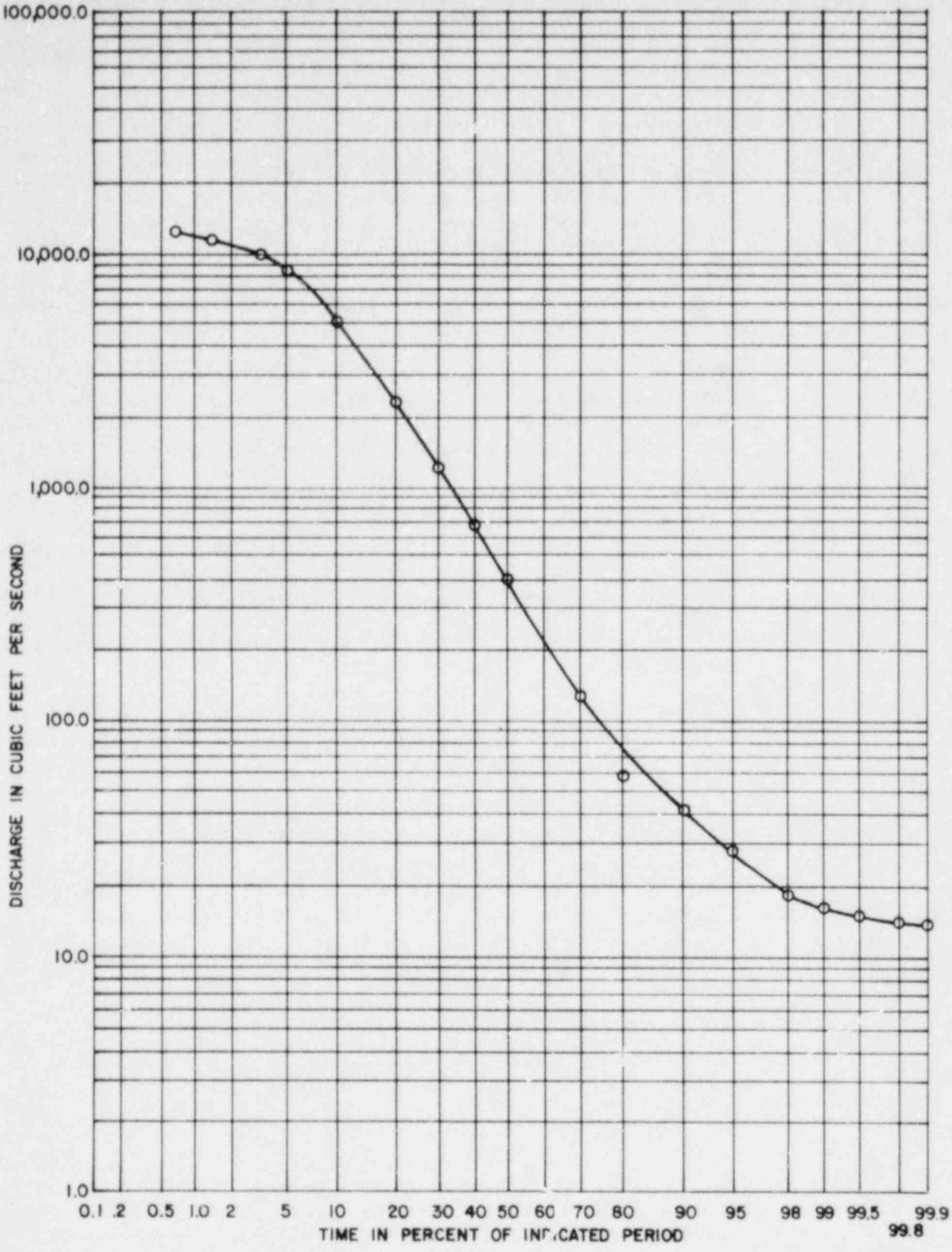
Q240.8 (ER) (2.4) Provide a flow-duration curve for the Neosho River at Wolf Creek reflecting regulation by the John Redmond Reservoir. Also provide an estimate of the 7 consecutive day once in 10 year low flow for the river at Wolf Creek under the same conditions. Discuss the effect of plant operation on these parameters. Provide in your discussion your assumptions regarding reservoir release rates and plant withdrawals.

R240.8 The nearest U.S. Geological Survey gaging station on the Neosho River downstream of John Redmond Reservoir and near the confluence of Neosho River and Wolf Creek is at Burlington, Kansas. This gaging station at Burlington, Kansas, is approximately five miles downstream of John Redmond Reservoir and the confluence of Neosho River and Wolf Creek is approximately 4 miles downstream of this gaging station. The flow-duration information for Neosho River at Burlington, Kansas, for the period October 1964 to September 1979 is presented in Figure 240.8-1. The 7-day 10-year low flow for the same period is 17.3 cfs.

During low flows, the flows in Neosho River below John Redmond Reservoir would constitute the releases from the reservoir for water rights and water quality purposes. Even with plant operation at WCGS, the releases for water rights and water quality will be made from the Reservoir and, hence, the flow-duration for the low-flow range would not be affected at Burlington nor at Wolf Creek.

The Attachment M to the supplemental testimony by NRC staff dated January 6, 1976 on contention I-1 during Atomic Safety Licensing Board hearings (Construction Permit Stage) gives average monthly flows in the Neosho River below John Redmond Reservoir with WCGS operation for the period 1951-1959.

Attachments A and B to the above testimony tabulate the water quality and water rights releases below John Redmond Reservoir. The plant makeup water rates (withdrawal from John Redmond Reservoir) are discussed in Section 3.3.6 of WCGS, ER(OLS). See response to Question 240.7 regarding the effects of plant consumptive water use on existing and projected downstream water users under low flow conditions.



PERIOD OF RECORD:
OCT. 1964 - SEP. 1979

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Figure 240.8-1
Flow-Duration Curve - Daily
Flow of Neosho River at
Burlington

Q240.9 (ER) (2.4) Provide the dates of the minimum daily flows shown in Table 2.4.3 of the ER. If these low flows were a result of reservoir filling, provide minimum daily flows (and dates) for the period after the reservoir began normal operation.

R240.9 See revised Table 2.4-3 for dates of minimum daily flows for the period September 1, 1964 through September 30, 1977. Regulated storage of John Redmond Reservoir began on September 1, 1964.

Q240.10 (ER) (2.4) Provide a description of the analysis used to determine the runoff into Wolf Creek Cooling Lake for the cooling lake simulation study. Describe the gaged basins used to extrapolate flows for Wolf Creek including location, size, period of record, whether the streams are effluent or influent, and any adjustments made other than for drainage area.

R240.10 Since Wolf Creek is ungaged, no records of stream flows are available. Streamflow data for Wolf Creek were synthesized from the U.S. Geological Survey records for the following gaging stations:

Gaging Station	Drainage Area (sq. mi.)	Period of Record Used
1. Neosho River at Council Grove, Ks.	250	1938-1977
2. Neosho River at Americus, Ks.	622	1963-1977
3. Neosho River at Strawn, Ks.	3015	1922-1963
4. Neosho River at Burlington, Ks.	3042	1962-1977
5. Neosho River at Iola, Ks.	3818	1917-1977
6. Virdigris River at Madison, Ks.	181	1955-1976

All the above stations are located adjacent to the Wolf Creek drainage area and the available data is adjusted to correlate with the creek's drainage area. The average intensity of streamflow at the gaging stations was applied to the drainage area of Wolf Creek to obtain the runoff into Wolf Creek cooling lake. No adjustments are made other than for drainage area.

The Neosho River and Wolf Creek are characterized as effluent streams in ER(OLS) Section 2.4.1.2.

Q240.11 (ER) (3.3) Justify the conservatism of the estimates of Wolf Creek Cooling Lake seepage, evaporation, and inflow that have been used as input to the consumptive water use analysis and cooling lake drawdown studies.

R240.11 Seepage

The maximum seepage estimated from the cooling lake and through the cooling lake dam is 0.102 cfs, when the lake level is at the normal operating level of 1087.0 feet MSL. (See Section 2.4.2.4.2 and Table 2.4-10 of ER(OLS) and Section 2.5.6.6.1 of FSAR.) A seepage of 3.5 cfs at the lake level of 1087.0 feet MSL was used in the cooling lake analysis. The use of the higher seepage of 3.5 cfs is conservative because, during drought conditions (August 1952 through May 1957), the higher seepage would force the cooling lake to operate at more severe conditions, greater lake drawdown and higher lake temperatures.

Evaporation

The evaporation predicted by LAKET are based on the most accurate predicted method available from published sources and experimental studies listed below:

Patrick Ryan and Donald Harleman, "An Analytical and Experimental Study of Transient Cooling Pond Behavior," MIT Report No. 161, 1973.

D. K. Brady, W. L. Graves and J. C. Geyer, "Surface Heat Exchange at Power Plant Cooling Lakes", Cooling Water Studies for Edison Electric Institute, Report No. 5, John Hopkins University, November 1969.

B. A. Tichenor and A. G. Christianson, "Cooling Pond Temperature vs. Size and Water Loss", presented at ASCE National Water Resources Engineering Meeting, Phoenix, Arizona, January 1971.

Inflows

The inflows into Wolf Creek cooling lake are estimated as described in response to Q240.10 (2.4). The estimated flows are shown in Table 2.4-22 of the FSAR.

During the historic drought period of 1952-1957, for a period of six consecutive months (September 1956 to February 1957), the flows are negligibly small. Also for the 7 month period, from August 1953 to February 1954, the flow is less than 0.2 cfs. Therefore, it can be concluded that the inflows used in the anlysis are conservative.

Q240.12 (ER) (2.4) Provide detailed stratigraphic sections used for seepage calculations along the seepage sectors shown on Figure 2.4-17. These sections should clearly identify the various stratigraphic members, their length, thickness, and elevations; and the location of wells or streams intersecting these members in the vicinity of the plant. Photo copies of sections plotted for Table 2.4-10 calculations are acceptable.

R240.12 The detailed stratigraphic sections were transmitted with formal response. The same stratigraphic sections, as well as other supporting technical information, were previously provided as written testimony on Contention I-2 during the earlier environmental hearings (Construction Permit Stage).

Q240.13 (ER) (7.1) Calculate the radiological consequences of a liquid pathway release from a postulated core melt accident. The analysis should assume, unless otherwise justified, that there has been a penetration of the reactor basemat by the molten core mass, and that a substantial portion of radioactively contaminated sump water was released to the ground. Doses should be compared to those calculated in the Liquid Pathway Generic Study (NUREG-0440, 1978). Provide a summary of your analysis procedures and the values of parameters used (such as permeabilities, gradients, populations affected, water use). It is suggested that meetings with the staff of the Hydrologic Engineering Section be arranged so that we may share with you the body of information necessary to perform this analysis.

R240.13 The requested analysis to calculate the radiological consequences of a liquid pathway release from a postulated core melt accident will be performed. The analysis will be conducted in accordance with guidance received from the NRC staff. The results of the analysis will be provided to the NRC in the form of a revision to the Environmental Report (OLS) in the near future.

Q240.14 (ER) (2.4) Descriptions of floodplains, as required by Executive Order 11988, Floodplain Management, have not been provided. The definition used in the Executive Order is:

Floodplain: The lowland and relatively flat areas adjoining inland and coastal waters including floodprone areas of offshore islands, including at a minimum that area subject to a one percent or greater chance of flooding in any given year.

a) Provide descriptions of the floodplains adjoining the Neosho River, Wolf Creek and Wolf Creek Cooling Lake adjacent to the site. On suitable scale map(s) provide delineations of those areas that will be flooded during the one percent (100 year) and .2 percent (500 year) chance floods both before and after plant construction.

b) Provide details of the methods used to determine the floodplains in response to a. above. Include your assumptions of and bases for the pertinent parameters used in the computation of the one percent flood flow and water elevation. If studies approved by the Federal Insurance Administration (FIA) are available for the site and adjoining area, the details of the analysis used in the reports need not be supplied. You can instead provide the reports from which you obtained the floodplain information.

c) Identify, locate on a map and describe all structures and topographic alterations in the floodplains.

Q240.15 (ER) (5.7)

a. Discuss the hydrologic effects of all items identified in response to question 14c. Discuss the alteration in flood flows in Wolf Creek below Wolf Creek Cooling Lake. Determine the effect of the cooling lake on the 50, 10, 1, and .2 percent chance floods (2 year, 10 year, 100 year, and 500 year floods) in Wolf Creek below the cooling lake. Expected reservoir water level and storage and the time of the storm should be taken into account.

b. Provide details of your analysis used in response to a. above.

R240.14/240.15

These two Questions (240.14 and 240.15) are interrelated. Therefore, a common response is provided. A description of the Neosho River basin and Wolf Creek watershed is given in Section 2.4.1.2 of the ER(OLS) and Section 2.4.1.2 of the FSAR for the Wolf Creek Generating Station (WCGS).

The flood prone area, the area flooded due to a 100-year flood, in the vicinity of the site prior to the construction of the WCGS and its facilities is shown in Figure 240.14/240.15-1. The flood prone area is taken from Flood Hazard Boundary Maps for Coffey County, developed by the Federal Insurance Administration, U.S. Department of Housing and Urban Development, dated August 1977. Maps showing the area flooded by a 500-year flood are not developed by the FIA and, hence, are not available. However, a Standard Project Flood (SPF) was developed for the Wolf Creek cooling lake and is presented below.

The facilities for WCGS, which may potentially alter the flood plains of the streams in the site area are the cooling lake dam, the makeup water screenhouse on the Neosho River below John Redmond dam, the circulating water screenhouse and discharge structure, the makeup discharge structure and the offsite roads and railroad track. All these facilities are identified in Figure 240.14/240.15-2. The circulating water screenhouse, discharge structure and the makeup discharge structure are built along the shoreline of the cooling lake and will have negligible effect on the Wolf Creek flood plain. A description of other facilities and their potential effects on the flood plains of the streams is given below.

Floods in Cooling Lake

A cooling lake was developed for WCGS by constructing a dam across Wolf Creek. The 100-year flood level in the cooling lake is estimated to be 1089.8 MSL. The flood prone areas above the dam due to a 100-year flood before and after the construction of the dam are shown in Figure 240.14/240.15-2. The boundaries of the property owned by the applicant are also shown in Figure 240.14/240.15-2. The area covered by the 100-year flood in the cooling lake is well within the property boundaries (Figure 240.14/240.15-2). Beyond the property boundary in the upper reaches of Wolf Creek, the 100-year flood in the cooling lake does

R240.14/R240.15 (continued)

not affect the flood prone area which existed prior to construction of the main dam.

The 500-year flood was not generated for the Wolf Creek cooling lake. However, a standard project flood (SPF) was developed for WCGS and is discussed in Section 2.4 of the WCGS FSAR addendum. The cooling lake level during a SPF is estimated to be at an elevation of 1091.7 feet MSL and the area potentially flooded due to SPF would be within the property boundaries.

The complete description of the development of flood hydrographs (100-year flood, and SPF) with and without the cooling lake is given in Section 2.4 of the FSAR addendum. These flood hydrographs are presented in Figures 2.4-17 and 2.4-19 of the FSAR addendum.

Floods in Wolf Creek Below Cooling Lake Dam

The peak flood flows in Wolf Creek below the cooling lake will be considerably smaller, compared to the peak flood flows prior to the construction of the cooling lake due to the storage capacity of the cooling lake available above the lake normal operating level of 1087.0 feet MSL. The peak flood flows in Wolf Creek below the cooling lake for 2-year, 10-year, 100-year and standard project floods were obtained by routing the respective flood hydrographs through the cooling lake and over the service and auxiliary spillways. The description of the spillways and the flood routing procedure are described in detail in Section 2.4 of the FSAR addendum. The starting elevation in the cooling lake was assumed to be at the service spillway crest level of 1088.0 feet MSL though a part of the flood could be absorbed by the storage capacity available between the normal operating level of 1087.0 feet MSL and spillway crest level. Table 240.14/240.15-1 presents the peak flood flows in Wolf Creek downstream of the cooling lake dam together with peak flows during preconstruction condition without the cooling lake. The table clearly shows that the postconstruction peak flood flows are much lower than the corresponding preconstruction flood peaks. Hence, the flooding of the areas below Wolf Creek dam due to Wolf Creek flood flows is much reduced after the construction of the cooling lake.

R240.14/240.15 (continued)

Makeup Screenhouse

The makeup screenhouse was built downstream of the stilling basin for John Redmond dam spillway, and on the east bank of the discharge channel. Figures 3.4-4, 3.4-5, and 3.4-6 ER(OLS) show the general arrangement and location of the makeup screenhouse. The screenhouse is built on the east bank of the discharge channel and as can be seen from Figure 240.14/240.15-2, its encroachment into the 100-year flood zone is very little. Hence, the additional flooding in the Neosho River below the John Redmond dam, due to the makeup screenhouse, is negligible.

Offsite Roads and Railroad Track

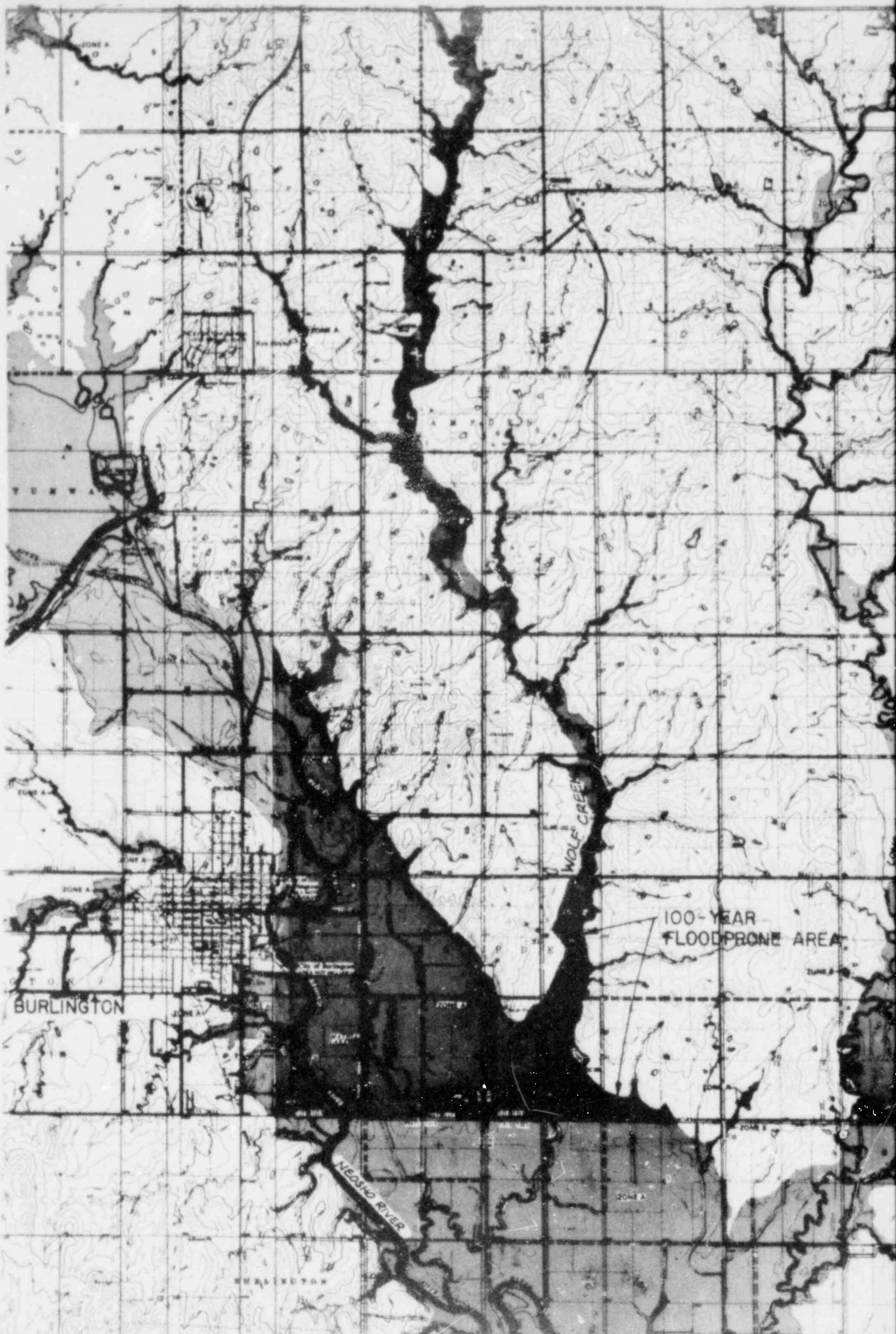
The offsite roads and railroad track are shown in Figure 240.14/240.15-2. The offsite railroad track crosses Long Creek, Scott Creek, Crooked Creek and Taucket Creek. Suitable bridge and culvert openings are provided wherever the roads and track cross the creeks.

TABLE 240.14/240.15-1

PEAK FLOOD FLOWS IN WOLF CREEK

(Below Cooling Lake Dam)

No.	Recurrence Interval (Years)	Peak Flow (Natural Condition) cfs	Peak Flow (With cooling lake) cfs	Maximum Cooling Lake Water Level (feet MSL)
1	2	3,725	290	1088.78
2	10	5,941	497	1089.31
3	100	8,363	928	1089.80
4	SPF	20,000	4,188	1091.70


WOLF CREEK
100-YEAR
FLOODPRONE AREA
BURLINGTON
NEOSHO RIVER

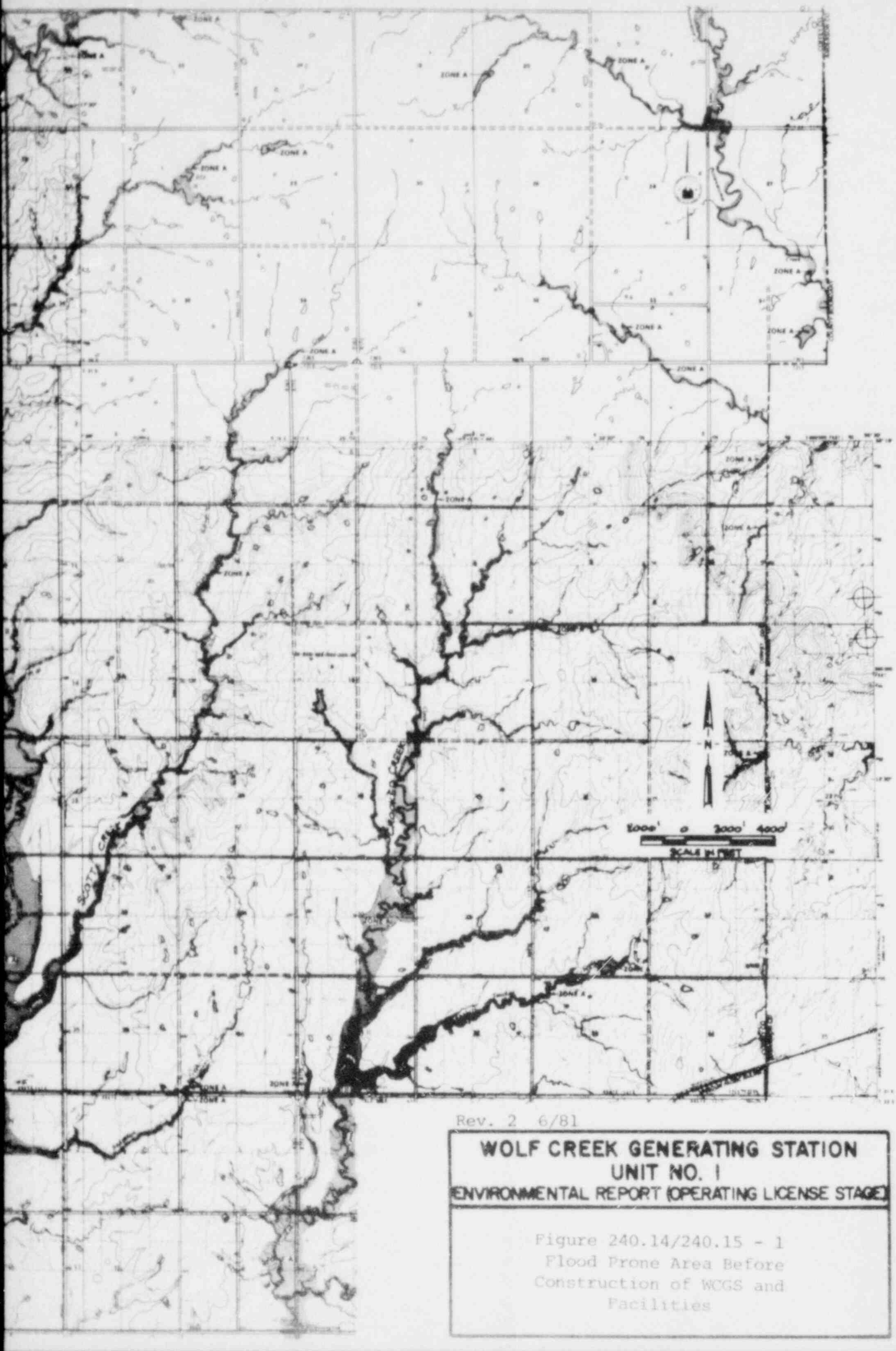


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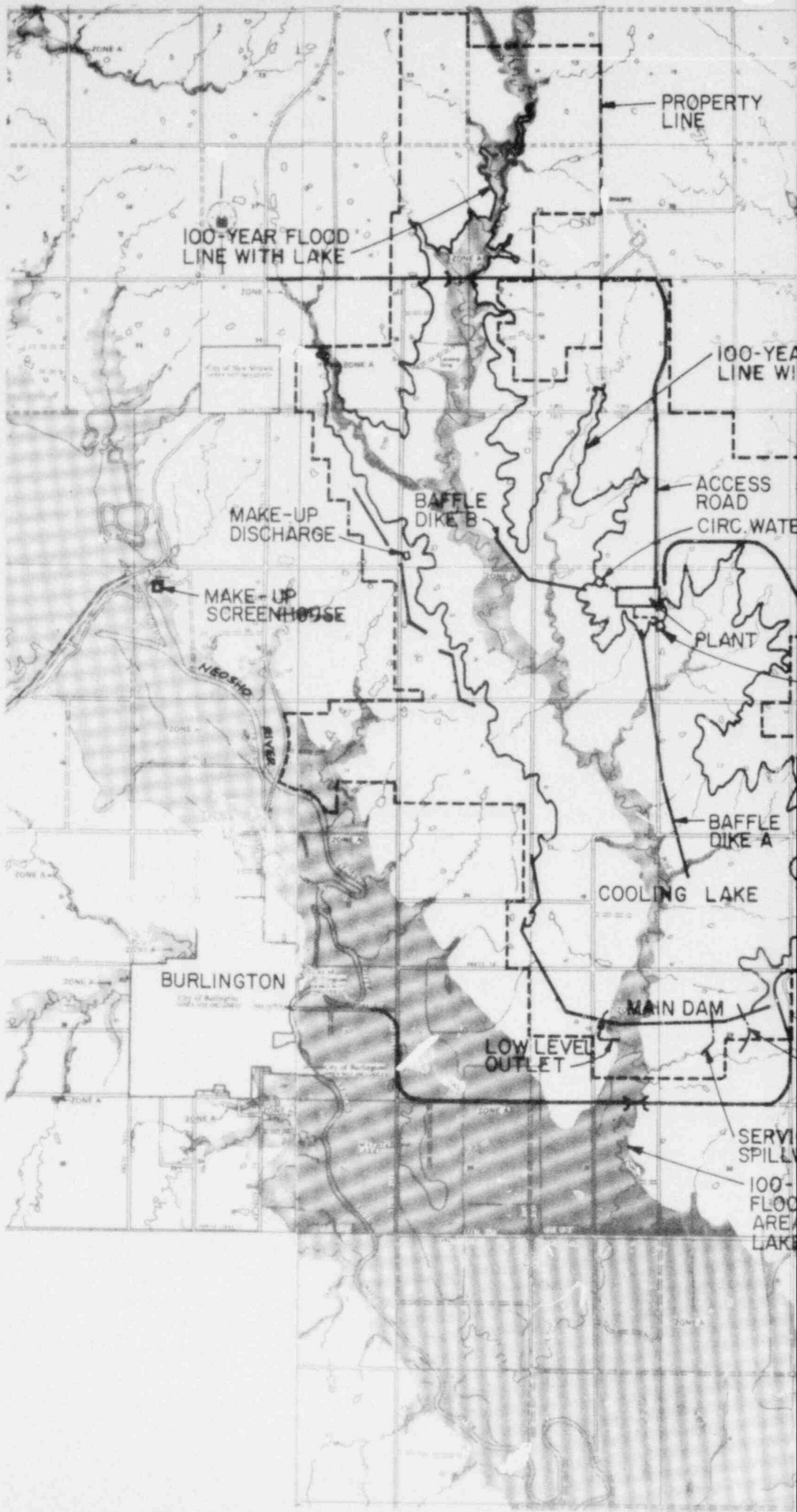
Figure 240.14/240.15 - 1
Flood Prone Area Before
Construction of WCGS and
Facilities


PROPERTY LINE
100-YEAR FLOOD LINE WITH LAKE
100-YEA LINE WI
ACCESS ROAD
CIRC. WATE
BAFFLE DIKE B
MAKE-UP DISCHARGE
MAKE-UP SCREENHOUSE
NEOSHO RIVER
PLANT
BAFFLE DIKE A
COOLING LAKE
BURLINGTON
MAIN DAM
LOW LEVEL OUTLET
SERVI SPILL
100- FLOO ARE LAK

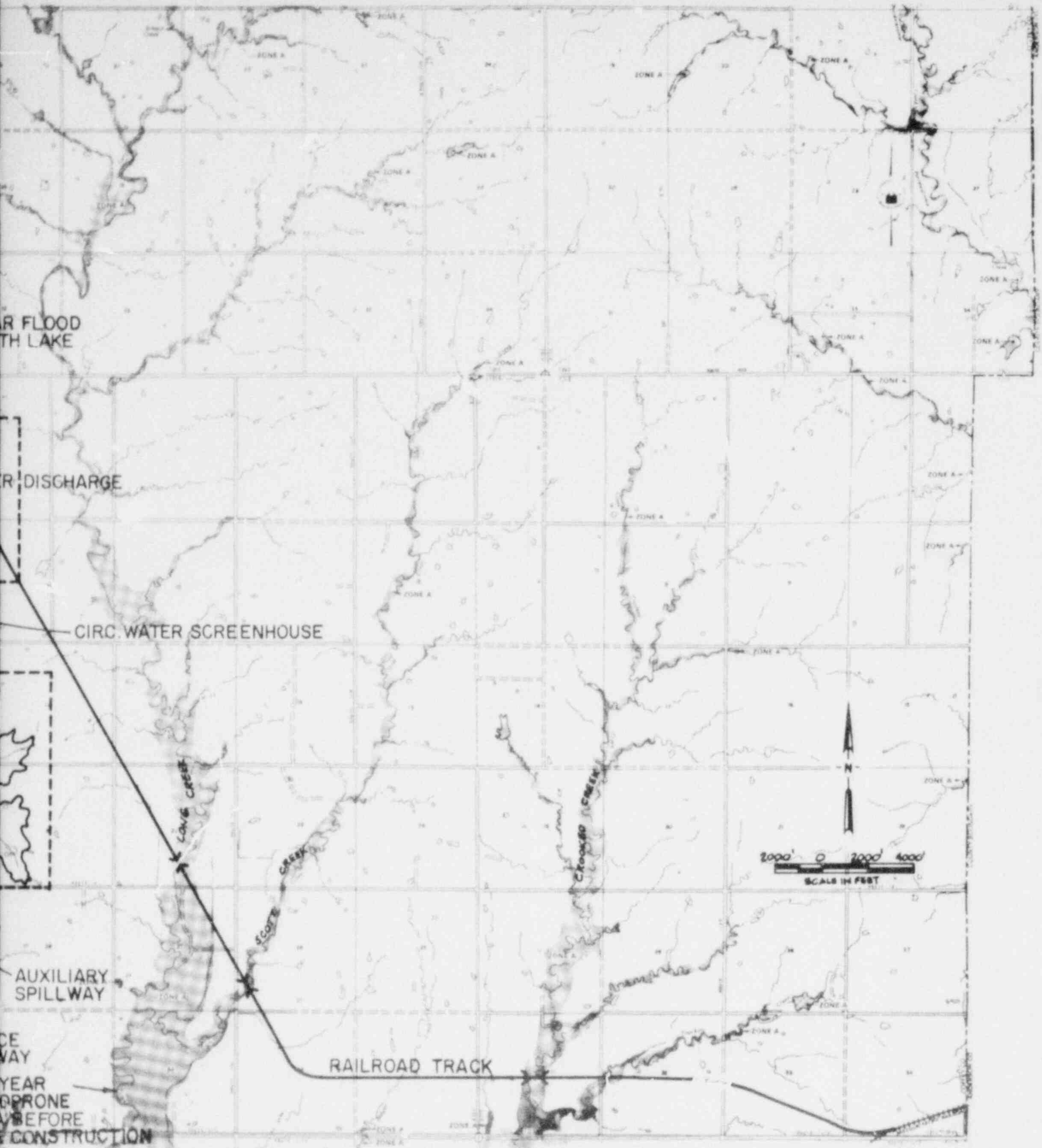


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Figure 240.14/240.15 - 2
Flood Prone Area Before
And After Construction Of
WCGS and Facilities

290.0 ENVIRONMENTAL ENGINEERING BRANCH

Q290.1 (ER) (3.9) Describe any changes in the routing of the transmission line corridors since the ER-OL (Sec. 3.9). What is the current state of completion (ER-OL Sec. 3.9)?

R290.1 Wolf Creek-Rose Hill Transmission line (345-kV) -- No changes to route, to be completed in 1983.

Wolf Creek-Craig Transmission line (345 kV) -- The Wolf Creek-Craig line has been changed and will terminate at a new substation -- West Gardner. The La Cygne-Craig transmission line will be intercepted and brought through the West Gardner substation where a ring bus arrangement will be used to connect these lines to the Wolf Creek 345 kV line. The West Gardner Substation will have three 345 kV lines (Wolf Creek-West Gardner, West Gardner-Craig, and West Gardner-La Cygne). Terminating the 345 kV Wolf Creek line at West Gardner will result in saving approximately 14 miles of 345 kV line. The transmission line corridor from Wolf Creek to West Gardner has not changed. Wolf Creek-West Gardner is to be completed in 1983.

Wolf Creek-Benton transmission line - no change. Completed in 1976.

Wolf Creek-La Cygne transmission line - no change. Completed in 1976.

Wolf Creek tap of Athens-Burlington transmission line - no change. Completed in 1975.

Wolf Creek to Coffey County REC transmission line - no change. Completed.

Q290.2 (ER) (3.9) Give details on the present status of the railroad spur routing and have there been any changes since the FES-CP Sec. 3.9?

R290.2

a. Railroad Spur Route: The route of the completed railroad spur is shown on drawing S-300 (copy provided with formal response).

b. Changes since FES-CP Section 3.9: The right-of-way for the offsite railroad spur varies from a width of 60 feet to 180 feet.

Q290.3 (ER) (3.9) Has the water pipeline been completed and have there been any changes in the proposed route (FES-CP Sec. 3.9)?

R290.3

a. The construction of the makeup water pipeline is complete.

b. The route of the existing pipeline varies from the proposed route shown in FES-CP Section 3.9 at the makeup water screen house (Corps of Engineers property) and at the makeup water discharge structure (KG&E property). The existing route of the pipeline is shown on drawings S-1, M-84, M-85, M-86 and M-87 (copies provided with formal response).

Q290.4 (ER) (3.9) What are the current plans for recreational and agricultural land use on site when WCGS becomes operational?

R290.4 No changes will result in recreational land use when WCGS becomes operational because there are no plans to open the lake for public recreational use as described in Section 2.8.

Land owned by the Applicants is presently being utilized for agricultural purposes. It is the Applicants' policy to lease such lands when such leasing is consistent with prior commitments and does not interfere with the future operation of WCGS. No change from this policy is anticipated when WCGS goes into operation. Section 2.8 also describes this land use policy for land adjacent to the cooling lake and inside the WCGS site boundary.

Q290.5 (ER) What mitigative measures will be taken by the applicant (or other agencies) for the protection of bald and golden eagles that may be attracted to the cooling lake? This is in regards to both protection from plant operation and structures and from recreational users of the cooling lake.

R290.5 Because the construction of the WCGS cooling lake will create habitat favorable for wintering Bald Eagles, mitigative measures have been taken for the protection of these endangered raptors. The Golden Eagle, since it occurs only rarely in this part of the state (Schwilling, Pers. Comm) would be of lesser concern.

Management considerations and their corresponding mitigative measures for Bald Eagles include:

1. Potential Hazards

   A. Human disturbance - The WCGS cooling lake is closed to the public and therefore human disturbance of Bald Eagles roosting or feeding on the cooling lake will be minimized.

   B. Shooting - Shooting is the most prevalent single cause of death among Bald Eagles (Coon et al. 1970). Restriction of public access will minimize the incidence of eagle shootings on the WCGS cooling lake.

   C. Electrocution - Electrocutions occur when an eagle, or other bird, with a wide wing span makes simultaneous contact with any two phase conductors or with a phase conductor and a ground wire. Powerlines with electrical ratings over 69 kv do not present a hazard because of wide line spacing. On powerlines with ratings of 69 kv or less, crossarm type distribution poles are the most likely to be involved with electrocutions (Ansell et al. 1980). The distribution poles used on the 69 kv line near the WCGS cooling lake are not the crossarm type.

2. Food Supply

   Wintering Bald Eagles feed primarily on crippled or healthy waterfowl and winter-killed

R290.5 (continued)

or live fish. They also feed on other waterbirds, upland game and small mammals. All of these food sources are available on or near the WCGS cooling lake.

3. Vegetative Habitats - Wintering Bald Eagles usually perch in large trees that are adjacent to foraging areas and provide protection from the wind (Griffin et al. 1980, Steenhoff et al. 1980). Modifications of the initial cooling lake basin clearing plan were made to increase the amount of standing timber left in the upper portions of the lake. Such areas will probably be utilized as perch sites. In addition, small stands of trees left at various locations around the lake will also provide excellent perch sites. It is also quite likely that Baffle Dikes A and B will be utilized for perching and foraging. This variety of potential perch sites should reduce usage of power poles for perching.

4. Avifauna Surveys - Surveys of the WCGS cooling lake have been initiated by the Applicant to determine the amount of Bald Eagle usage and identify any developing problems. Surveys are conducted on a semi-monthly basis during the months of January-April and September-December. Three ground surveys (each at a different time of day) are conducted during each half-month period. Aerial surveys of both the WCGS cooling lake and John Redmond Reservoir will be conducted on a monthly basis beginning in September, 1981.

REFERENCES

Ansell, A. R., and W. E. Smith, 1980, Raptor Protection Activities of the Idaho Power Company in Workshop on Raptors and Energy Developments, R. H. Howard and J. F. Gore, ed. p. 56-70.

Coon, N. C., L. N. Locke, E. Cromartie and W. L. Reichel, 1970, Causes of Bald Eagle Mortality, J. Wildl. Dis. 6(1):70-76.

R290.5 (continued)

Griffin, C. R., T. S. Baskett and T. S. Sparrowe, 1980, Bald Eagles and the Management Program at Swan Lake National Wildlife Refuge in Trans. 45th North Am. Wild. and Nat. Resources Conf.

Schwilling, M., Non-game, Threatened and Endangered Project Leader, Kansas Fish and Game, 1981, Personal Communication.

Steenhoff, K., S. S. Berlinger and L. H. Fredrickson, 1980, Habitat Use by Wintering Bald Eagles in South Dakota, J. Wildl. Manage. 44(4):798-805.

Q290.6 (ER) Was the crawfish frog observed in the area to be inundated by the cooling lake mudflat area? If so, are there other preferred habitat areas within the area that currently maintain a localized population of this species?

R290.6 Records exist which document the occurrence of the northern crayfish frog (Rana areolata) for twelve eastern Kansas counties, including Coffey County. Although there was a single observation of this species in 1976 on the mudflats of John Redmond Reservoir, there have been no observations made of the crayfish frog on the WCGS site. While the lack of observations for this species on site does not entirely rule out the possibility of their occurrence, it does indicate that no large colonies, similar to those referenced by Collins (1974), exist on site.

REFERENCE

Collins, J. T., 1974, Amphibians and Reptiles in Kansas, Univ. of Kans. Museum of Natl. Hist., Publ. Ed. Ser. No. 1, 283 p.

Q290.7 (ER) Has the baseline terrestrial ecology been done for the proposed ROWs? Please provide the data.

R290.7 No baseline terrestrial ecology data has been collected for the transmission line right-of-ways. During the ER(CPS) no commitments were made by the Applicant and no recommendations were made by the Commission in the WCGS Final Environmental Statement to perform such monitoring. Consequently, there are no plans to perform ROW monitoring.

Q290.8 (ER) Have there been any changes in the site boundaries? Where are they?

R290.8 The site boundary was changed in a few minor ways between that described in the Environmental Report Construction Permit Stage (ER[CPS]) and the Environmental Report-Operating License Stage (ER[OLS]). Figure 2.1-8 of the ER(CPS) and 2.1-6 of the ER(OLS) should be compared to show the changes. The changes resulted in less property being purchased for WCGS proper. The nominal acreage within the site boundary in the ER(CPS) was 10,500 acres and the actual amount purchased was 9,818 acres. The specific changes are:

- Sections 13 and 24, T21S-R15E -- Boundary moved east to section line;
- Section 30, T21S-R16E -- Boundary moved north to half-section line (See revised ER(OLS) Figure 2.1-6);
- Section 17, T21S-R16E -- Boundary excludes NW 40 acres (See revised ER(OLS) Figure 2.1-6);
- Section 9, T21S-R16E -- Boundary moved west to section line; and
- Section 36, T20S-R15E -- Boundary moved west to follow lake contour.

Q290.9 (ER) How many hectares on site are grazed prairie and how many are old farmland?

R290.9 In answering this question, grazed prairie was understood to be grasslands in which the sod has never been tilled, and old farmland was interpreted as land that was once cultivated and has since been returned to grass. There are an estimated 626 hectares of grazed prairie and 72 hectares of old farmland that are above elevation 1087 and within the site boundary. Information concerning demography of land below elevation 1087 is given in Section 4.1.1 of the ER (CPS).

Q290.10 (ER) (2.1.3) Provide a Table similar to Table 3.9-1 indicating the percentage of prime and unique farmlands onsite.

R290.10

TABLE 290.10-1

PRIME AND UNIQUE FARMLANDS ON WCGS SITE

	Prime Farmland	Unique Farmland	Total Acres	Percent Prime & Unique
Onsite	7,756 acres*	0 acres	9,818	79%

*The total acreage is based on field inspection sheets and is an estimate. Exact acreage of prime farmland can be supplied upon issuance of the US Soil Conservation Service Master Soil Map of Coffey County.

Q290.11 (ER) (2.2.1) Provide an update of the listing of Rare and Endangered Species.

R290.11 One species, the Bald Eagle, named on the official list of threatened and endangered species for the United States (U.S. Dept. of Interior, 1979) and classified as endangered by the state of Kansas, was observed on and near the WCGS site. No other species on the federal list has been observed during monitoring activities.

One species listed on the state of Kansas endangered species list, the Neosho madtom (Noturus placidus), has been collected during monitoring activities at WCGS. It has been collected consistently at two Neosho River locations since 1978.

Two bird, one fish, and one amphibian species classified as threatened by the state of Kansas have been collected or observed near WCGS. The prairie falcon was observed in 1979 and again in 1981 as a winter resident. The least tern was observed at John Redmond Reservoir (JRR) in 1977. The blue sucker has consistently been collected at several Neosho River locations since 1978. This species has been collected at JRR (Location 1) most frequently. The northern crayfish frog has been observed only once on the JRR mudflats in 1976.

The bobcat, a species previously listed as endangered (federally), has been observed by tracks in the north floodplain area in 1977 during monitoring and in 1980 as an incidental siting by site personnel.

The following list includes those species classified as endangered or threatened by the state of Kansas.

ENDANGERED WILDLIFE IN KANSAS

1.	Black-footed Ferret	Mustela nigripes
2.	Gray Bat	Myotis grisescens
3.	Peregrine Falcon	Falco peregrinus
4.	Whooping Crane	Grus americana
5.	Eskimo Curlew	Numenius borealis
6.	Bald Eagle *	Haliaeetus leucocephalus
7.	Neosho Madtom *	Noturus placidus
8.	Pallid Sturgeon	Scaphirhynchus albus
9.	Sicklefin Chub	Hybopsis meeki
10.	Central Newt	Notophtalmus viridescens louisianensis

R290.11 (continued)

11.	Grotto Salamander	Typhlotriton spelaeus
12.	Gray-bellied Salamander	Eurycea multiplicata griseogaster
13.	Cave Salamander	Eurycea lucifuga
14.	Small Amphibious Snail	Pomatiopsis lapidaria
15.	Warty-backed Mussel	Quadrula nodulata
16.	Heel-splitter Mussel	Anodonta suborbiculata

THREATENED WILDLIFE IN KANSAS

1.	Prairie Falcon *	Falco mexicanus
2.	Least Tern *	Sterna albifrons
3.	Blue Sucker *	Cycleptus elongatus
4.	Arkansas Darter	Estheostoma cragini
5.	Topeka Shiner	Notropis topeka
6.	Alligator Snapping Turtle	Macroclemys temmincki
7.	Northern Crawfish Frog *	Rana areolata circulosa
8.	Riffle Beetle	Optioservus phaeus

* Found on or near WCGS site

Q290.12 (ER) (5.5) ovide a discussion on the potential short-term nd long-term effects of electric fields on humans and describe the grounding procedures to be utilized to prevent primary and secondary shocks.

R290.12 Electric utilities commonly employ various grounding practices and techniques as simple and highly effective methods for keeping induced voltages and currents from having harmful effects. All transmission lines associated with Wolf Creek are 345 kV or less. Transmission at these voltages is called EHV (extra high voltage) transmission. When electric utilities began building UHV (ultra high voltage) transmission lines (greater than 500 kV) in the 1960's the potential for increased effect on humans was recognized and studied.

One study conducted by American Electric Power during 1962-1972 with the assistance of the John Hopkins medical group studied electrostatic field effects on the human body (Scherer, et al. undated). One of the objectives of the study was to determine if the electric field could cause either short or long-term effects on human health.

Medical examination was made on 11 linemen who performed live line maintenance at 345 kV using both barehand and hot-stick methods. The medical study consisted of opthamological, otolarynogological, urological, and neuro-psychiatrical as well as physical and laboratory examinations. The nine year continuous study revealed no effects in their health resulting from exposure to high voltage lines. No evidence of any malignancy, or changes in physical, mental, or emotional states were found.

Numerous other studies have also been completed or are ongoing. EPRI collected and reviewed this information and published two reports summarizing the biological effects of high-voltage electric fields (EPRI RP381, 1975; EPRI EA-1123, 1979). The 1975 report concluded and the 1979 report confirms the conclusion that it is highly improbable that electric fields from transmission lines have any significant biological effects on healthy individuals who encounter such fields in a normal way under normal conditions. However, the reports also relate that there may be subtle and as yet undetected effects of such electric fields. Further studies to determine if other effects exist are presently being conducted.

R290.12 (continued)

Years of operating experience have indicated that with proper grounding EHV and UHV transmission lines pose no hazard to the health and well being of humans. Grounding techniques employed by KG&E and KCPL include for 345 kV lines:

1. Static wires overhead of the lines;
2. Ground wires on wooden structures;
3. Ground rods on wooden or steel structures, if required, to limit ground resistance to 10 ohms or less;
4. Fences grounded at 1/4 mile intervals that run parallel to the line or within 200 feet of the center line;
5. Fences that cross the line grounded 50 feet on each side of the center line for KG&E and 80 feet for KCPL; and
6. Minimum ground clearance of 30 feet in open country and higher elsewhere.

These features limit the potential shock hazard to secondary or imperceptible shocks well below the painful shock or let-go shock threshold.

REFERENCES

EPRI RP 381, 1975, Biological Effects of High-Voltage Electric Fields.

EPRI EA-1123, 1979, Biological Effects of High Voltage Electric Fields: An Update.

Scherer, Jr., H. N., and B. J. Ware, Undated, Environmental Effects of High Voltage Transmission, American Electric Power Service Corporation.

Q290.13 (TR) (5.5) Provide a discussion of the potential problems of seasonal waterfowl impacting the proposed transmission lines bordering the Wolf Creek Cooling Lake.

R290.13 There is no doubt that birds collide with transmission lines and that populations utilizing Wolf Creek Cooling Lake (WCCL) will be susceptible to such collisions. However, the potential for such collisions can be greatly reduced through a wide variety of mitigative measures (Thompson, 1978). Preventive measures taken by the Applicant to reduce the potential for transmission line collisions include siting of lines, tower design and prevention of fright/flight collision potential.

1. Initial siting of lines

Only a small percentage of the existing 345 and 69 kV transmission lines pass over WCCL. In the areas where crossings occur standing timber should help to reduce the potential hazard. Standing timber will reduce the clearance between lines and the land configuration, thereby channeling the birds over the lines. In some cases, existing lines paralleled each other thereby clustering the corridors to reduce collision potential.

Two additional 345 kV lines are to be constructed to transmit power from WCGS. Both enter the area from the east, with one traveling to the West Gardner substation in a NNE direction and the other going down the east side of WCCL then west to the Rose Hill substation. The Wolf Creek-Rose Hill line is positioned close to the existing 69 kV line. Paralleling these lines should reduce collision potential.

2. Tower Design

By reducing the number of horizontal planes formed by powerlines, the collisions involving flocks flying through the lines will be reduced. The existing 345 kV lines at WCGS have both two plane and three plane sections. The new 345 lines will have two horizontal planes.

R290.13 (continued)

3. Prevention of Fright/Flight Reactions

The WCGS cooling lake is closed to public access. By restricting human disturbance and hunting, mortality due to collisions when birds are startled or distracted will be minimized.

4. Surveys

Surveys of the WCGS cooling lake have been initiated by the Applicant in order to determine the amount of waterfowl usage and identify any developing trends. Surveys are conducted on a semi-monthly basis during the months of January-April and September-December. Three ground surveys (each at a different time of day) are conducted during each half-month period. Aerial surveys of both the WCGS cooling lake and John Redmond Reservoir will be conducted on a monthly basis beginning in September, 1981.

291.0 ENVIRONMENTAL ENGINEERING BRANCH

Q291.1 (ER) Provide the following information on the lime sludge pond:

a. Location on the station site, including the distance from the pond wall to the cooling lake;

b. Major diversions;

c. Materials of construction;

d. Need for and frequency of clearout and ultimate disposal of wastes removed;

e. Estimated seepage rate from the pond into the groundwater;

f. Estimated composition and flow rate of effluent from the pond into the cooling lake.

R291.1

a. The lime sludge pond is located north of the switch yard and west of the meteorological tower (see Figure 2.4-14). With the cooling lake at normal operating pool level (elevation 1987.0 ft), the distance from the base of the lime sludge pond to the cooling lake will be approximately 50 feet.

b. The lime sludge pond has two diversions, a sluice structure and an emergency spillway. The spill height for the sluice structure is at elevation 2003'5" and for the emergency spillway at 2004'.

c. The lime sludge pond is unlined and has been constructed by excavating the existing grade of the pond area to a maximum height for the bottom of 1997.5' elevation. The excavated soil (inorganic cohesive soil) was used to build the dikes around the pond. The dike slopes are 3:1, vertical to horizontal. Dike slopes are covered with either four inches of seeded topsoil or twelve inches of filter type II covered by twelve inches of riprap class facing.

d. The lime sludge pond is sized to contain all the influent from the lime softener blowdown, carbon and sand filter backwash, and regenerative waste for 2 units in operation and 40 years of plant life. The resulting lime sludge pond size is 180

R291.1 (continued)

acre-ft with an average depth of 7.8 ft and corresponding surface area of 1 million square feet.

e. The seepage rate from the lime sludge pond is expected to be less than 10 gpm assuming upper bound permeability values for underlying soil and rock formations and will probably be less than 1 gpm. The runoff into the lime sludge pond will be negligibly small due to dikes on three sides and a intercepting drainage ditch on the fourth side.

f. At the end of 40 years of plant operation, the sludge accumulated in the lime sludge pond for 2 units in operation is estimated to be 19 acre-ft and approximately 1 ft deep (for the influent values listed in Figure 3.3-1 of the ER(OLS); values are doubled for 2 units in operation). The remainder of the lime sludge pond (161 acre-ft and 6.8 ft depth) at the end of 40 years will still have sufficient capacity to accommodate the worst rainfall. The 100 year-24 hour rainfall in the vicinity of the Wolf Creek Station is only 8 inches (U.S. Commerce Weather Bureau, Technical Paper No. 40). Also, the lime sludge pond volume will have sufficient capacity to accommodate the worst recorded wet years (from the Chanute, Kansas weather data used in the LAKET analysis) from 1949 to 1951 (typically, on an annual average basis, the precipitation rate in the Wolf Creek Station area is lower than the natural evaporation rate). These three consecutive wet years would increase the sludge pond water level by only 2.5 ft, leaving 4.3 ft margin in the lime sludge pond (the 1 ft sludge accumulation included).

The spillway in the lime sludge pond was originally designed for use during heavy rainfalls. However, with reduced demineralized makeup water design demand and thus, the corresponding reduction in pretreatment and demineralizer wastes (reduced lime softeners blowdown, carbon and sand filter backwash, and regenerative waste), the spillway is no longer required even during the heaviest of rainfalls as discussed previously.

Q291.2 (ER) (3.6) Please provide more details on the calculations of the blowdown discharge limits calculated in Section 3.6.2.2 of the OLER. In particular:

a. Provide a complete description of the model used to calculate the allowable blowdown limits;

b. Indicate the values used for the diffusion parameters and flow velocities in these calculations. Describe the model assumptions made in these calculations;

c. The data given in the OLER imply that the concentrations of the TDS, $SO_4^=$ and Cl^- in the blowdown are the same as in the cooling lake. However, such factors as incomplete diffusion or mixing of solutes or concentration stratification in the cooling lake might make the blowdown solute concentration different from that of the lake as a whole. Indicate whether such factors have been considered and, if so, what analysis has been made;

d. Provide the bases of or the source(s) for the criteria for TDS, $SO_4^=$ and Cl^- cited for the Neosho River.

R291.2

a., b. The following is a brief description of the analysis and results for the dispersion of blowdown discharge from Wolf Creek Lake in the Neosho River.

The TDS concentration distribution in the Neosho River is analyzed with a steady state dispersion model assuming the effluent discharge as a point continuous source on one of the banks of the river. The dispersion in the vertical and transverse directions of the river is considered. The longitudinal dispersion is neglected as it will be lower in comparison with the convection due to the ambient velocity of the river. The velocity in the river cross-section is assumed constant and an equivalent rectangular cross-section of the river is assumed for computation.

The following equation is used to find the concentration under steady state conditions:

$$C = \frac{C_o Q_o}{4\pi \sqrt{D_y D_z}\, X} \exp\left[-\frac{U}{4X}\left(\frac{Y^2}{D_y} + \frac{Z^2}{D_z}\right)\right] \qquad \text{Equation 1}$$

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R291.2 (continued)

in which:

C = Concentration at any point in the river

C_o = Effluent concentration

Q_o = Rate of flow of effluent

U = Average velocity of flow in the cross-section

D_y, D_z = Dispersion coefficients in the y and z directions

X = Longitudinal distance

Y = Lateral distance

Z = Vertical distance

As the model is for unbounded channel, the effect of boundaries of the channel are taken care of by using method of images.

The dispersion coefficients were calculated from the following empirical equations developed for natural streams (Ref. 1).

$$\log \left(\frac{D_y}{UH}\right) = -3.547 + 1.378 \log \left(\frac{B}{H}\right) \quad \text{Equation 2}$$

$$\log \left(\frac{D_z}{\nu}\right) = -8.1 + 1.558 \log \left(\frac{UH}{\nu}\right) \quad \text{Equation 3}$$

in which:

B = Top width of flow in river

H = Hydraulic depth of flow

ν = Kinematic viscosity of water

Different combinations of Neosho River discharge, blowdown discharge and initial effluent TDS concentration are used in the computations. Figure 291.2-1 is a summary of the results. The maximum flow area in the cross-section along the length of the river which is having a concentration $\geq$ 500 mg/l (includes 400 mg/l Neosho River ambient TDS concentration) is computed and plotted against the blowdown discharge with C_o as a variable. From these curves the blowdown discharges and C_o values

R291.2 (continued)

corresponding to the maximum flow area equal to 25 percent of the total flow cross-section are picked and plotted on Figure 291.2-1 with the Neosho River discharge as a variable. The 25 percent flow area is designated as a mixing zone according to Kansas Water Quality Criteria for interstate and intrastate waters of Kansas.

The following is used as input for the dispersion calculations:

1. An average section of the two surveyed cross-sections, one at the confluence with Wolf Creek and the other 600 feet downstream, is assumed downstream of the confluence of Wolf Creek with Neosho River. The rectangularized cross-section adopted for computation has a width of 92 feet and depth of 9.0 feet for a discharge of 1335 cfs.

2. The average velocity through the river for a discharge of 1335 cfs is computed as 1.6 ft/sec. The bottom slope of the river is obtained from the USGS (Burlington and Le Roy Quadrangle Sheets, 7.5 minute series) topographic maps. A Manning's 'n' of 0.05 is assumed in the velocity computations.

3. The concentrations are computed at intervals of distances both laterally and vertically.

4. The point of injection for this computation is assumed to be at 5 feet from the bottom.

5. The values of dispersion coefficients used for a river discharge of 1335 cfs are calculated from equations (2) and (3) and they are:

   $D_y = 0.101\ ft^2/sec$

   $D_z = 0.00031\ ft^2/sec$

c. The cooling lake water quality calculations were based on complete mixing in the cooling lake. This issue of using complete mixing in the cooling lake water quality calculations has been discussed previously during the Atomic Safety and Licensing Board hearings (Construction Permit Stage). In this testimony, the NRC staff agreed that the use of complete mixing in the water quality calculations was valid.

R291.2 (continued)

d. The Kansas Water Quality Criteria for interstate and intrastate waters of Kansas, approved by Environmental Protection Agency August, 1978, is used to establish criteria for TDS, $SO_4^=$ and Cl^- (see ER(OLS) Section 3.6.2.2).

REFERENCE

1. Bansel, M. K., "Dispersion in Natural Streams," Journal of the Hydraulics Division, ASCE, Vol. 97, No. Hyll, Proc. Paper 8540, November 1971, pp. 1867-1886.

Q291.3 (ER) (2.4) Outline the derivation of the concentrations given in Table 3.6-1. Are the values for the cooling lake averages over the whole lake - are they steady state values? Discuss why the normal values for the Redmond Reservoir are so much higher than those given in Table 2.4-11.

R291.3 Table 3.6-1 lists the chemical constituents of the water in the John Redmond Reservoir and the Wolf Creek cooling lake (for one and two units in operation) covering a period of 1949 through 1964 which includes a 2 percent chance drought. Since the regulated storage of the John Redmond Reservoir did not begin until September 1, 1964, the John Redmond Reservoir water quality data in Table 3.6-1 were developed on the basis of published Neosho River water quality data (obtained from "Water Resources Data for Kansas," U.S. Geological Survey and Kansas State Board of Health, Division of Sanitation). With these Neosho River data as input, the LAKET program was used to predict the total dissolved solids (TDS) levels in the John Redmond Reservoir. The predicted TDS levels in the reservoir provided data for the calculation of the cycles of concentration (the cycles of concentration is defined as the ratio of the concentration of TDS in the circulating water to that in the makeup water and represents the effect of evaporation on the concentration of dissolved minerals). The concentrations of the other constituents in the water, listed in Table 3.6-1, were then determined by simply increasing these constituents concentrations for the Neosho River by the cycles of concentration, i.e., cycles of concentration times the concentration of the constituents.

The cooling lake water quality data listed in Table 3.6-1 were developed in a similar fashion. The John Redmond Reservoir water quality data were used as input into LAKET to predict the TDS levels in the cooling lake. The cycles of concentration were then determined which was used to cycle up the other water quality constituents. However, the cooling lake data includes sulfuric acid addition (for scale control in the condenser). This means that, with the added acid, the TDS and sulfate levels are increased by more than the cycles of concentration value, while the alkalinity is reduced due to a lower pH. The effects of acid addition are described in ER(OLS) Section 3.6.2.

The Wolf Creek cooling lake water quality data tabulated in Table 3.6-1 were predicted by the

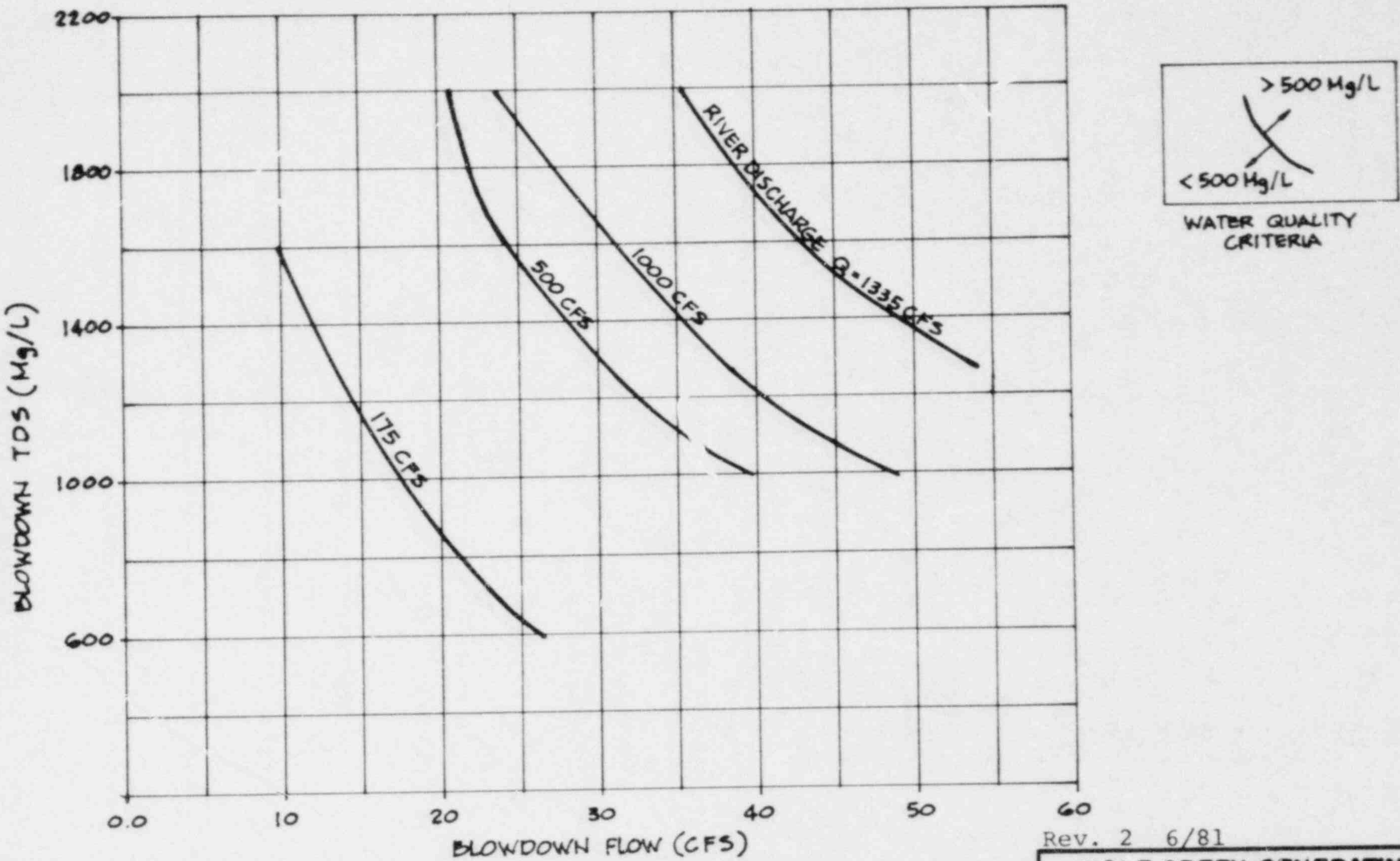

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Figure 291.2 - 1

TDS Limited Blowdo

R291.3 (continued)

LAKET program based on the conservation of total dissolved solids and water as a function of time. For a given time interval, the cooling lake water quality is assumed constant over the entire lake (i.e., complete mixing).

The John Redmond Reservoir water quality data given in Table 3.6-1 are different than those given in Table 2.4-11 because the water quality data in Table 3.6-1 are based on a longer time interval (the TDS data are for a period of 1949 to 1964) than just the three years tabulated in Table 2.4-11. This difference in data base results in higher water quality data values for the John Redmond Reservoir and represents the record period of water quality data. For the cooling lake design, a record period of water quality data is essential and the use of these higher values are conservative.

Q291.4 (ER) Indicate whether essential service water is withdrawn continuously or only during an accident or shutdown?

R291.4 Essential service water (ESW) is not withdrawn continuously or used during shutdown. ESW is used during accident conditions and for testing.

Q291.5 (ER) Provide estimates of the maximum total residual chlorine concentration (including that combined as chloramines and chloroorganics) to be expected at the circulating water discharge outlet to the cooling lake.

R291.5 Chlorination of the condenser cooling water is designed for three 30-minute applications per day. The chlorine dosage will be varied to maintain a free residual chlorine between 0.1 and 0.5 mg/l at the condenser outlet during each chlorination period. The total chlorine residual (including chlorine combined as chloramines and chloroorganics) will depend on the chlorine demand of water. However, during Atomic Safety Licensing Board hearings (Construction Permit Stage) in 1976, it was reported that the total chlorline residual would range between 0.68 mg/l and 1.08 mg/l at the circulating water discharge outlet to the cooling lake.

Q291.6 (ER) Where is the service water discharged? Is sulfuric acid added to the service water? If so, how much is added?

R291.6 The service water is discharged into the circulating water (CW) system downstream of the condensers prior to CW system leaving the power block. Sulfuric acid is not added to the service water system.

The principle expected corrosion products from water passage through the circulating and service water systems will be from the piping and heat exchangers. The concentrations of these corrosion products will be low, on the order of ppb or less. The potential chemical species are summarized below:

Carbon Steel - Fe_2O_3, Fe_3O_4, $Fe(OH)_3$, $Fe_2O3.3H_2O$

90-10 Cupronickel - Cu_2O, CuO, $NiCuO_2$, Ni_3O_4

Stainless Steel - Fe_2O_3, Fe_3O_4, $Fe(OH)_3$, $Fe_2O_3.3H_2O$, $NiFe_2O_4$, Cr_2FeO_4, $NiCr_2O_4$, Ni_3O_4, Cr_3O_4

The concentration of the species will depend upon the ratios of metals present in the system, temperature and chemical composition of the water. The underground service water piping will have cathodic protection which will reduce corrosion in this pipe.

Q291.7 (ER) According to the OLER, Ammonia, Hydrazine, Potassium Chromate, and Turco Decon 4521 and 4520 are used in the power block system. Provide estimates of the usage of these chemicals. Also discuss the ultimate fate of these chemicals. Identify the pathways to the environment from the plant and indicate the amount and concentrations of these chemicals in the pathways.

R291.7 Ammonia

Expected blowdown from normal operations should not exceed .25 ppm NH_3 (See FSAR Table 10.3-4). The blowdown from Hot Standby is less than 10 ppm. All other conditions should have NH_3 concentration of less-than-or-equal-to .5 ppm.

Hydrazine

FSAR Table 10.3-4 shows hydrazine concentration as 75-100 ppm during cold hydro and cold wet layup. Otherwise the hydrazine content should not exceed the 0_2 by 5 ppb. The maximum 0_2 concentration in blowdown and feedwater is less than 100 ppm.

The path: to the environment for NH_3 and hydrazine would be from condenser tube leakage to the circulating water.

Potassium Chromate

Potassium Dichromate is used in the component cooling water system. Pathways to the environment would be from heat exchanger leakage to the service water system.

Normal operational levels of K_2Cr0_4 in the CCW are 175-225 ppm ($Cr0_4$). Initial system conditioning will require 1000 ppm ($Cr0_4$) for the first week after filling the system.

The initial filling residue and any subsequent system drain down would be collected, tested and disposed of in an approved manner, e.g. wastes treated to bring the chromium concentrations to less than 5 ppm, or the waste would be removed to a disposal facility.

Turco Decon 4521 and 4502 (not 4520)

Turco Decon is used to decontaminate parts/equipment and its usage is dependent on the work being done. When used, Turco Decon 4521 is mixed with water, 8 oz to the gallon; and 2 lbs of Turco Decon 4502 is mixed with a gallon of water.

Turco Decon is disposed as drummed solid waste via the chemical waste tank.

Q291.8 (ER) Indicate the concentration and types of chemicals discharged in the rad-waste system effluent into the cooling lake.

R291.8 The reactor coolant system is the normal source of chemicals which may be discharged, after treatment by the liquid radwaste processing system, via the radwaste effluent to the lake.

Maximum releases are provided in Table 291.8-1. Each concentration is based on an average expected flow rate of 1,394 gals/day.

TABLE 291.8-1

TYPE AND CONCENTRATION OF CHEMICALS IN RADWASTE EFFLUENT TO COOLING WATER LAKE

ITEM	OUTPUT CONCENTRATION
Boric Acid	4 ppm
Chlorides	0.15 ppm
Fluorides	0.15 ppm
Suspended Solids	1.0 ppm
pH Control Agent (Li^7OH)	2.2 ppm (as Li)
Silica	0.2 ppm
Aluminum	0.05 ppm
Calcium	0.05 ppm
Magnesium	0.05 ppm

Q291.9 (ER) (3.6) According to the OLER Section 3.6.3.2 each demineralizer train will be regenerated once every 26 days, and only one will be used at any given time with the other train kept as a spare. Explain why the relevant entries of Table 3.6-2 are calculated for twice the above regeneration rate.

R291.9 See revised Section 3.6.3.2. Each demineralizer train will be regenerated once every 13 days.

Q291.10 (ER) (3.6) According to Table 3.6-2 of the OLER about two mole equivalents of H^+ are used in regeneration of the demineralizers for each mole equivalent of OH^-. As a result, during each regeneration, one-half the acid is discharged unused into the alkaline lime sludge pond. Please verify or correct the above entries in the Table.

R291.10 See Table 3.6-2 corrections to sodium hydroxide entries. This table provides the quantity of chemicals going into the primary and mixed bed demineralizers, but the effluent from the demineralizers may contain different proportions of H^+ and OH^-.

Q291.11 (ER) (3.6) Provide details on the derivation of the numbers given in Table 3.6-6 of the OLER.

R291.11 Table 3.6-6 of the OLS-ER lists the impurities removed by one demineralizer train in the treatment of 216,000 gallons of makeup condensate. Based on the specified influent water quality and the design effluent water quality, the demineralizer manufacturer's guaranteed this removal of impurities.

Q291.12 (ER) Describe the program for monitoring TDS, $SO_4^=$, and Cl^- concentrations in the Neosho River or in the blowdown to ensure that discharge criteria are met.

R291.12 Blowdown discharges from Wolf Creek Cooling Lake (WCCL) will comply with Kansas water quality criteria. The monitoring program which will document compliance with the criteria will be delineated by the requirements of the operating NPDES permit issued by the State of Kansas. At this time the NPDES permit has not been modified to cover WCCL discharges. See the response to Question 291.15 for additional discussion concerning the Wolf Creek NPDES permit.

Q291.13 (ER) Indicate whether discharged fluids, including oil spills in the transformer vault discharged through the oily waste separator system. If not, describe the discharge system where the effluents go and the amount of oily discharge to be expected. Describe the oily waste separator system and the fate of the separated oil and aqueous wastes after leaving the system.

R291.13 Any potentially oily waste, including oil spills in the transformer vaults, can be directed to the oily waste separator where oils and liquids are separated by their density differences. Should an oil spill be well contained, the oil could instead be cleaned up and drummed for reclaiming.

Table 3.6-7 gives a summary of oily waste discharge rates. Separated oil is reclaimed from the separator and aqueous wastes are routed to the cooling lake.

A drawing showing the site drainage plan and routing of piping to the oil separator was included with formal response.

Q291.14 (ER) (3.4) Verify or correct the following changes in the OLER supplied during the site visit. Annual use of NaOCL for potable water disinfection 315 lbs/yr instead of 1315 lbs/yr (Table 3.6-2). Lime softener blowdown contains ferric hydroxide instead of ferrous hydroxide (page 3.6-5).

R291.14 Annual use of NaOCl for potable water disinfection should be 315 lbs/yr instead of 1,315 lbs/yr.

The lime softner blowdown contains ferric hydroxide instead of ferrous hydroxide.

Q291.15 (ER) Please supply a list, and copies if available, of all permits needed to discharge effluents during station operation. The OL-ER, Section 12, states that the discharge permit No. 1-NE07-R002 will be modified as WCGS becomes operational. Describe the expected modifications. If available give pollutant limits for the modifications. Identify and describe effluent discharges into the cooling lake or the lime sludge pond that will not be covered by a permit.

R291.15 A copy of the present NPDES permit (No. I-NE07-P001) issued by the Kansas Department of Health and Environment (KDHE) is attached. This permit controls effluents at three onsite locations:

001 Domestic waste treatment plant discharge
002 Stormwater runoff from the construction site
003 Concrete batch plant holding pond discharge

Since closure of the Wolf Creek Cooling Lake (WCCL) dam in November 1980, all plant effluents are being contained in the WCCL impoundment of water and there have been no discharges from Wolf Creek. Consequently, monitoring of the NPDES parameters is presently not required. The response to Question 291.17 discusses the range of time intervals which are projected to be required to fill the WCCL.

Prior to discharging from the lake the present NPDES permit will be modified to reflect the discharge point being the WCCL outlet. Discussions with KDHE personnel indicate that pollutant limits required in the present permit would be typical of those required to be in compliance with Kansas Water Quality Criteria if the operating NPDES permit were issued today.

All effluent discharges from Wolf Creek are either into the cooling lake or the lime sludge pond. (See Question 291.1 concerning discharges from the lime sludge pond.) All drainage in the vicinity of the plant is into the cooling lake so monitoring at the outlet of the cooling lake means that all effluent discharges will be covered by a permit.

1

State of Kansas . . . John Carlin, Governor

DEPARTMENT OF HEALTH AND ENVIRONMENT

Joseph F. Harkins, *Secretary*

Forbes Field
Topeka, Kansas 66620
913-862-9360

March 21, 1980

Kansas Gas & Electric Co. - Wolf Creek Station
201 North Market
P.O. Box 208
Wichita, Kansas 67201

RECEIVED MAR 1980

Re: Kansas Water Pollution Control
Permit No. I-NE07-P001

Gentlemen:

This is to inform you that you have fulfilled all filing requirements for a Kansas Water Pollution Control Permit and Authorization to Discharge under the National Pollutant Discharge Elimination System (NPDES). We are pleased to forward your new permit. While it is permissible to make as many copies as needed for monitoring and reporting purposes, you need to retain the original permit for your files.

We suggest you carefully read the terms and conditions of your permit and that you understand that these terms and conditions are enforceable under both State and Federal law.

We look forward to working with you in the achievement and maintenance of high quality water for the State of Kansas.

Sincerely yours,

Gerald A. Stoltenberg

Gerald Stoltenberg, P.E.
Director
Division of Environment

GS:am4Q1
Enclosure
cc: Southeast District

Kansas Permit Number: I-NE07-P001

Federal Permit Number: KS-0079057

KANSAS WATER POLLUTION CONTROL PERMIT AND AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

Pursuant to the provisions of Kansas Statutes Annotated 65-164 and 65-165, the Federal Water Pollution Control Act as amended, (33 U.S.C. 1251 et seq; the "Act"),

Owner: The Kansas Gas and Electric Company

Owner's Address: 201 North Market, P.O. Box 208
Wichita, Kansas 67201

Facility Name: Wolf Creek Station

Facility Location: Burlington, Kansas 66839
Coffey County

Receiving Stream & Basin: Neosho River via Wolf Creek Impoundment
Neosho River Basin

is authorized to discharge from the waste treatment facility described herein, in accordance with effluent limitations and monitoring requirements as set forth herein.

This permit shall become effective March 21, 1980, will supersede all previous permits and/or agreements in effect between the Kansas Department of Health and Environment and the permittee, and will expire April 30, 1983.

FACILITY DESCRIPTION:

Discharge consists of package plant effluent from domestic wastes, stormwater runoff from the plant site, and overflow from sediment control holding ponds treating process water from a concrete batch plant.

[signature]

Secretary, Kansas Department of Health and Environment

21 March 1980

Date

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

The permittee is authorized to discharge from outfall(s) with serial number(s) as specified in the application for this permit. The effluent limitations shall become effective on the dates specified herein. Such discharges shall be controlled, limited, and monitored by the permittee as specified. The initial reporting period shall begin in April 1980 and end in June 1980 . Each consecutive three month period thereafter shall constitute a reporting period. There shall be no discharge of floating solids or visible foam in other than trace amounts.

	EFFLUENT LIMITATIONS	MONITORING REQUIREMENTS	
Effective Date	Final Limitations Upon Issuance		
Outfall Number and Effluent Parameter(s)		Measurement Frequency	Sample Type
001 - Domestic Waste Treatment Plant into Wolf Creek			
Flow - MGD (Base Flow = 0.03 MGD)	----	Weekly	
Biochemical Oxygen Demand (5-Day)		Weekly	grab
Daily Average-mg/l(lbs/day)	30(7.5)		
Daily Maximum-mg/l(lbs/day)	45(11.3)		
Total Suspended Solids		Weekly	grab
Daily Average-mg/l	30(7.5)		
Daily Maximum-mg/l	45(11.3)		
Free Available Chlorine		Weekly	grab
Daily Maximum-mg/l	1.0		
pH - Standard Units	6.0-9.0	Weekly	grab

002 - Stormwater runoff from construction site

During the period beginning on the effective date and lasting through the date of expiration the permittee is authorized to discharge from outfall(s) serial number(s) 002

Such discharges shall be limited and monitored by the permittee as specified below:

Monitoring of the effluent will not be required unless there is a significant change in the quality or quantity of the subject discharge. The Water Quality Criteria for Interstate and Intrastate Waters of Kansas as formulated by the Kansas Department of Health and Environment, Regulation 28-16-28, will be applicable.

1. The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units.
2. The discharge shall be essentially free of visible oil or grease and in no circumstances result in deterioration of the receiving water's quality.
3. Control of excessive suspended solids shall be undertaken as necessary to prevent receiving water deterioration.

4. There shall be no sludge banks or deposition of solids downstream from the outfall.

5. There shall be no discharge of floating solids or visible foam in other than trace amounts.

Any violation of the above referenced Water Quality Criteria shall be reported immediately to the Kansas Department of Health and Environment, Bureau of Water Pollution Control, in Topeka, Kansas.

003 - Discharge from sediment control holding pond receiving process water from the concrete batch plant

Total Suspended Solids Daily Maximum-mg/l	50	Monthly	grab
pH-Standard Units	6.0-9.0	Monthly	grab

B. STANDARD CONDITIONS

In addition to the specified conditions stated herein, the permittee shall comply with the attached Part I Standard Conditions dated May 1, 1979.

C. SCHEDULE OF COMPLIANCE

None

D. SUPPLEMENTAL CONDITIONS

1. This permit shall be modified, or alternatively, revoked and reissued, to comply with any applicable effluent standard or limitation issued or approved under Sections 301 (b)(2), (C), and (D), 304 (b)(2), and 307 (a)(2) of the Clean Water Act, if the effluent standard or limitation so issued or approved:

   a. Contains different conditions or is otherwise more stringent than any effluent limitation in the permit, or

   b. Controls any pollutant not limited in the permit.

   The permit as modified or reissued under this paragraph shall also contain any other requirements of the Act then applicable.

Effective May 1, 1979

STANDARD CONDITIONS FOR
KANSAS WATER POLLUTION CONTROL AND
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
PERMITS

PART I - GENERAL CONDITIONS

1. Representative Sampling

A. Samples and measurements taken as required herein shall be representative of the nature and volume of the monitored discharge. All samples shall be taken at the locations designated in this permit, and unless specified, at the outfall(s) before the effluent joins or is diluted by any other body of water or substance.

B. Monitoring results shall be recorded and reported on forms acceptable to the Division and postmarked no later than the 28th day of the month following the completed reporting period. Signed copies of these, and all other reports required herein, shall be submitted to:

Kansas Department of Health & Environment
Division of Environment
Water Pollution Control Section
Topeka, Kansas 66620
(913) 862-9360

2. Schedule of Compliance: No later than 14 calendar days following each date identified in the "Schedule of Compliance", the permittee shall submit to the above address, either a report of progress or, in the case of specific actions being required by identified dates, a written notice of compliance or noncompliance. In the latter case, the notice shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next schedule requirements, or, if there are no more schedule requirements, when such noncompliance will be corrected.

3. Definitions

A. The "daily average" discharge means either the total discharge by weight during a calendar month divided by the number of days in the month that the facility was operating, or the average concentration for the month. The daily average discharge shall be determined by the summation of all measured daily discharges by weight divided by the number of days during the calendar month when the measurements were made, or by the summation of all concentrations determined during the calendar month divided by the number of samples collected and analyzed.

B. The "daily maximum" discharge means the total discharge by weight or average concentration during a 24 hour period.

C. The "monthly average", other than for fecal coliform bacteria, is the arithmetic mean of the values for effluent samples collected in a period of 30 consecutive days. The monthly average for fecal coliform bacteria is the geometric mean of the value of the effluent samples collected in a period of 30 consecutive days.

D. The "weekly average", other than for fecal coliform bacteria, is the arithmetic mean of the values for effluent samples collected in a period of seven consecutive days. The weekly average for fecal coliform bacteria is the geometric mean of the values for effluent samples collected in a period of seven consecutive days.

E. The "grab sample" is an individual sample collected in less than 15 minutes.

F. A "composite sample" is a combination of individual samples in which the volume of each individual sample is proportional to the discharge flow, or the sample frequency is proportioned to the flow rate over the sample period.

G. The "Act" means the Clean Water Act, Public Law 95-217.

H. "Division" means Division of Environment, Kansas Department of Health and Environment.

I. "Department" means the Kansas Department of Health and Environment.

4. Test Procedures: All analyses required by this permit shall conform to the requirements of Section 304(h) of the Act, and shall be conducted in a laboratory certified by the Department. For each measurement or sample the permittee shall record the exact place, date, and time of sampling; the date of the analyses; the analytical techniques or methods used; and, the results. If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved procedures, the results shall be included in the Discharge Monitoring Report form required in 1.B. above. Such increased frequency shall also be indicated.

5. Records Retention: All records and information resulting from the monitoring activities required by this permit, including all records of analyses and calibration and maintenance of instrumentation and recordings from continuous monitoring instrumentation, shall be retained for a minimum of 3 years, or longer if requested by the Division.

6. Change in Discharge: All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant not authorized by this permit or of any pollutant identified in this permit more frequently than or at a level in excess of that authorized shall constitute a violation of the permit. Any facility expansions, production or flow increases, or process modifications which will result in new, different, or increased discharges of pollutants shall be reported to the Division at least one hundred eighty (180) days before such changes.

7. Noncompliance Notifications: If, for any reason, the permittee does not comply with or will be unable to comply with any daily maximum or weekly average effluent limitation specified in this permit, the permittee shall provide the Department with the following information in writing within 5 days of becoming aware of such condition:

A. description of the discharge and cause of noncompliance, and
B. the period of noncompliance, including exact dates and times or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate and prevent recurrence of the noncomplying discharge.

The above information shall be provided with the submittal of the regular Discharge Monitoring Report form for violations of monthly average of daily average effluent limitations.

8. Facilities Operation: The permittee shall at all times maintain in good working order and efficiently and effectively operate all treatment, collection, and control systems or facilities used to achieve compliance with the terms and conditions of this permit. Maintenance of treatment facilities which results in degradation of effluent quality shall be scheduled during non critical water quality periods and shall be carried out in a manner approved in advance by the Division. The permittee shall take all necessary steps to minimize any adverse impact to waters of the State resulting from noncompliance with any effluent limitations specified in this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

9. Bypassing: Any diversion from or bypass of facilities necessary to maintain compliance with this permit is prohibited, except where necessary to prevent loss of human life or severe property damage; or where excessive storm drainage or runoff would damage any facilities necessary to comply with this permit. The permittee shall immediately notify the Division by telephone of each bypass and shall confirm the telephone notification with a letter explaining what caused the spill or bypass and what actions have been taken to prevent recurrence.

10. Removed Substances: Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in a manner acceptable to the Division.

11. Power Failures: The permittee shall provide an alternate power source sufficient to operate and wastewater control facilities or halt or otherwise control production and all discharges upon the loss of the primary source of power to the wastewater control facilities.

12. Right of Entry: The permittee shall allow authorized representatives of the Division or the Environmental Protection Agency upon the presentation of credentials, to enter upon the permittee's premises where an effluent source is located or in which any records are required to be kept by this permit, and at reasonable times to have access to and copy any records required to be kept by this permit, to inspect any monitoring equipment or monitoring method required in this permit; and to sample any discharge from the facility and any waste or materials generated or stored on the premises.

13. Transfer of Ownership: The permittee shall notify the succeeding owner, controlling person, or operator of the existence of this permit by certified letter, a copy of which shall be forwarded to the Division.

14. Availability of Reports: Except for data determined to be confidential under Section 308 of the Act, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Department. Effluent data shall not be considered confidential. Knowingly making any false statement on any such report may result in the imposition of criminal penalties as provided for in Section 309 of the Act and K.S.A. 65-170c.

15. Permit Modification: After notice and opportunity for a hearing, this permit may be modified, suspended or revoked in whole or in part during its terms for cause including, but not limited to, violations of any terms or conditions of this permit; obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or, a change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.

16. Toxic Pollutants: Notwithstanding Paragraph 15 above, if a toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307(a) of the Act for a toxic pollutant which is present in the discharge and such standard or prohibition is more stringent than any limitation for such pollutant in this permit, this permit shall be revised or modified in accordance with the toxic effluent standard or prohibition and the permittee so notified.

17. Civil and Criminal Liability: Except as authorized by statute and Paragraph 9 "Bypassing", nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

18. Oil and Hazardous Substance Liability: Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject to under Section 311 of the Act, or K.S.A. 65-164 et seq. The municipal permittee shall promptly notify the Division by telephone upon discovering crude oil or other petroleum derivative in its sewer system or wastewater treatment facilities.

19. Industrial Users: The municipal permittee shall require any industrial user of the treatment works to comply with Sections 307 & 308 of the Act, and any industrial user of storm sewers to comply with Section 308 of the Act.

20. Property Rights: The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of or violation of federal, state or local laws or regulations.

21. Operator Certification: The permittee shall assure that his wastewater facilities are under the supervision of an operator certified by the Department. If the permittee does not have a certified operator, or loses its certified operator, he shall take the appropriate steps to obtain a certified operator as required by K.A.R. 28-16-29.

22. Property Rights: The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

23. Removal From Service: The permittee shall inform the Division at least 3 months before a pumping station or other waste treatment facility is to be removed from service, and shall make arrangements acceptable to the Division of decommissioning that will provide adequate protection for the public health, and ground and surface waters.

Q291.16 (ER) Indicate the present status of Wolf Creek Cooling Lake (WCCL) with respect to completion of the Dam and filling.

R291.16 The Wolf Creek Cooling Lake (WCCL) construction was completed in late 1980. Filling began on November 13, 1980, and has continued intermittently until the present time. As of 5/28/81, WCCL level is 1060.55 and per Figure 2.4-20 (Cooling Lake Area - Capacity Curves) of the FSAR, the lake is at 23 percent of its normal capacity and 41 percent of its low level operating capacity.

Q291.17 (ER) Indicate the present prediction for completion of filling of Wolf Creek Cooling Lake (WCCL).

R291.17 The prediction for the filling of WCCL during the worst case drought at a 41 cfs fill rate is 23 months to the minimum operating level and 41 months to the normal operating level. However, the prediction for an average year at 120 cfs is 5 months to minimum operating level and 14 months to the normal operating level.

Q291.18 (ER) Please provide the results of aquatic biological surveys conducted to date relative to aquatic organisms in WCCL.

R291.18 Scheduled aquatic monitoring on WCCL has been accomplished in February and April of 1981. However data analyses has not been completed by consultants. Data will be submitted to KG&E in May of 1982 and will be available for review by the NRC at WCGS.

Q291.19 (ER) Provide details of the monitoring program on WCCL during filling and as planned after station operation begins. This should include information on icthyoplankton and young-of-the-year fishes, especially in the area of cooling water intake.

R291.19 The Applicants have initiated the lake filling phase environmental monitoring program on Wolf Creek Cooling Lake (WCCL). Cooling lake monitoring includes limnological and fis' -y studies designed to investigate the cooling .e as it fills. Lake monitoring will characterize the chemistry and biology of the cooling lake while providing information on the success of the fish stocking program. The sampling schedule for this phase of monitoring is outlined in Tables 291.19-2 and 291.19-3. Details of the lake filling phase are outlined as follows:

WATER QUALITY

Surface waters will be collected six times per year in the cooling lake at Locations 2 and 6 (Figure 6.1-1). Duplicate water samples will be collected from a depth of one meter using nonmetallic water samplers with the exception of bacteriological and oil and grease samples which will be collected at the surface of the water.

Water quality parameters are presented in Table 291.19-1. Preservation and analytical methods for water quality appear in ER(OLS) Table 6.1-5.

PHYTOPLANKTON

Water samples for phytoplankton analysis will be collected six times per year at Locations 2 and 6 (Figure 6.1-1; Table 291.19-2). The samples will be stored in bottles containing m³ preservative. The inverted microscope method will be used to determine phytoplankton species composition and abundance. Oil immersion will be utilized for identification and enumeration using the following reporting units:

Algal Form	Reporting Unit units/ml)
Diatoms	Each frustule
Unicellular	Each cell
Colonial	4 cells (colonial blue-greens like *Microcystis* are reported in 50 cell units)
Filamentous	100 m lengths

R291.19 (continued)

Biovolume determinations will be made using the geometrical configuration that best suits the species and will be expressed as microliters per liter (1/l). Appropriate taxonomic keys will be used as identification aids. Carbon fixation rates and chlorophyll a concentrations will be determined and used as indices of phytoplankton primary productivity.

ZOOPLANKTON

Duplicate zooplankton samples will be collected six times per year at Locations 2 and 6 in the cooling lake (Figure 6.1-1; Table 291.19-2). The zooplankton community will be sampled with a conical plankton net. At each location, two bottom to surface hauls will be collected, combined, and preserved. Samples will be examined qualitatively to generate a checklist of zooplankton occurring in the cooling lake. Replicates will be collected at each location to determine mean zooplankton standing crop (mg/l).

PERIPHYTON

Periphyton collections in WCCL will not be initiated until the cooling lake reaches operating pool level (1087 MSL) or one year prior to station operation. Sample analysis, upon initiation of collections, will be similar to analytical methods utilized on Neosho River samples.

MACROINVEPTEBRATES

Duplicate bottom samples will be collected six times per year from Locations 2 and 6 in the cooling lake (Figure 6.1-1; Table 291.19-2). Samples will be collected using a Ponar grab quantitative collecting device.

All quantitative samples will be sieved and the organisms that are retained will be fixed and stained. All organisms will be identified to species, if possible, or to the lowest positive taxonomic level. Identifications will be made using appropriate taxonomic keys. All benthic data will be reported as the number of organisms per square meter of substrate ($no./m^2$).

FISH

The fishery study will provide data useful to KG&E's management effort. The fish study has been designed to evaluate KG&E's stocking program by targeting stocked species of fish. The year and sampling effort utilized in the cooling lake

R291.19 (continued)

follows recommendations made in The Kansas Fish and Game Commission manual of survey techniques for reservoir management. The sampling schedule for fishery studies during lake-fill appears in Table 291.19-3. Specifications for gear to be utilized is shown in Table 291.19-4.

Catch data will be expressed in units of effort. Additional parameters measured in the cooling lake will include conductivity, secchi disk readings, and temperature profiles. Physical data (depth, secchi disk and temperature) will be recorded at the beginning and end of each net set. Sample locations will be established and identified with land marks to ensure consistency over time.

A semi-balloon trawl will be used to sample young-of-year (YOY) fish during summer and fall months (Table 291.19-3). No larval fish sampling is scheduled for WCCL during the lake filling phase.

The planned operational monitoring program will be designed to assess the effects of station discharges on the environment. The operational studies will be continuations of the pre-operational lake filling phase studies with modifications based on study findings, lake use, and other factors. Changes to sampling frequency and additional studies as described in Section 6.2.1 of the ER(OLS) will be implemented.

The proposed schedule for operation monitoring is shown in Table 291.19-5. Larval fish sampling will be included in the operational phase monitoring of WCCL. Larval fish will be collected on a twice a month basis from April through July at Location 8. YOY and adult fish sampling will follow the methodology used in the last year of lake filling phase monitoring.

TABLE 291.19-1

WATER QUALITY PARAMETERS MEASURED IN SURFACE WATER SAMPLES

General Water Quality Parameters

Alkalinity, total
Calcium
Chloride
Color, true
Conductance, specific
Iron, soluble
Iron, total
Magnesium
Magnanese, total
Oxygen, dissolved
Oxygen, saturation
pH
Potassium
Residue, filtrable (total dissolved solids)
Residue, nonfiltrable (total suspended solids)
Sodium
Sulfate
Temperature
Turbidity

Aquatic Nutrients

Ammonia
Nitrate
Nitrite
Organic nitrogen, total
Orthophosphate, soluble
Phosphorus, total
Silica, soluble

Indicators of Industrial and Municipal Contamination

Bacteria, fecal coliform
Bacteria, fecal streptococci
Biochemical oxygen demand (5-day)
Chemical oxygen demand
Hexane soluble materials
Organic carbon, total

Trace Metals

Copper, total
Lead, total
Mercury, total
Selenium, total
Zinc, total

TABLE 291.19-2

SAMPLING SCHEDULE FOR THE AQUATIC PORTION OF THE 1981 LAKE FILLING PHASE OF THE CONSTRUCTION MONITORING PROGRAM FOR WOLF CREEK GENERATING STATION

DISCIPLINE	Feb	Apr	Jun	Aug	Oct	Dec
Water Quality						
Cooling Lake[a]	X	X	X	X	X	X
Aquatic Ecology						
Cooling Lake						
Phytoplankton	X	X	X	X	X	X
Zooplankton	X	X	X	X	X	X
Macroinvertebrates						
Benthos	X	X	X	X	X	X

[a] = Cooling Lake Locations 2 and 6

TABLE 291.19-3

FISH SAMPLING SCHEDULE FOR THE LAKE FILLING PHASE ENVIRONMENTAL MONITORING PROGRAM AT THE WOLF CREEK GENERATING STATION, 1981

	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cooling Lake												
Electrofishing[a]	X	X	X	X	X	X	X	X	X	X	X	X
Trap netting[b]			X	X								
Gill netting										X		
Seining					X	X	X	X	X	X		
Trawling						X	X	X	X	X		

[a] Winter sampling will depend on ice conditions.

[b] Trap netting will be in March or April depending on water temperature.

TABLE 291.19-4

SUMMARY OF GEAR TO BE UTILIZED FOR FISH SURVEYS IN THE COOLING LAKE FOR WOLF CREEK GENERATING STATION

GEAR TYPE	DESCRIPTION[a]	UNIT OF EFFORT
D.C. electrofishing	Boat mounted boom shocker	Approximately 30 min per location
Trap net	Large frame fyke nets	4 net nights
Gill net	Uniform mesh flag nets 100 ft x 8 ft with monofilament panels of 1, 1.5, 2.5, or 4 in. bar mesh	4 net nights
Seine	50 ft x 6 ft bag seine	2 - 90° arc drags per location
Trawl	Semiballoon otter trawl	

[a] From A Manual of Survey Techniques for Reservoir Management, Kansas Fish and Game Commission.

TABLE 291.19-5

SAMPLING SCHEDULE IN THE COOLING LAKE DURING THE OPERATIONAL MONITORING PROGRAM

Sample Type	Month								Location			
	Feb	Apr	May	Jun	Jul	Aug	Oct	Dec	2	6	8	9
Water Chemistry[a]	X	X	X	X	X	X	X	X	X	X	X	X
Phytoplankton	X	X		X		X	X	X	X	X	X	X
Zooplankton	X	X		X		X	X	X	X	X	X	X
Macroinvertebrates	X	X		X		X	X	X	X	X	X	X
Larval Fish[b]		X	X	X	X						X	
Adult Fish[c]	X	X		X		X	X	X	X	X	X	X

[a] Water chemistry samples will be collected monthly for the first year of operation.

[b] Twice monthly April - July.

[c] Winter sampling will depend on ice conditions.

Q291.20 (ER) (3.4) Provide better schematics showing the siting and configuration of the make-up water intake, the cooling water intake and the essential service water intake. The ER-OL provides figures showing locations, but details of configurations and adjacent shoreline are needed, [ER-OL p. 3.4-2, p. 3.4-3].

R291.20

a. Makeup Water Screen House (MU Intake)
   1. Siting of the MUSH is shown on S-1 and S-128.
   2. Configuration is shown on A-100 and A-101.
   3. Adjacent shoreline is shown on S-125, S-126 and S-127.

b. Circulating Water Screen House (Cooling Water Intake)
   1. Siting is shown on S-1 and S-11.
   2. Configuration is shown on A-115, A-116, A-117, S-490, S-491, S-492, S-493 and S-494.
   3. Adjacent shoreline is shown on S-62, S-183, S-185 and S-188.

c. Essential Service Water Pumphouse (ESW Intake)
   1. Siting is shown on S-1 and S-11.
   2. Configuration is shown on A-K901, A-K902 and C-KC305.
   3. Adjacent shoreline is shown on S-80 and S-184.

Referenced drawings were provided with formal response.

Q291.21 (ER) (3.4) Clarify the following: The statement "The Wolf Creek Generating Station cooling system is designed to support two 1150-Mwe pressurized water reactors operating at 100 percent average annual load factor" (p. 3.4-1) is contradictory to the following statement, "Analyses indicate that the cooling lake will supply adequate water for the operation of one unit operating at 100 percent average annual load factor and two units operating at 88.5 percent average annual load factor" (p. 3.4-2).

R291.21 The statement on page 3.4-1 has been changed to read: "The Wolf Creek Generating Station, Unit No. 1 (WCGS) cooling system is designed to support two 1150-MWe pressurized water reactors (PWR) operating at a 100 percent average annual load factor for normal conditions."

The analyses referred to on page 3.3-2 (not 3.4-2) indicated that during the once-in-50-year drought, that the cooling lake water level was lower and could support two 1150 MWe PWRs operating at an 88.5 percent average annual load factor.

Q291.22 (ER) Discuss the aquatic biotic monitoring program for area of makeup water intake in the Neosho River. Indicate the parameters to be monitored, the frequency and timing of sampling, the date(s) of program initiation, its duration and the location of the sampling stations.

R291.22 The aquatic monitoring program for the area of the Neosho River near the makeup water intake began in 1973. The results from that monitoring phase until the present can be found in the consultant's annual reports and in the ER(CPS), Sections 6.1.1.3.2 and 6.1.1.3.1.1, plus ER(OLS), Sections 2.2.2 and 2.4.3.1.1.1.

In 1981, the monitoring in this area will include the following parameters: water quality, phytoplankton, zooplankton, macroinvertebrates and fish. The schedule of sampling is enclosed and begins on January 1, 1981. The location of the sampling is the Neosho River directly below the stilling basin at John Redmond Reservoir. All fish impingement work is performed at the makeup water screen house (MUSH) which is located on the east side of the Neosho River about 150 yards below the John Redmond Reservoir dam.

The impingement study is performed exclusively by KG&E and was committed to by the utility in the FES, Section 6.1.3.2. Sample dates within the months are randomly selected. Collection work is performed twice per month from August to March and twice per week from April to July. This impingement monitoring is a one year program which was started in November, 1980.

SCHEDULE OF SAMPLING NEAR MAKEUP WATER INTAKE

Discipline	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Water Quality				X		X				X		X
Phytoplankton				X		X				X		X
Zooplankton				X		X				X		X
Macroinvertebrate				X		X				X		X
Fish												
Electroshock	X	X	X	X	X	X	X	X	X	X	X	X
Seining				X	X	X	X	X		X		X
Larval Fish				°	°	°	°					
Impingement	°	°	°	*	*	*	*	°	°	°	°	°

° - twice monthly
* - twice weekly
X - once monthly

Q291.23 (ER) Outline the aquatic biotic monitoring program for the site area during station operation (see requests by staff in FES-CP. Sections 6.1.3.2. p. 6-3, 6.2.3.2. p. 6-7).

R291.23 The planned operational monitoring program for the site area will include activities on Wolf Creek Cooling Lake (WCCL) as described in response 291.19 and the Neosho River. Biological sampling on the Neosho River during the operational monitoring program will be essentially the same as established in the last year of the Lake Filling Phase (Tables 291.23-1 and 291.23-2).

TABLE 291.23-1

PROPOSED SAMPLING SCHEDULE FOR THE AQUATIC BIOLOGICAL PORTION OF THE OPERATIONAL MONITORING PROGRAM FOR WOLF CREEK GENERATING STATION

Discipline	Apr	Jun	Aug	Oct	Dec
Aquatic Ecology					
Neosho River					
Phytoplankton	X	X		X	X
Periphyton[a]		X	X	X	X
Zooplankton	X	X		X	X
Macroinvetebrates					
Benthos	X	X		X	X
Qualitative	X	X		X	X
Drift[b]	X	X		X	X

[a] Neosho River Locations 4 and 10
[b] Neosho River Location 1

TABLE 291.23-2

PROPOSED FISH SAMPLING SCHEDULE FOR THE LAKE FILLING PHASE ENVIRONMENTAL MONITORING PROGRAM AT THE WOLF CREEK GENERATING STATION, 1981

	Feb	Apr	May	Jun	Jul	Aug	Oct	Dec
Neosho River								
Electrofishing[a]	X	X	X	X	X	X	X	X
Seining[b]		X	X	X	X	X	X	X
Larval fish[c]		X	X	X	X			

[a] Monthly at Location 1; Locations 4 and 10 i April, June, October and December.

[b] Locations 4, 10 and 11 in April, June, October and December; Location 1 during all indicated months.

[c] Day-night sampling twice monthly at Location 1.

Q291.24 (ER) Describe any stocking of fish in WCCL that has already taken place, including date introduced, species and number introduced. Also provide a description of future plans for stocking fish in the WCCL.

R291.24 Stocking activities on WCCL, both past and future, are designed to establish a desirable fishery in the lake. A fishery dominated by predator species will reduce negative impacts on plant operations due to impingement of forage and roughfish species. Stocking activities will additionally maintain options concerning future use of the lake.

The WCCL stocking program was initiated in 1978 and continued in 1979 with the renovation of selected ponds in the lake area followed by restocking with forage and gamefish. In 1980 that portion of Wolf Creek owned by KG&E and all ponds on KG&E property not previously renovated were treated to remove roughfish. Major stockings of forage and game species have followed renovation during preliminary filling of the cooling lake in 1980 and into 1981. All stocking activities to date are outlined in Table 291.24-1.

Table 291.24-2 outlines scheduled stocking of fish into the WCCL for 1981 and proposed stocking for the next several years. The number and species outlined in Table 291.24-2 after 1981 are based on a typically developing fishery. However, long-term stocking plans will be modified based on the success of various species and may result in increased or decreased rates for a given species.

TABLE 291.24-1

STOCKING RECORD OF WOLF CREEK COOLING LAKE

SPECIES	DATE(S)	NUMBER	LOCATION
Flathead Minnow	8/78	56,000	Subimp.
Largemouth Bass	8/78	3,500	Subimp.
Flathead Minnow	9/79	75,000	Subimp.
	11/79	52,000	Subimp.
Bluegill	9/79	5,000	Subimp.
Smallmouth Bass	11/79	40	Subimp.
Largemouth Bass	9/79	2,400	Subimp.
Flathead Minnow	5/80	90,000	UHS
	6/80	65,000	UHS
	8/80	270,000	Subimp.
	9/80	57,500	Subimp.
Bluegill	5/80	130	Subimp.
	6/80	3,150	UHS
	8/80	16,000	Subimp.
	9/80	12,700	Subimp.
Red-ear Sunfish	8/80	2,000	Subimp.
Black Crappie	10/80	1,000	Subimp.
Smallmouth Bass	8/80	500	Subimp.
Largemouth Bass	6/80	6,000	UHS
	10/80	1,000	Subimp.
Striped Bass	6/80	1,200	UHS
Walleye	6/80	7,000	UHS
	7/80	5,000	UHS
Blue Catfish	10/80	35,000	WCCL
Channel Catfish	5/80	100	Subimp.
	6/80	3,100	UHS
	8/80	25,000	Subimp.
	10/80	25,000	WCCL
Striped X White Bass Hybrid	5/81	50,000	WCCL

Subimp = Subimpoundment of WCCL
UHS = Ultimate Heat Sink Basin
WCCL = Wolf Creek Cooling Lake

TABLE 291.24-2

PLANNED STOCKING PROGRAM FOR
WOLF CREEK COOLING LAKE

SPECIES	1981	1982	1983	1984
Black Crappie	25,000			
Smallmouth Bass	50,000	50,000	25,000	
Spotted Bass	25,000*	25,000*	25,000*	
Largemouth Bass	100,000	50,000		
Striped Bass	50,000	50,000		
Striped X White Bass Hybrid	50,000**	50,000		50,000
Walleye	120,000	120,000	120,000	50,000
Blue Catfish	50,000	50,000	50,000	50,000
Channel Catfish	50,000	50,000	50,000	

* Actual Number Dependent on Supply
** Stocked 5/81

Q291.25 Provide the details and discuss the impacts of return of material collected from the plant intake screens to the Neosho River.

R291.25 The plant intake screens are located on the Wolf Creek Cooling Lake (WCCL). Any material impinged on these screens would be either removed from the collection pit and disposed of onsite or returned to WCCL. There is no possibility of material impinged on the screens being returned to the Neosho River which is approximately five miles away.

However, the makeup water screen house (MUSH) intake will impinge material which could be returned to the Neosho River. This material is washed off the vertical travelling screens (VTS) into a collection pit which drains into the makeup channel. During low flow, the channel dead ends but still remains contiguous with the reservoir stilling basin. The channel becomes a flow-through system whenever John Redmond Reservoir releases large amounts of water.

Some fish fall back into the channel from the pit. However, because the makeup channel dead ends during the winter months, the fish will either be recycled on the VTS or eaten by the large groups of gulls which visit the area. Decay is slow because of the cold temperatures, thus allowing the gulls ample time to clean up the dead fish in a couple of days. The slow decay rate of the fish would also minimize any limnological effects which might occur due to the dead fish.

During the winter months, the large number of impinged fish are pumped from the collection pit into a dumpster and then disposed of onsite. From April to November, the impingement is less than one percent of the number of fish impinged during the winter. These fish will be allowed to drain back into the channel via the collection pit unless a significant number is present. Whereby, the fish will be collected in a 4½ foot deep bucket net and disposed of in an onsite landfill according to state and local regulations. A significant number of fish is that which impedes the flow of water through the VTS to such a degree as to endanger the operation of the pumps.

The effect of these fish being returned to the Neosho River would be minimal. The numbers involved are small, usually less than 100 per 24-hour period. High BOD concentrations would be

R291.25 (continued)

spotty and would probably be the highest near the outfall of the collection pit drain pipe. In other areas of the channel, the BOD levels should be comparable to the Neosho River BOD levels because the pumps would be continually drawing "fresh" water into the channel. When the channel and the Neosho River merge during high flow, the effects of the returned material would be even less because the larger volume of water would dilute any effects from so few dead fish.

In conclusion, there will be no material returned to the Neosho River from the plant intake screens. Material from the MUSH screens could be returned to the Neosho River but the effects should be minimal.

310.0 SITING ANALYSIS BRANCH

Q310.1 (ER) Are there any substantial changes in the station external appearance or layout which have been made subsequent to the description in the OL-ER? If so, please describe.

R310.1 The following buildings/structures have been added to the immediate power block area (See revised Figure 2.1-4):

1. An Auxiliary Warehouse located just east of the Shop Building;

2. Technical Support Center located between the Administration Building and Shop Building;

3. Security Building located south of the Administration Building;

4. Security Diesel Generator located immediately north of the northwest corner of the Security Building; and

5. A covered walkway connecting the Turbine Building, Administration Building, Technical Support Center, Shop Building, and Security Building.

These are low visibility structures and do not change the skyline appreciably.

The Emergency Operations Facility (EOF) - Simulator Complex has been located on the site but 2.8 miles northwest of the power block area (see revised Figure 2.1-6).

Q310.2 (ER) Are there any new roads or rail lines or relocations of roads or rail lines near the plant which have been proposed subsequent to the description in the OL-ER? If so, please describe.

R310.2 There are no new roads or rail lines and no relocations of existing roads or rail lines since the description in the ER(OLS).

Q310.3 (ER) (2.1.3) Section 2.1.3.3.4 of the OL-ER states: "Currently, there are no plans for public use of the cooling lake or lands within the site boundary adjacent to the cooling lake not needed during operation of the station and related facilities." It also states that the visitors center location has not been selected.

Have the plans for public use of the cooling lake and adjacent lands been revised? If so, please describe. Also, has the visitors center site been selected? If so, please give its description and location.

R310.3 Section 2.8 of the ER(OLS) addresses public use of the cooling lake and adjacent lands. As stated therein, there are no plans for public use of the cooling lake. Lands adjacent to the cooling lake and inside the WCGS site boundary will be used to the extent practical as it was prior to its purchase for the WCGS site.

The Visitors Center is located about 2.8 miles northwest of the plant at the Emergency Operations Facility (EOF) complex (See Figure 2.1-6). The center occupies 760 square feet of display space in the EOF/Simulator/Visitors Center building.

Q310.4 (ER) (2.1.3) Section 2.1.3.2.11 mentions "an increase in the number of large rural homesites on nearby agricultural land." i.e., within five miles of the site.

Because of this increase, have the 1980 census results differed significantly from the 1980 population forecasts in Table 2.1-2, ER-OL? If so, please revise the population data for the five mile area around the site.

R310.4 Since census results are not generated based on distances from Wolf Creek, the applicants conducted a house survey in 1980 to determine the population distribution around the site. The actual 1980 population within 5 miles of Wolf Creek was 3,412 versus 3,640 projected in Table 2.1-2. The sectors whose populations differed the most from that projected were those which contain Burlington and New Strawn. This is primarily attributable to increased numbers of temporary construction personnel settling in these communities. Once Wolf Creek construction is complete the operations staff will only number 10 percent of the peak construction staff. Table 2.1-2 has been updated to reflect the 1980 population information.

Q310.5 (ER) Provide an estimate of the average annual number of workers required for the operation of Wolf Creek Unit No. 1. State whether the workers are employees or contractors. Also provide an estimate of the average annual operating workers' payroll for the unit.

R310.5 It is estimated that 284 persons including security personnel will be required for the permanent operating staff of WCGS. All are expected to be KG&E employees. (This does not include additional or contract employment during refueling.)

The annual payroll for the first full year of operations is estimated to be $5.5 million.

Q310.6 (ER) Local purchases of goods and services for a nuclear power plant operation may frequently have a significant impact on the local economy. (For these purposes local may be defined as either the host county or the host county and one or more contiguous counties.)

Please provide information on local purchases of goods and services expected to be made by the plant during a typical year of operation. To the extent possible, identify specific types of dollar amounts of these purchases. If it appears that there will be no significant local purchases, explain why.

R310.6 Once WCGS is in operation local purchases of goods and services will no longer be at the level of those purchases during the construction period. Many of the supply and maintenance items and the specialized services required for operations and maintenance are not available in the local area or are not price competitive. Most purchases will be made in Wichita and Kansas City. Local purchases of goods such as small tools and office supplies are unlikely to exceed $25,000 per year.

Q310.7 (ER) Construct a table containing dollar estimates of taxes attributable to Wolf Creek No. 1, for each of the first five full years of operation. Provide the dollar estimates by type of tax, and by taxing jurisdiction. What percent of the jurisdictions' total tax revenues are represented by the taxes attributable to the Wolf Creek No. 1 Plant?

R310.7 The most significant impact of taxes attributable to WCGS will be on local jurisdictions within Coffey County. As shown in Table 310.7-1, WCGS will be paying taxes to 20 individual county jurisdictions in amounts ranging in 1985 from $11 to $6,499,187 and contributing up to 99 percent of the revenues received by various jurisdictions. In addition, WCGS will be paying about $600,000 per year to the State of Kansas for its education and institutions building fund, based on property owned in Coffey County.

Taxes will also be paid to other nearby counties through which transmission lines will pass. Estimated amounts for these taxes are shown on Table 310.7-2, together with estimated income and franchise taxes for 1987.

TABLE 310.7-1

WOLF CREEK GENERATING STATION
AD VALOREM TAX ESTIMATES
COFFEY COUNTY TAXING JURISDICTIONS
1985 - 1989

TAXING JURISDICTION	1985 WCGS TAX	1985 % of TOTAL REVENUES	1986 WCGS TAX	1986 % of TOTAL REVENUES	1987 WCGS TAX	1987 % of TOTAL REVENUES	1988 WCGS TAX	1988 % of TOTAL REVENUES	1989 WCGS TAX	1989 % of TOTAL REVENUES
State of Kansas	$ 593,089	3.61	$ 600,166	3.59	$ 606,155	3.57	$ 612,200	3.55	$ 618,411	3.53
Coffey County	6,499,187	89.61	6,576,910	89.30	6,642,726	88.82	6,709,070	88.34	6,776,197	87.86
Townships										
Avon	236	41.99	238	41.75	241	41.62	243	41.33	246	41.21
Hampden	1,356	99.27	1,373	98.99	1,386	98.44	1,400	97.83	1,414	97.32
Pottawatomie	500	43.03	500	42.37	500	41.74	500	41.08	500	40.45
Star	194	48.87	197	48.76	199	48.54	201	48.32	204	48.43
Unified School Districts										
No. 243	32,778	5.43	33,079	5.39	33,379	5.36	33,730	5.34	34,081	5.30
No. 244	5,011,288	95.78	5,071,103	95.44	5,121,778	94.92	5,173,035	94.40	5,214,721	93.89
No. 245	32,139	5.22	32,987	5.28	33,332	5.25	33,672	5.22	34,013	5.20
Cemetary Districts										
Altamont	126	48.84	127	48.47	129	48.50	130	48.15	131	47.64
Bowman-Adgate	579	46.58	586	46.40	592	46.18	598	45.93	604	45.69
Pleasant Hill	272	53.23	276	53.18	279	52.94	282	52.71	284	52.30
Stringtown	2,980	99.33	3,014	98.95	3,045	98.42	3,074	97.84	3,104	97.27
Wharton	32	10.88	34	11.41	34	11.22	35	11.36	35	11.22
Watersheds										
No. 24	11	.04	11	.04	11	.03	11	.03	11	.03
No. 48	635	4.03	675	4.21	681	4.19	688	4.17	694	4.14
No. 90	62	.10	63	.10	63	.10	64	.10	65	.10
No. 93	3,983	44.97	4,027	44.77	4,053	44.36	4,078	43.95	4,104	43.56
Fire Districts										
No. 5	581	4.96	588	4.95	594	4.92	600	4.89	606	4.87
No. 40	1,304	11.92	1,304	11.73	1,304	11.55	1,304	11.38	1,304	11.20
Southeast Kansas Regional Library	197,668	54.16	200,042	53.97	202,119	53.69	204,135	53.40	206,171	53.11
Total	$12,379,000		$12,527,300		$12,652,600		$12,779,100		$12,906,900	

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TABLE 310.7-2

ESTIMATED AD VALOREM TAXES 1985 - 1989
($000)

Year	Coffey County	Anderson County	Butler County	Franklin County	Greenwood County	Johnson County	Lyon County	Miami County	Total All Counties
1985	12,379	34	66	116	77	17	5	48	12,743
1986	12,527	34	70	118	81	17	12	49	12,909
1987	12,653	35	71	119	82	17	12	50	13,038
1988	12,779	35	72	120	83	18	13	50	13,169
1989	12,907	35	72	121	84	18	13	50	13,300

OTHER ESTIMATED TAXES 1987
($000)

Federal Income	$92,945
Kansas, Income & Franchise	32,600
Missouri, Income & Gross Receipts	10,021

Q310.8 (ER) Please provide the distances of the proposed transmission corridors from the following properties listed in the National Register of Historic Places:

Samuel J. Tipton House	Harris Vicinity	Anderson County
Columbia Bridge	Peoria	Franklin County
I. O. Pickering House	Olathe	Johnson County

Please give the same information for any other archeological and historical sites or properties listed or eligible for listing located within 2 km of the corridors.

R310.8 The distances of the proposed Wolf Creek-Craig transmission corridors from the following properties are: Samuel J. Tipton House, 9.8 km; Columbia Bridge, 2.1 km; and I. O. Pickering House, 16.9 km. The Wolf Creek-Craig transmission line has been shortened (approximately 14 miles) and is now the Wolf Creek-West Gardner transmission line terminating at the West Gardner Substation (See response to NRC question 290.1).

The National Register of Historic Places for Kansas dated February, 1981, obtained from the Kansas State Historical Society in Topeka, was examined to determine if any other archaeological and historical sites or properties were located within 2 km of the transmission corridors. None were found within 2 km of the corridors. The nearest site (greater than 4.3 km) was the C. N. James Cabin, 305 S. State Street, Augusta in Butler County.

311.0 SITING ANALYSIS BRANCH

Q311.1 As published in the Federal Register (Vol. 45, No. 116, June 13, 1980, Pages 40101-40104) the Nuclear Regulatory Commission (NRC) has revised its policy regarding accident considerations in National Environmental Policy Act (NEPA) reviews. Information regarding the site as well as events arising from causes external to the plant which are considered possible contributors to the risk associated with the plant are to be discussed. References to safety evaluations is acceptable provided the Environmental Report contains a complete overview with references to specific sections of the FSAR. Accordingly, please provide an analysis of all offsite activities and an assessment of potential hazards including: (1) transportation, (2) mining and mineral exploration and/or operations, (3) industrial activities, and (4) military activity.

R311.1 The requested analysis is presently provided in WCGS FSAR Addendum Section 2.2. See revised Section 2.1.1.2.

Q311.2 (ER) (2.1.2.3) Section 2.1.2.3, Page 2.1-9, discusses peak monthly transient population at John Redmond Reservoir. Please provide an estimate of peak daily usage as well.

R311.2 The Corps of Engineers has recreational use statistics which indicate that during an average summer month daily use of the recreational area averages 1,400 persons. Peak usage of the John Redmond Reservoir occurred on July 5, 1979 when 10,820 persons entered the recreational area.

Q311.3 (ER) (2.1.3.2) Section 2.1.3.2.9, Page 2.1-18, and Figure 2.1-23 identifies several abandoned and one operating quarry within 5 miles. It is difficult to read Figure 2.1-23. Please clearly identify the location of these quarries. Please identify the maximum quantity and type of any explosives stored at the quarries. Please identify the frequency, quantity and transportaton route for each explosive type delivered to each quarry.

R311.3 Active and abandoned quarries within 5 miles of the plant site are identified in new Figure 2.1-23a. Abandoned quarries do not have explosives stored at the quarry. The only operating quarry is located 3 miles south-southeast of the plant site (See Figure 2.1-23a). The maximum quantity of explosives stored at this quarry is approximtely 15 tons of ammonium nitrate-fuel oil mixture. Irregular shipments of up to 15 tons of this explosive are delivered to the quarry via US75 and FAS10 (Figure 2.1-7). US75 is utilized to deliver explosives to other quarries located beyond five miles from WCGS. The maximum load the shipper's trucks can carry is 20 tons of explosives. Usually less than a maximum load is loaded on a truck for delivery with the explosives consisting of 75 percent ammonium nitrate-fuel oil mixture and 25 percent class A explosives.

Q311.4 (ER) (2.1) Figures 2.1-3, 5, 6 and 7, etc., show an abandoned A.T. & S.F. railroad line passing through the Wolf Creek Site. FSAR question 310.01 requested an explanation of the status of this line and discussion of any easements which may exist relative to this railroad line. For completeness, please include your response to FSAR question 310.01 in the ER.

R311.4 The information requested by FSAR question 310.01 was already contained in the FSAR Addendum Section 2.2.1.4 as follows:

The Santa Fe Railroad and right-of-way located 0.3 mile west of the plant site is abandoned. By Interstate Commerce Commission Order in Finance Docket No. 26591, dated February 4, 1972, captioned Atchinson, Topeka and Santa Fe Railroad Company Abandonment, B.H. Junction and Gridley, Franklin and Coffey Counties, it was ordered that the branch line of the railroad extending between milepost 0.0 at B.H. Junction, Kansas, and milepost 52 plus 1,518 feet at Gridley, Kansas, be abandoned. With this abandonment, title of the right-of-way property reverted to the fee simple title owners.

This information is included in Section 2.1.1.2.

320.0 UTILITY FINANCE BRANCH

Q320.1 (ER) (1.1) Please provide further information on KEPCo, including present status of purchase of 17% of WCGS and of applications for membership in SPP and MOKAN, and the latest annual report. Please provide information available for KEPCo which corresponds to that giver for KG&E and KCPL in Tables 4-6, 16-18, 25-34 of the section 1.1.

R320.1 The purchase of a 17 percent interest of WCGS by KEPCo has been approved by the Kansas Corporation Commission, and the Kansas State Legislature has passed an authorization measure. This measure was signed by the Governor on April 17, 1981.

KEPCo will apply for membership in SPP and MOKAN as soon as the purchase is completed. This is expected by October, 1981.

It is not possible to provide more detailed information on KEPCo than is provided in the text and tables of the ER(OLS) revised. As shown in Table 1.1-3, KEPCo's only owned capacity will be the 195.5 MW of WCGS in 1984 and two low-head hydro projects with 29.35 MW in 1986.

Consolidated data are not available on system fuel costs, peak hour conditions, interchanges, etc., nor are comparisons maintained on system forecasts and actual peaks and energy for the 27 member cooperatives.

Q320.2 (ER) (1.3) In section 1.3.1 of the ER-OL, reserve margin deficiencies due to delay of WCGS operation are stated which for Sunflower Electric exceed expected sales to Sunflower by KEPCo. Please given details of KEPCo/Sunflower generation and purchases to support the margins stated.

R320.2 Section 1.3-1 of the ER(OLS) has been revised. The earlier statements are not applicable.

Q320.3 (ER) (1.1) On p. 1.1-27 of the ER-OL in the description of the KCPL econometric model C, R^2 and DW are not defined. Please do so.

R320.3 Definitions of terms not identified are as follows:

C = Constant

R^2 = Coefficient of determination

$\bar{R}^2$ = R^2 adjusted

DW = Durbin-Watson coefficient

Q320.4 (ER) (1.1) There appear to be typographical slips in the tables for Section 1.1 of the OL-ER. For example, in Table 1.1-12 all entries in the third column (GWH increase) from 1980 on are inconsistent with columns 2 and 4. Please provide any corrected tables for Section 1.1.

R320.4 Table 1.1-12 has been corrected and revised. All tables in Section 1.1 of the ER(OLS) have been updated with the exception of Table 1.1-7a.

Q320.5 (ER) (1.3) Please provide current revised umbers for any entries in Tables B.2-1 and 2 which have been significantly affected by changes in interest and escalation rates since completion of the ER-OL. Please provide any corresponding revisions of the text tables on p. 1.3-3.

R320.5 Tables 8.2-1 and 8.2-2 have been revised, as have the text tables on pages 1.3-3 and 1.3-4.

Q320.6 (ER) Please provide the most recent forecast (if any) updated by the current actual numbers of the electricity demand and the capacity for the applicants and the powerpools.

R320.6 The most recent forecasts of energy and demand, together with 1980 actual experience are given for KG&E and KCPL in Tables 1.1-12 and 1.1-13. KEPCo actual experience through 1979 and forecasts are provided in Table 1.1-14. Capacity data for the Applicants are presented in Tables 1.1-1, 1.1-2, 1.1-3, 1.1-4a and 1.1-5a. SPP and MOKAN energy, peak load and capacity data are presented in Tables 1.1-8, 1.1-9, 1.1-10 and 1.1-11.

Q320.7 (ER) Please provide, the estimate or evaluation of a reduction in the demand for electricity (use and capacity) as a result of various load management programs by the Applicant.

R320.7 The forecasts for energy and peak load in Tables 1.1-12, 1.1-13 and 1.1-14 take into account the effects of load management programs and reduced rates of growth in demand related to population, economic and social factors. It has not yet been possible to isolate the individual factors that contribute to a reduction in a growth rate.

Q320.8 (ER) Please provide the change (if any) in the reserve requirements of the applicant and the powerpool.

R320.8 There have been no changes to date in the reserve requirements for the Applicants and the power pools.

Q320.9 (ER) Please provide the fuel mix you would use in providing the replacement energy in case WCGS does not come on line. Also, provide the cost of producing electricity (mills/kwh) by each fuel type.

R320.9 The fuel mixes to be used in providing replacement energy in the event of a delay for WCGS are given in Table 1.1-30 and shown below:

FUEL MIX WITHOUT WCGS - IN PERCENT

	1 Year Delay	2 Year Delay	3 Year Delay
		KG&E	
Coal	61.7	57.4	60.4
Oil	0.3	5.4	4.9
Gas	38.0	37.2	34.7
		KCPL	
Coal	97.3	97.0	93.2
Oil	2.6	2.9	6.8
Gas	0.1	0.1	0.1

Estimated fuel costs for replacement energy are:

FUEL COSTS IN MILLS PER KWH

	1 Year Delay		2 year Delay		3 Year Delay	
	KG&E	KCPL	KG&E	KCPL	KG&E	KCPL
Coal	18.8	19.6	20.5	21.9	22.4	24.7
Oil	61.1	191.6	71.0	207.6	76.7	199.6*
Gas	37.7	55.4	45.3	70.2	51.4	91.5

* Oil costs went down for third year of delay for KCPL because the oil units will change from low-load spinning reserve units to operation as base load units. The oil units operate at a more efficient heat rate when fully loaded.

These fuel costs may be compared with the following estimated nuclear fuel costs in mills per Kwh:

MILLS PER KWH AT CAPACITY FACTORS OF:

	.60	.50	.75	.65
1984	8.9	9.1		
1987			8.1	8.3

Q320.10 (ER) Please provide the capacity charge, and the price of electricity paid to the powerpool to satisfy the future demand increase in case WCGS does not come on line. Please provide the portion of total incremental demand satisfied by in-house generation and the purchase from powerpool.

R320.10 It is assumed that this question refers to charges that are based on pool obligations. Therefore, the capacity deficiencies used are those shown in Tables 1.1-1 and 1.1-2 which contain data reported to the MOKAN pool. If WCGS were delayed, KG&E and KCPL would have to make capacity purchases from outside their systems to cover projected deficiencies in capacity responsibility. These capacity deficiencies are based on each utility's expected "capacity responsibility" which includes its system demand plus firm purchases and sales, etc.

On this basis the projected capacity deficiencies will be as follows, in the event of a delay:

	Capacity Deficiencies in MW	
Delay in Years	KG&E	KCPL*
One	37	178
Two	97	285

*KCPL's deficiencies are based on 20 percent reserve margin while KG&E's are 15 percent.

KG&E estimates the capacity charge would be $156.30/KW per year through 1984, calculated as follows:

> Capacity charge = $610 per KW x fixed charged rate of approximately .23 = $140.30 plus fixed operations and maintenance (O&M) costs of $16/KW per year = $156.30
>
> Through 1985 the capacity charge would be $140.30 plus fixed O&M costs of $17.60/KW per year = $157.90

KCPL estimates that the capacity charge in the time frame 1985-1987 would range between $125 and $150/KW per year.

If the capacity charges estimated by KG&E are applied to the capacity deficiencies above, the following total capacity charges are obtained.

R320.10 (continued)

Delay in Years	Capacity Charges KG&E	Capacity Charges KCPL
One	$ 5,783,100	$27,821,400
Two	$15,316,300	$45,001,500

In addition to the capacity charges there would be energy costs. In the event of a delay for WCGS, KG&E would use all available coal capacity but then purchase as much outside coal capacity as possible before burning more expensive oil or gas in KG&E plants. It is assumed that the full capacity deficiency would be purchased about 60 percent of the time. On this basis the costs would be as follows:

For a one year delay:
37,000 x 8760 x .60 x 1.47¢ per KWH = $2,858,738

For a two year delay:
97,000 x 8760 x .60 x 1.62¢ per KWH = $8,259,278

If for the purpose of illustration KCPL's energy costs are computed on the same basis, they would be for one year:

178,000 x 8760 x .60 x 1.47¢/KWH = $13,752,850

For two years:

285,000 x 8760 x .60 x 1.62¢/KWH = $24,266,952

The total capacity charges and energy costs would then be:

Delay	Cost Element	KG&E		KCPL	
		Total Cost in Thousands			
One year	Capacity charge	$ 5,783		$27,821	
	Energy cost	2,859		13,753	
	Total		$ 8,642		$ 41,574
Two Years	Capacity charge	$15,316		$45,002	
	Energy cost	8,259		24,267	
	Total		23,575		69,269
Two Years	Total Cumulative Costs		$32,217		$110,843

Any delay of WCGS would cause KG&E to burn large quantities of gas and oil.

R320.10 (continued)

It is assumed that "total incremental demand" refers to the increase in capacity responsibility without WCGS for the years 1984 over 1983 and 1985 over 1984. The table which follows gives the projected KG&E system capacity responsibility both with and without WCGS.

Projected KG&E System Capacity Responsibility 1983-1985

	KG&E Total System Capacity Responsibility[a]		KG&E System Capacity	Capacity Balance
With WCGS				
1983	2050		2111	+61
1984	2091		2549	+458
1985	2151		2549	+398
Without WCGS				
1983	2050		2111	+61
1984	2148	98 Increase[b]	2111	-37
1985	2208	60 Increase[b]	2111	-97

[a]Includes KG&E system demand plus firm transactions.
[b]The 57 MW increase in capacity responsibility in 1984 and 1985 without WCGS is due to KG&E's power supply obligations to REC's which are different with and without WCGS.

If the "total incremental demand" is defined as the increase in capacity responsibility without WCGS for the years 1984 over 1983 and 1985 over 1984, then the following situation would exist:

In 1984 without WCGS, there would be a 98 MW increase in demand, 37 MW of which would have to be purchased outside KG&E. The remaining 61 MW would be satisfied by existing generation. In 1985 there would be an additional 60 MW increase in demand, all of which would have to be purchased outside KG&E. On a cumulative two year basis the increase would amount to 158 MW of which 97 MW would have to be purchased outside KG&E.

KCPL will have to make up any deficits through purchases outside the utility (based on a 20% reserve).

Q320.11 (ER) What fixed charge rate has been used to calculate the capital cost portion of the total cost of generating electricity by nuclear fuel? Please refer to Table B.2-2. Why is fixed charge into year 1986 higher than the year 1983 (269.10 vs. 217.58 million dollars)? What inflation rates have been used to arrive at 1986 numbers in this table and other places?

R320.11 Fixed charge rates used to calculate the capital cost portion of the cost of generating electricity by nuclear fuel are as follows:

	1984 (Applied for 9 months)	1987
KG&E	23.0%	24.0%
KCPL	27.23	21.63
KEPCo	13.82	12.71

The differences in the calculated amounts shown in Table 8.2-2 are due to the facts that the fixed charge is applied for 9 months in 1984 and that taxes and costs of money are different for the individual owners year by year.

Inflation rates vary by year but in general are those estimated by Data Resources, Inc. For 1980 and future years they are as follows:

INFLATION RATES BY YEARS

	1980	1981	1982	1983	1984	1985	1986
Materials	9.5	9.9	10.0	9.0	8.6	9.8	9.6
Labor	10.0	10.9	10.6	10.5	10.5	11.4	10.4

The composite escalation rate over the life of the project is estimated to be 8.3 percent.

Q320.12 (ER) (1.1) Please refer to pages 1.1-43 and 1.3-3. Please provide the basis for calculating the fuel savings or consumptions (in terms of quantity and dollar both) resulting from bringing or not bringing WCGS on line. The unit of coal consumption on this table appears to be incorrect. The response to Question 3 may be extended to answer Question 6.

R320.12 Both KG&E and KCPL use computer runs to estimate future system consumption of fuels and to optimize station use so as to achieve lowest total cost. Unit fuel costs projected to exist in future years are applied to the quantities obtained to determine the costs for additional fossil fuels. In comparing costs with and without WCGS, a credit is taken for nuclear fuel not burned in the without WCGS case. The results of these computations are given on page 1.3-3 and shown below:

ADDITIONAL FUEL CONSUMPTION AND COSTS WITHOUT WCGS AND WITH INDICATED DELAYS

Fuel	Unit Measure	1985 One Year Delay	1986 Two Year Delay	1986 Cumulative	1987 Three Year Delay	1987 Cumulative
KG&E						
Coal	(000) Tons	-	-	-	-	-
Oil	(000) Bbls	236	697	933	683	1,616
Gas	MMCF	31,639	29,352	61,171	29,929	91,100
Net Additional Fuel Cost (000)		$89,156	$137,590	$226,646	$167,034	$393,780
KCPL						
Coal	(000) Tons	800	954	1,754	1,057	2,811
Oil	(000) Bbls	129	206	335	693	1,028
Gas	MMCF	50	15	65	0	65
Net Additional Fuel Cost (000)		$21,270	$32,994	$54,264	$82,211	$136,475
TOTAL						
Coal	(000) Tons	800	954	1,754	1,057	2,811
Oil	(000) Bbls	365	903	1,268	1,376	2,644
Gas	MMCF	31,689	29,367	61,236	29,929	91,165
Net Additional Fuel Cost (000)		$110,426	$170,584	$280,910	$249,245	$530,255

Q320.13 (ER) Please provide new estimates, if any, of decommissioning and dismantling costs.

R320.13 No new estimates have been made of decommissioning and dismantling costs.

450.0 ACCIDENT EVALUATION BRANCH

Q450.1 (ER) Will applicant initiate pre-operational fog monitoring program to provide baseline data? If so, provide details of the plar If not, expla'n why such a study will not be undertaken.

R450.1 A pre-operational fog monitoring program is being planned. The purpose of the study is to document the frequency of occurrence of natural fog (as opposed to fogs induced by the operation of the cooling lake) along Highway 75 which is located from 0.5 miles to 2.0 miles west of the cooling lake.

Table 2.3-29 of the WCGS FSAR Addendum Revision 1 2/81 shows that the predominant frequency of light wind (less than 3 meters per second) is from the sectors southeast through south. This corresponds with the Dames & Moore Program FOGALL analyses which shows the maximum increase in ling lake induced fogging frequency along Highway 75 to occur approximately 3 miles south through 2 miles north of New Strawn, Kansas.

While the details of the fog monitoring program are not completely defined at this time, it is anticipated that a transmissometer and continuous analog recorder will be installed along Highway 75 at a point within 2 to 3 miles of New Strawn, Kansas. The instrument will continuously monitor visibility at an elevation of 1.5 to 2 meters above ground level. Maximum visibility resolution will be at least 100 meters.

The fog monitoring program will be initiated in 1981 and will continue through plant startup. An annual analysis will be performed to categorize fogging occurrences by visibility classes and to correlate fog occurrences with the meteorological data acquired at the WCGS meteorological tower.

A detailed description of the specific fog monitoring program will be provided in forthcoming revisions to the WCGS ER(OLS) and FSAR Addendum.

Q450.2 (ER) Please provide a transportation map detailing any controlled roads, uncontrolled roads, and railroads within two miles of the cooling lake. In addition, if available, provide data on the extent of traffic density on the controlled and uncontrolled roads.

R450.2 See Figure 450.2-1.

Coffey County has not developed traffic flow data for the roads near the cooling lake. The following data are annual average daily traffic estimates (AADT) made by the Kansas Highway Commission for Highway 75 north of Burlington between the city limit and New Strawn.

Year	AADT
1972	3000
1976	2880
1978	3800
1980	4685

Traffic counts were made by KG&E in 1979 to determine the impact of construction related traffic on local highways. These counts would not be relevant to the operational period for WCGS. It is estimated that during operations the average daily traffic on the controlled access road to the plant will be between 350 and 400 vehicles.

TABLE 450.2 - 1

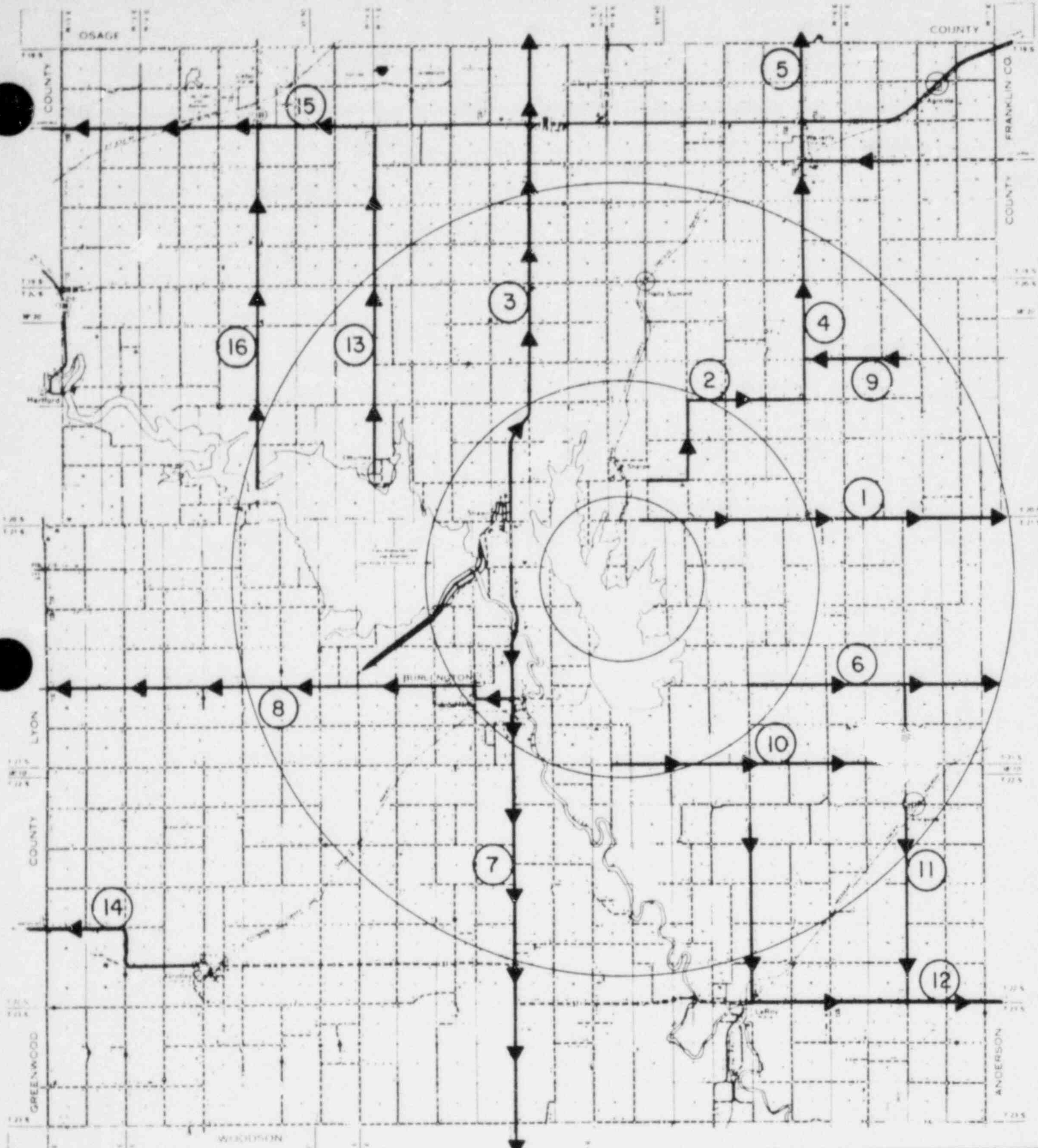
Evacuation Routes Listing (Sheet 1 of 2)
Road Identification

Subzone	Route Identification per Figure 450.2-1
Center (0-2 mile)	(a) FAS 1935 east (1) to Anderson County (b) FAS 153 east (2) to FAS 149 north (4) to Kansas 31 north (5) to Osage County
A1	U.S. 75 north (3) to Osage County
B1	FAS 153 east (2) to FAS 149 north (4) to Kansas 31 north (5) to Osage County
C1	(a) FAS 149 north (4) to Kansas 31 north (5) to Osage County (b) FAS 10 east (6) to Anderson County
D1	(a) U.S. 75 south (7) to Woodson County (b) FAS 10 west (8) to Lyon County (c) FAS 1472 (10) east to Anderson County
E1	(a) U.S. 75 north (3) to Osage County (b) U.S. 75 south (7) to Woodson County
A2	(a) U.S. 75 north (3) to Osage County (b) Kansas 31 north (5) to Osage County
B2	FAS 1134 west (9) to FAS 149 north (4) to Kansas 31 north (5) to Osage County
C2	(a) FAS 1935 (1) to Anderson County (b) FAS 10 east (6) to Anderson County
C3	(a) FAS 10 east (6) to Anderson County (b) FAS 1472 (10) to FAS 1135 north (11) to FAS 10 east (6) to Anderson County (c) FAS 1135 south (11) to Kansas 57 east (12) to Anderson County
C4	(a) Kansas 57 east (12) to Anderson County (b) FAS 1135 south (11) to Kansas 57 east (12) to Anderson County
D2	U.S. 75 south (7) to Woodson County
D3	(a) FAS 10 west (8) to Lyon County (b) U.S. 75 south (7) to Woodson County
E2	FAS 10 west (8) to Lyon County

TABLE 450.2-1 (Sheet 2 of 2)

Subzone	Route Identification per Figure 450.2-1
E3	(a) FAS 793 north (13) to old U.S. 50 west (15) to Lyon County (b) U.S. 75 north (3) to Osage County
E4	(a) U.S. 75 north (3) to Osage County (b) FAS 793 north (13) to old U.S. 50 west (15) to Lyon County
K1	Kansas 57 east (12) to Anderson County
K2	Kansas 57 east (12) to Anderson County
K3	Kansas 57 west (14) to Greenwood County
K4	Kansas 57 west (14) to Greenwood County
K5	FAS 10 west (8) to Lyon County
K6	FAS 152 north (16) to old U.S. 50 west (15) to Lyon County
K7	(a) U.S. 75 north (5) to Osage County (b) Old U.S. 50 west (1[illegible]) to Lyon County
K8	Kansas 31 north (5) to Osage County

Note: Numbers in parentheses indicate road segment numbers as identified in Figure 450.2-1.



WOLF CREEK GENERATING STATION
UNIT NO. 1
ENVIRONMENTAL REPORT (OPERATING LICENSE STAGE)

Figure 450.2 - 1

Transportation Map
(Showing Evacuation Routes)

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Q450.3 (ER) Please provide a copy of the latest version of the FOGALL Model User's Guide.

R450.3 One complete copy of the FOGALL certification/users manual was provided with formal response. This manual contains proprietary program code listings which are not to become public record. This information was provided only to assist the NRC in its evaluation of WCGS-ER(OLS) and WCGS FSAR Addendum.

Q450.4 (ER) Please provide documentation of the procedure used to validate the FOGALL Model.

R450.4 The procedure used to validate the FOGALL model is described in the certification/users manual provided in response to Question 450.3.

The verification of FOGALL was performed by executing two test cases and manually calculating the expected results. One test case utilized source water temperature constant with time and area. The second case varied the source water temperature over the source area each hour. In addition, hand calculations were performed to verify that the results of each subroutine conformed with the respective applied theoretical model or mathmetical equation.

The model design is based upon accepted principles of atmospheric physics; computed values were hand verified; and the test cases were designed to detect fog, no fog, ice, and no ice conditions at defined receptors. The validation procedure, therefore, provides a high degree of confidence that the FOGALL results are representative of actual conditions.

47.0 RADIOLOGICAL ASSESSMENT BRANCH

Q470.1 (ER) (2.1.3.2.4) Confirm that the land use i Table 2.1-18 has not changed since 1978.

R470.1 See new Table 2.1-18a which provides updated nearest receptor information determined in 1980. Dose calculations presented in Section 5.2 are based upon the 1980 receptor information.

Q470.2 (ER) (2.1.3.3.4' Provide information concerning the location of the visitors center and an estimate of the number of visitors anticipated annually.

R470.2 The Visitor's Center is located in the EOF complex about 2.8 miles northwest of the power block (See Figure 2.1-6). The number of visitors anticipated annually at the Visitor's Center is 5,000 - 7,000 based on projections of visits to the Wolf Creek construction site.

Q470.3 (ER) (2.1.-15) What is the fraction of daily intake of cows derived from pasture during the grazing season?

R470.3 Essentially 100 percent of the daily intake of cattle is derived from pasture during the grazing season. As the pasture becomes depleted late in each annual grazing season, farmer-stockmen may provide supplemental feed to their pastured livestock.

Q470.4 (ER) (2.1.3.4.1) Provide information concerning the population served by the City of LeRoy's Municipal Water System.

R470.4 The population of LeRoy determined during the 1980 census is 624 persons.

Q470.5 (ER) (5.2)	Provide a copy of the information referenced in Section 5.2 that was to have been updated in mid-1980.
R470.5	See revised Section 5.2 and Appendix 5A.
Q470.6 (ER) (Appendix 5A)	Appendix 5A of the ER states that a summary of dose models and a list of assumptions used for Wolf Creek were presented in Appendix 5.2A of the ER-Construction Permit Stage, however in reviewing this information, the addition of the computer code FOOD in the ER-OL became apparent. Therefore, please provide an updated summary of the dose models and assumptions used.
R470.6	Appendix 5A has been revised. Computer Code FOOD and other dose models have been replaced with more current computer codes (GASPAR, LADTAP II) and information in Appendix 5A is for these current codes.