00340

Department of Energy
Washington, D.C. 20545

Docket No. 50-537
HQ:E:82:025

July 28, 1982

Mr. Paul S. Check, Director
CRBR Program Office
Office of Nuclear Reactor Regulation
U.S. Nuclear Regualtory Commission
Washington, D.C. 20555

Dear Mr. Check:

AMENDMENT NO. XV TO THE ENVIRONMENTAL REPORT FOR THE CLINCH RIVER BREEDER REACTOR PLANT

The application for a Construction Permit and Class 104(b) Operating License for the Clinch River Breeder Reactor Plant, docketed April 10, 1975, in NRC Docket No. 50-537, is hereby amended by the submission of Amendment No. XV to the Environmental Report, pursuant to 10 CFR Part 51. This amendment incorporates revisions to Section 3.4, "Heat Dissipation System;" Section 3.6, "Chemical and Biocide Wastes;" Section 3.9, "Transmission Facilities;" Section 4.1, "Site Preparation and Plant Construction;" Section 5.2, "Radiological Impact From Routine Operation;" Section 5.4, "Effects of Chemical and Biocide Discharges;" Section 5.6, "Effects of Operation and Maintenance of the Transmission System;" and Section 5.8, "Resources Committed." These changes are incorporated for editorial corrections and consistency with the NPDES permit application. Also included are Appendix F, "Supplemental Alternative Siting Analysis Update for the LMFBR Demonstration Plant," Appendix G, "Update to the CRBRP Alternative Siting Analysis Within the TVA Power Service Area," and recent responses to NRC questions. This material was previously provided and is now being entered into the formal document.

A Certificate of Service, confirming service of Amendment No. XV to the Environmental Report upon designated local public officials and representatives of Government agencies, will be filed with your office after service has been made. Three signed originals of this letter and 41 copies of this amendment, each with a copy of the submittal letter, are hereby submitted.

Sincerely,

John R. Longenecker

John R. Longenecker
Acting Director, Office of the
Clinch River Breeder Reactor
Plant Project
Office of Nuclear Energy

Enclosure

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CRBRP ENVIRONMENTAL REPORT

AMENDMENT XV

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coordinates 548.500 and 2477.623, as shown on Figure 3.4-9. Temperature of the discharge and the Clinch River temperature characteristics are given in Table 3.4-4. The blowdown has a total dissolved solids concentration as indicated in Table 3.6-1 compared with the river water. Cooling tower blowdown is continuous except during periods of intermittent chlorination of the circulating water to alleviate algae and slime growth. The blowdown is stopped whenever total residual chlorine concentration exceeds 0.14 mg/l, as discussed in Section 3.6. 15

The treated chemical wastes, sanitary effluent and, occasionally, liquid radwaste are combined with the cooling tower blowdown prior to discharge. Where control of blowdown flow is required, the individual waste systems have storage capacity for the periods when cooling tower blowdown is not available.

Estimated time of travel of the cooling water across the condenser and to the end of contained discharge lines is approximately two and one-half minutes. Since the Clinch River Breeder Reactor Plant utilizes a closed cycle cooling system for heat dissipation, the mortality of organisms entrained in the cooling system is assumed to be 100 percent.

TABLE 3.4-1

DESIGN PARAMETERS AND CONDITIONS

Ambient Conditions		
Design Wet Bulb Temperature	76°F	
Relative Humidity	50%	
Condenser		
Steam Flow Rate to Condenser (100 % Load)	2.2×10^6 lb/hr	
Condensate Flow Rate from Condenser (100 % Load)	2.8×10^6 lb/hr	
Circulating Water Flow Rate	185,200 gpm (Condenser) 400 gpm (Exhauster)	9
Heat Rejected	2.052×10^9 Btu/hr	6
100% Load	975 MWt	
Temperature Rise	22°F	6
Cooling Tower		
Circulating Water Flow Rate	212,200 gpm	9
Heat Rejected	2.256×10^9 Btu/hr	9
Approach to Wet Bulb	11°F	6
Range	21.34°F	9
Circulating Water Pumps		
Quantity	3	6
Design Flow	63,000 gpm per pump	9

TABLE 3.6-1

PRELIMINARY ESTIMATES OF EFFLUENT WATER CONCENTRATIONS

	Clinch River (Background)*		CRBRP Waste Streams: Cooling Tower Blowdown**		Neutralized Plant Wastes+	Sanitary Wastes	Discharge to River: Annual Quantity++	Discharge to River: Concentration v	
	Avg. Conc. (mg/l)	Max. Conc. (mg/l)	Based on Avg. River Conc. (mg/l)	Based on Max. River Conc. (mg/l)	Based on Avg. Discharge - 100 gpm (mg/l)	Based on the Design Loading (mg/l)	(10^4 lbs/yr)	Average (mg/l)	Maximum (mg/l)
Total Alkalinity (as $CaCO_3$)	87.0	100.0	218.0	250.0	<50.0	--	NA	239.0	286.3
Ammonia Nitrogen (as N)	0.04	0.23	.10	.58	--	0.5	0.47	0.70	2.50
BOD	<1.0	1.3			--	12.0	3.5	5.3	15.0
Calcium	29.0	35.0	72.0	87.5	224.0	--	57.0	85.0	108.0
Chloride	3.0	40.0	7.50	100.0	43.0	--	7.8	11.8	32.3
Residual Chlorine	vv	vv			--	1.0	0.1	0.14	0.14
COD	<4.0	12.0	10.0	30.0	--	25.0	11.2	16.8	40.0
Copper ‡ (µg/l)	36.0	170.0	90.0	425.0	--	--	0.13	0.20	0.93
Total Dissolved Solids (TDS)	125.0	150.0	312.0	375.0	1350.0	--	277.0	355.0	415.0
Total Iron ‡ (µg/l)	530.0	6500.0	1325.0	16250.0	--	--	0.63	0.95	1.72
Lead (µg/l)	<11.0	35.0	<28.0	87.5	--	--	<0.01	<0.03	<0.03
Magnesium	7.7	9.4	19.25	23.5	75.0	--	13.0	19.6	21.4
Manganese ‡ (µg/l)	55.0	180.0	138.0	450.0	1.0	--	0.09	0.13	0.18
Nickel ‡ (µg/l)	<50.0	60.0	<125.0	150.0	--	--	0.01	0.02	0.11
Nitrate (NO_3)	0.45	1.4	1.13	3.5	3.2	66.0	2.3	3.4	5.6
pH	7.6	8.2	7.6	8.2	6.5-8.5	6.9	NA	6.5-8.5	6.5-8.5
Total Phosphate					1.0	5.0	0.10	0.14	1.00
Potassium	1.26	1.7	3.15	4.25	15.0	--	2.3	3.5	4.8
Silica (SiO_2)	4.3	6.0	10.75	15.0	27.0	--	6.5	9.8	15.3
Sodium	3.3	7.0	8.25	17.5	345.0	--	21.0	22.0	31.0
Sulfate (SO_4)	16.0	27.0	40.0	67.5	780.0	--	62.0	70.0	97.0
Total Suspended Solids (TSS)	7.0	40.0	17.5	100.0	<30.0	5.0	21.9	33.0	114.0
Zinc ‡ (µg/l)	36.0	570.0	90.0	1425.0	--	--	0.03	0.05	0.08

* Based on "Status of the Nonradiological Water Quality and Nonfisheries Biological Communities in the Clinch River Breeder Reactor Plant, 1975-78", TVA, Feb. 1979.

**Includes several minor recycled waste streams (Make-Up Water System equipment rinses, backwashes and blowdown; non-radioactive floor drains). These do not measureably affect the Cooling Tower Blowdown Chemical Concentrations.

+Includes Make-up Water Demineralizer and Steam Condensate Polisher regeneration wastes, Auxiliary Boiler blowdown and Non-Radioactive Lab and Sampling wastes

++Computed as follows:
Quantity from Cooling Tower Blowdown = (Avg. conc.) (Annual Avg. Blowdown = 2,327 gpm) (Plant Load Factor = 68.5%)
Quantity from Neutralized Plant Wastes = (Conc.) (Flow = 100 gpm) (24 hr/day operation) (365 operating days/yr)
Quantity from Sanitary Wastes = (Conc.) (Flow = 5 gpm) (24 hr/day operation) (365 operating days/yr)

v $\frac{\Sigma(\text{Conc.})(\text{Flow})}{\Sigma(\text{Flow})}$ where Ave. Conc. is based on average river conc. (cooling tower blowdown) and average discharge flow (neutralized plant wastes) and Max. Conc. is based on max. river conc. and max. discharge flow.

vv Field measurements using the orthotolidine calorimetric method repeatedly showed the chlorine residual concentration to be below the limits of detection (<0.05 mg/l). As there are no nearby sources of chlorine additions to the river, it can be assumed that the ambient level is zero.

‡ Includes contribution to effluent quantities from condenser erosion/corrosion.

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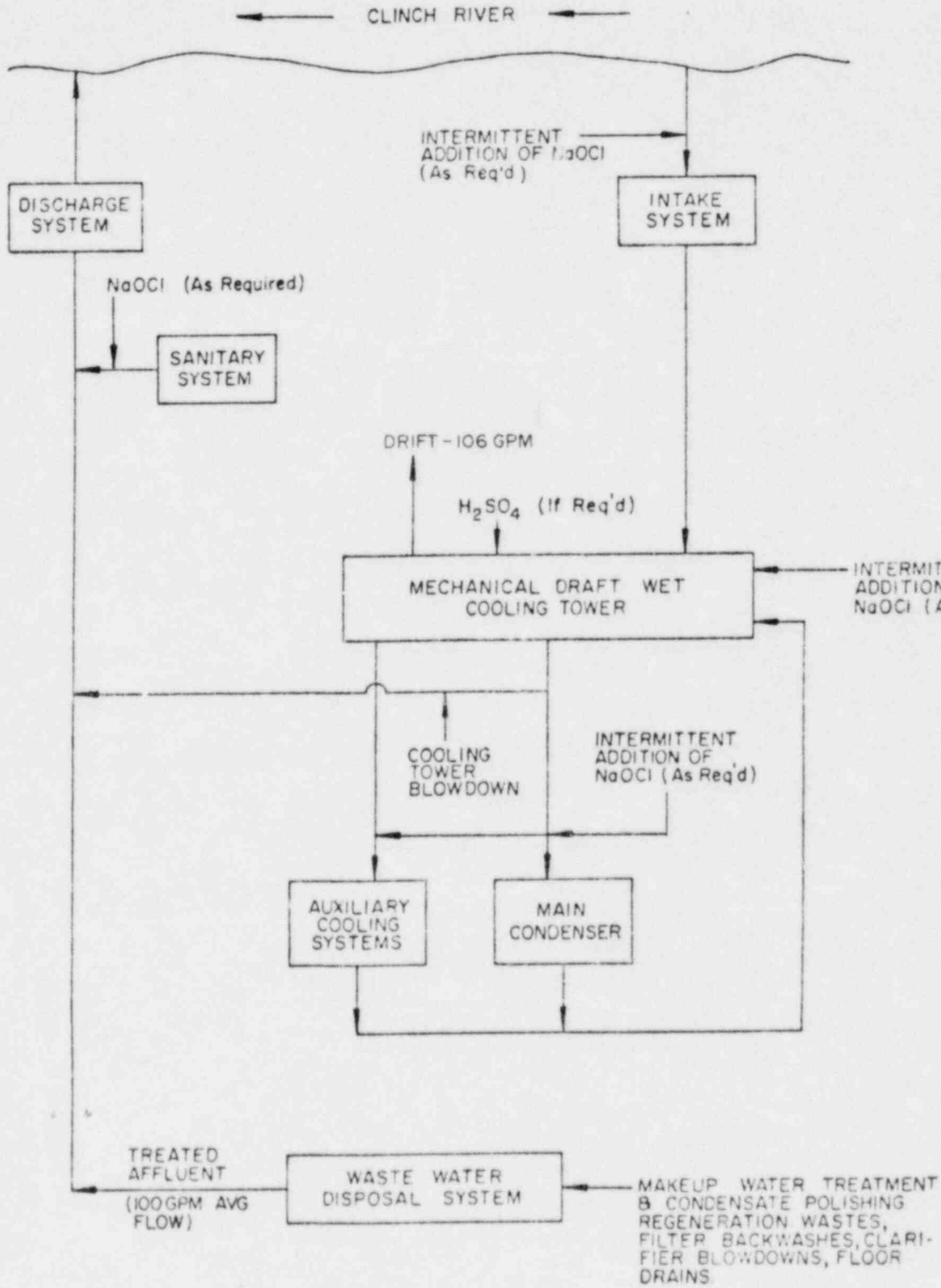

Figure 3.6-1 CHEMICAL AND BIOCIDE ADDITIONS AND DISCHARGES AT MAXIMUM POWER OPERATION

3.9.8 DESIGN DESCRIPTION OF PROPOSED TRANSMISSION LINE

To connect the CRBRP generation into the area power system, a new loop connection will be constructed connecting the existing TVA-owned Ft. Loudoun-Roane 161-kV Transmission Line located approximately 2.8 miles northeast of the plant site. The loop connection will be constructed on separate rows of structures with adequate lateral separation to assure that the structural failure of one of the circuits would not jeopardize the integrity of the other circuit.

These transmission line connections will be designed to meet the medium design loading requirements of the National Electrical Safety code. In addition, TVA design cases provide for wind loadings of approximately 85 mile per hour winds on bare conductor and vertical loading strength based on one inch of radial ice. These loading conditions assure adequate strength even under extreme weather conditions.

Structures proposed for this loop connection will be compact, narrow based steel towers.

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Each circuit of the loop connection will consist of three 2,034,500 C mil (1.68-inch diameter), 72/7 stranding ACSR conductors, one conductor per phase and one 7 No. 9 alumoweld shield wire. Wire tensions for the conductors and shield wire will be selected to assure that vibration damage will not occur. Long experience with transmission lines in the Tennessee Valley area have verified that where everyday tensions are kept below 18 percent of the ultimate strength of the cable, vibration will not be a problem.

Galloping of conductors is a condition that has never been observed on lines in the eastern portion of the TVA system. TVA has had only minor reports of galloping in its entire operating experience; these have occurred only on short span lines in the central and western portions of TVA's service area.

As stated earlier, shield wires will be installed on the loop connections to provide lightning protection for the circuits. Even though the lines are located in an area with an isokeraunic level of 50, TVA's experience has shown that the outages on similar type lines in this area varies from zero to three flashover interruptions annually per 100 miles of line. The use of circuit breakers with high speed reclosing relays results in the majority of these interruptions being momentary.

3.9.9 EXISTING SUBSTATIONS AFFECTED

No existing substation will be affected by the construction of the proposed CRBRP with the possible exception of some possible adjustments in switching facilities. The need for these facilities will be determined as the Clinch River Project develops. If such adjustments are deemed necessary, they will be very minor in nature.

NRC QUESTIONS ABOUT SECTION 4

NRC Letter November 19, 1974 - Giambusso

None

NRC Letters February 13, 1975 and April 23, 1975 - Dicker

Question B8 (4) - Amendment I, Part II, pages AI-125 and 126
Question B9 (F4.1) - Amendment I, Part II, page AI-127
Question C5 (4.1) - Amendment I, Part II, page AI-134
Question C16 (4) - Amendment I, Part II, page AI-155
Question D4 (4.2) - Amendment I, Part II, pages AI-171 and 172
Question G8 (4) - Amendment I, Part II, page AI-304
Question G10 (4.1) - Amendment I, Part II, pages AI-306 and 307
Question G12 (4) - Amendment I, Part II, page AI-309

NRC Letter October 26, 1981

Question 290.1R (All Sections) - Amendment XV 15

habitat such as cottontail, woodchuck and striped skunk will initially experience population reductions of approximately 20 percent during site clearing followed by population increases to approximately equal those prior to construction as cleared habitat peripheral to most site activities becomes available for habitation. Populations of white-footed mice, cotton rats, house mice, golden mice and short-tail shrews will initially decrease by approximately 15 percent during site clearing followed by a population increase of approximately 20 percent above pre-construction levels as open, cleared habitat becomes available for habitation.

Populations of forest dwelling birds such as ruffed grouse, American woodcock, woodpeckers, blue jay, flycatchers, vireos and warblers will decrease by approximately 20 percent due to habitat loss during construction. Following construction, populations of these birds will increase slightly to approximately 85 percent of those prior to construction. Species typical of open habitat such as mockingbird, 9 | 15
grackle, cowbird, cardinal, indigo bunting, American goldfinch and most sparrows will initially decrease by approximately 15 percent during clearing and then increase approximately to preconstruction populations during construction as abundant open habitat becomes available. Pest birds such as crows, starlings and house sparrows will increase during construction to approximately 20 percent greater than prior to construction.

Reptile populations are expected to decrease by approximately 50 percent during site clearing and construction because of habitat loss and construction roadkills. Amphibian species' populations are expected to initially decrease by approximately 20 percent followed by a 100 percent increase during construction as they colonize ponds and as insect pests become abundant near construction activities.

Threatened and endangered wildlife will be affected in proportion to effective habitat loss the same as other wildlife. The bald eagle and osprey species have active nests along Watts Bar Lake and may occassionally visit the Clinch River to feed. Neither species is expected to be affected by CRBRP construction. The bald eagle is listed as endangered in the U.S. and Tennessee, while the osprey is listed as endangered in Tennessee. The eastern cougar, if present on ORR, ranges widely and is not expected to be affected by construction. The cougar is listed as endangered in the U.S. and in Tennessee. Cooper's hawk, listed as threatened in Tennessee, resides in mature hardwood forests of ORR where it feeds on songbirds. The sharp-shinned hawk, also listed as threatened in Tennessee, resides in open forest where it feeds on birds as large as pigeons. Both species have ample feeding habitat and range widely in search of food. They are not expected to be affected by facility construction. The marsh hawk is a winter resident of ORR and is listed as threatened in Tennessee. It feeds on small mammals and an occasional reptile in open habitat and may benefit from increased small mammal populations on disburbance land. Other threatened and endangered species discussed in Section 2.7.1.4.5 are only possible residents of ORR and are not expected to be affected by construction activities. 9

Within the proposed areas of construction, soil erosion potential, equipment limitations, revegetation potential and natural productivity have been identified using the general information provided by the 1942 soil survey of Roane County[3] and from Figures 2.7-2, 2.7-3, 2.7-4 and 2.7-5. Soil types have been identified and the acres of soil affected by construction activities have been determined by soil map analysis. Soil ratings and estimates of acres affected by construction activities are shown in Table 4.1-3. Only approximately 10 acres of soil that will be disturbed by construction have a moderate to severe erosion potential due to steep, erosable slopes. Approximately 40 acres of disburbance land have wetness or stoniness that severely restricts equipment use. Approximately 40 acres of disturbance land have a severe or moderate to severe seedling mortality rating. Natural productivity of disturbance land is generally low or moderate.

The location and extent of specific problem soils, relative to proposed construction activity, will be determined by on-site investigation. Construction guidelines will be responsive to 9
consideration of erosion and revegetation problem areas.

4.1.1.7 IMPACT ON HUMAN HABITATION

The CRBRP Site is a forest area devoid of human habitation; therefore, construction of the CRBRP will involve no relocation or association problems.

A small industrial park is located 1.5 miles to the north, a commercial camping area is located about one mile southeast and several houses are scattered throughout the area south of the Clinch River within one or two miles of the Site. Noise associated with construction activities could disturb people in these areas to some degree because of the natural quietness of the area. Construction noise will vary with the particular phase of construction, the mix of equipment used for each phase and the cycle of the equipment. Phases of construction for the CRBRP will include preparing the Site, excavating, placing foundations, erecting structures, finishing details and cleanup as shown in 15
Figure 4.1-4. Construction equipment noise ranges are listed in
Table 4.1-4 and the noisiest equipment types operating during 9
each construction phase at an industrial construction site are listed in Table 4.1-5. To characterize the noisiness, a Noise Pollution Level (NPL)

has been calculated for each phase of the construction. The NPL in decibels (dB) is defined as the sum of the A-weighted average sound pressure level and 2.5 times the standard deviation of the A-weighted average sound pressure level.[4] Table 4.1-6 is a list of descriptors of NPL values which can be used in interpreting the NPL levels in Table 4.1-5.

Locations of existing dwellings are given in Figure 2.1-7. The two dwellings nearest the generation portion of the facility are more than 0.6 mile away. Another dwelling is located over 0.3 mile from the river-water pumphouse. Construction noise impact may be assessed with consideration of: (1) probable construction noise levels (see Table 4.1-4 and 4.1-5), (2) NPL Descriptors (see Table 4.1-6), (3) the distances involved, (4) the temporary nature of construction and (5) the intermittent nature of construction noise. Construction noise would be noticed by few residents south of the site and, for occasional, limited time periods, may cause some annoyance.

As stated earlier, explosion noise will be minimized by the use of small 6
multiple charges.

Construction of plant and transmission facilities will cause negligible aesthetic disturbance to resident and transient populations because of the limited construction duration, the limited number of viewing locations and the distances involved. Plant and transmission facilities are described in Section 3.0. Existing and projected resident and transient populations are described in Section 2.2 and site layout and topography are described in Section 2.1. The main plant structures are to be located in a wooded area with higher elevations northward and a slope southward down to the Clinch River.

Locations for viewing construction of the main plant structures are limited by the natural terrain and the surrounding forest (see Section 3.1). A portion of the largest structure, the reactor containment building may be visible at a distance of approximately 1.6 miles to motorists crossing the Gallaher Bridge. Construction of facilities associated with the main plant (e.g., water intake and discharge, railroad extension and barge unloading area) involves 6 only low height equipment and structures. Approximately 10 homes on the southern side of the Clinch River will have a limited view of some portion of plant construction.

No provision for living quarters will be made for workers or their families on the Site. Housing and school facilities will be available in nearby communities as discussed in Section 8. 6 The peak construction force is estimated to be approximately 10 5,400 persons. 8

Full compliance with fire laws and regulations will be considered a necessity and a fire plan will be proposed that will set forth in detail the plan for prevention, control and extinction of fires on and in the vicinity of the project area and quarry site. 8

Several archaeological sites have been investigated in the area as described in Section 2.3; however, all field work at these sites was completed as of June, 1982. 15 8 The Hensley family cemetery, described in Section 2.3, is located on the tip of the peninsula and is to be preserved with the family retaining the right of access. 9 The cemetery is not in the immediate construction area. Care will be exercised to insure that the cemetery remains intact.

4.1.1.8 SOIL EROSION AND SEDIMENT CONTROL

A soil erosion and sediment control plan will be developed and 15 implemented for the planned construction activities at the plant site. The objective of the plan will be to control the erosion and sedimentation resulting from construction activities by minimizing soil exposure, collecting and controlling rainfall runoff in the construction area, and by shielding and/or binding soil on cut slopes where stabilization is required. Sedimentaton in the Clinch River will be controlled by placing runoff treatment ponds and sand filters in such a manner to collect and treat rainfall runoff. These ponds will be installed prior to major earthwork commencing in their respective watershed.

Inspections of the site will be performed on an on-going basis to identify areas of evident and potential erosion to assure that timely corrective action is taken. Corrective action will include, but not be limited to, seeding, placement of rip-rap or crushed stone on slopes and exposed surfaces, temporary diversion ditches and sediment traps such as hay bales, sand bags, filter screens and stone traps. 15

A 25-foot buffer zone will be provided between the Clinch River and the site construction activities except in the following areas:

a. The railroad spur going underneath Highway 58 Gallaher Bridge, RR Station 31 + 00 (RM 14.0);

b. The 48" corrugated metal pipe for drainage underneath the railroad spur, RR Station 29 + 39 (RM 14.0);

c. The 36" corrugated metal pipe for drainage underneath the railroad spur, RR Station 50 + 00 (RM 14.25);

d. The extension of the 6-foot concrete culvert underneath the railroad spur and access road, Rd. Station 1 + 84 (RM 14.5);

e. The 14-foot corrugated metal pipe underneath the railroad spur and access road, Rd. Station 5 + 35 (RM 14.6);

f. Road and railroad enbankment closer than 25 feet to the Clinch River between Rd. Station 5 + 35 and Rd. Station 19 + 50;

g. The barge unloading facility (RM 14.75);

h. The water discharge outfall (RM 16.0);

i. The water intake (RM 17.9);

j. The corrugated metal pipe for the quarry treatment pond discharge (RM 18.25); and

k. Where existing River Road appurtenances are presently closer than 25 feet to the Clinch River. 15

In addition, all existing vegetation such as trees, shrubs, and grass which do not interfere with the construction, will be left in place and preserved to stabilize these areas and prevent unnecessary soil exposure.

Dredge material will be disposed of in a designated spoil area. A dike or berm will be constructed around the spoil area to control drainage from dredge material and prevent dredged material from returning to the river. In areas where fill material is placed within the 25-foot buffer zone but not within the confines of sheet piling or coffer dams, erosion control measures including, but not limited to, berms, straw bale barriers, check dams, filter barriers and mulching will be used.

Water sprinkling on laydown, storage, and parking areas, unpaved roads and other areas of the Site will be used to control dust formation. Dust control will be accomplished through the use of sprinkler trucks which will obtain water from the Clinch River. Specific areas will be designated along the river at which the trucks may obtain water. These areas will be inspected during 15
the normal inspection tours for evidence of damage to the river bank. Any observed damage to the river bank will be repaired and corrective actions taken.

The CRBRP Erosion and Sediment Control Plan will incorporate the Environmental Protection Agency and State of Tennessee standards of performance for new sources, best management practices, best professional judgement and other applicable guidance documents to control the potential pollution resulting from the construction activity.

The extent and comprehensiveness of the plan will allow the aforementioned agencies to no longer require an aquatic biological monitoring program. The plan will require that specific mitigation methods be taken to minimize erosion from water, wind and gravity.

4.1.2 EFFECTS ON WATER USE

4.1.2.1 WATER USE

Water used during the site preparation, plant construction and 8
quarry preparation and operation will come from two sources; raw water from the Clinch River and potable water from the Bear Creek Water Filtration Plant.

Raw water will be used in dust control, compaction of fill material and aggregate crushing and washing, with a peak demand of less than 60,000 gallons per day. Water for the quarry operations will be initially pumped from the Clinch River and then recycled through a settling basin, with makeup from the
river required only for losses and evaporation. The intake for 13
water drawn from the Clinch River will be floated to insure sediment is not disturbed.

Potable water will be used in fire protection, sanitary facilities and production of concrete with a peak demand of 150,000 gallons per day. It is presently planned that potable water from the Bear Creek Filtration Plant will be piped to the site along existing roadways. Further into the construction period, the supply system will consist of a yard storage tank with make-up water coming from the potable water supply.

4.1.2.2 GROUNDWATER

Movement of groundwater at the Site is from groundwater highs to adjacent groundwater lows and hence to the Clinch River which serves as a ground water sink to the Site area. Thus, the Clinch River acts as a barrier to the movement of groundwater from the Site to the wells and springs presently in use south of the Clinch River, as discussed in Section 2.5.

During excavation, perched water tables and seep areas may be encountered and will be controlled by installing drainage ditches at the bottom of designated slopes and by installing drain pipes into the rock foundation. 8

Water will be collected in sump pits located at the periphery of 8
the excavated slopes to permit pumping to a holding basin for settlement of suspended solids prior to discharging into the river. Since the normal river water elevation is 741 feet, it is anticipated that additional dewatering control and rock treatment may be required from elevation 741 to the base of excavation at 712.5 feet, primarily in the weathered limestone on the east side 8
of the excavation (plant north as reference). The normal pattern of groundwater movement to the river will be restored after the plant has been constructed and backfill has been placed around the structures.

4.1.2.3 IMPACT ON AQUATIC ECOLOGY

Construction of the River Water Intake Facility, Plant Discharge Structure and Barge Unloading Facility on the Clinch River will necessitate excavation and dredging, fill placements (including riprap) and other construction activities below normal water level, elevation 741 feet. In addition, limited dredging and placement of fill (including riprap) below elevation 741 feet will be required for improvement of the access road and construction of the railroad spur. Impact of these construction activities on various forms of aquatic life, benthic habitat and other aquatic uses is expected to be minor and of short duration.

During construction of the barge unloading facility, the proposed construction sequence, described in Section 4.1.1.3, will tend to minimize siltation in the Clinch River. Only 0.4 acre of river bottom below the 741-foot elevation will be disturbed during construction. Dredging will be from the river bank near river mile 15.0 and the dredged material (as will all dredged material resulting from the intake and discharge structures, access road and railroad construction) will be deposited so as to prevent material from re-entering the river. 7 15

Revised positioning of the barge unloading facility results in an estimated dredging of 11,000 cubic yards of material, and filling with 700 cubic yards of sand. This disturbed area is more limited than that previously planned, so adverse impacts are expected to be correspondingly reduced. 9

Construction of the intake and discharge facilities will impact approximately 0.22 and 0.06 acres, respectively, of river and shoreline below elevation 741 feet. A cofferdam will be constructed near the location of the river water pumphouse to permit work to proceed "in the dry." This cofferdam will eliminate siltation in the river during construction of the pumphouse. However, some turbid water will enter the river during cofferdam construction.

The limited dredging and placement of granular fill and riprap associated with the access road and railroad will impact less than 0.8 acre of existing river bottom below normal water level. Dredging and excavation activities, in summary then, will be limited to several small areas of the right bank and river bottom of the Clinch River between CRM 14 and 18, amounting to less than 1.5 acres. The impact of these construction activities is minimal and is expected to be of relatively short duration. Impacted aquatic organisms are expected to recover within a relatively short period. 7 9

A baseline survey, as described in Section 2.7.2, was conducted on the Clinch River at the Site to identify and characterize the existing biological communities. The results of this survey indicate that communities in areas where construction impact may occur are dominated by common chironomid and oligochaete species. These species will recover rapidly in the construction area. Fish species are expected to avoid areas of high turbidity and will not be impacted by construction activities.

4.1.2.4 RUNOFF TREATMENT PONDS

Five runoff treatment ponds and a quarry runoff treatment pond serve the Site during the construction and operating periods. The ponds are designed to process water from a 24-hour storm (5 inches) having a recurrence interval of 10 years in addition to anticipated dewatering flows. Rainfall events greater than the design event will be discharged by means of the riser overflow pipe.

The primary function of the ponds is to provide a quiescent settling environment and filtration system so that stormwater discharged to the Clinch River meets the conditions cited in the NPDES Permit. Consequently, the pond configurations have been developed on the principles of sedimentation/filtration theory and best management practices. 15

Suspended solids are removed by processing the collected stormwater through the sand/aggregate filter. Individual pond filters will vary in total filter area and number of perforated risers.

The pond outlets are provided with energy dissipation structures to minimize potential erosion caused by the discharge to the river.

When settled solids reach a predetermined thickness, the individual pond and filter medium will be physically cleaned. Maintenance frequency will vary from a period of several weeks during construction, to upwards of four to six months during the plant operational phase. In the event total suspended solids concentration in the effluent exceeds 50 mg/l, treatment pond system performance will be evaluated. Appropriate corrective action will be taken as required.

TABLE 4.1-1

APPROXIMATE LAND AREAS AFFECTED BY CRBRP
CONSTRUCTION ACTIVITIES 10

Category	Acres Disturbed		
	Temporary	Permanent	
Access Roads and Railroads (on-site)	30	30	
Access Railroad (off-site)	4	4	
Parking Area	19	2	
Barge Unloading Area	4	4	
Impounding Ponds	7	7	9 13
Quarry Including Stock Pile Area, Crusher and Facility	60*	-	
Concrete Batch Plant	5	-	
Riverwater Intake, Pumphouse, Discharge Line	6	.5	
Spoil Areas and Sanitary Land Fill Area	43*	-	
Storage and Other Work Areas	67	-	
Permanent Plant Buildings and All Land within Security Barrier	37	37	
Meterorological Tower Areas	10	10	
Additional Security Areas Required For 150 foot line of sight beyond security barrier - to be grassed, mowed - not restored to original condition	-	19	
TOTAL	292	113.5	9

*All May Not Be Required 13

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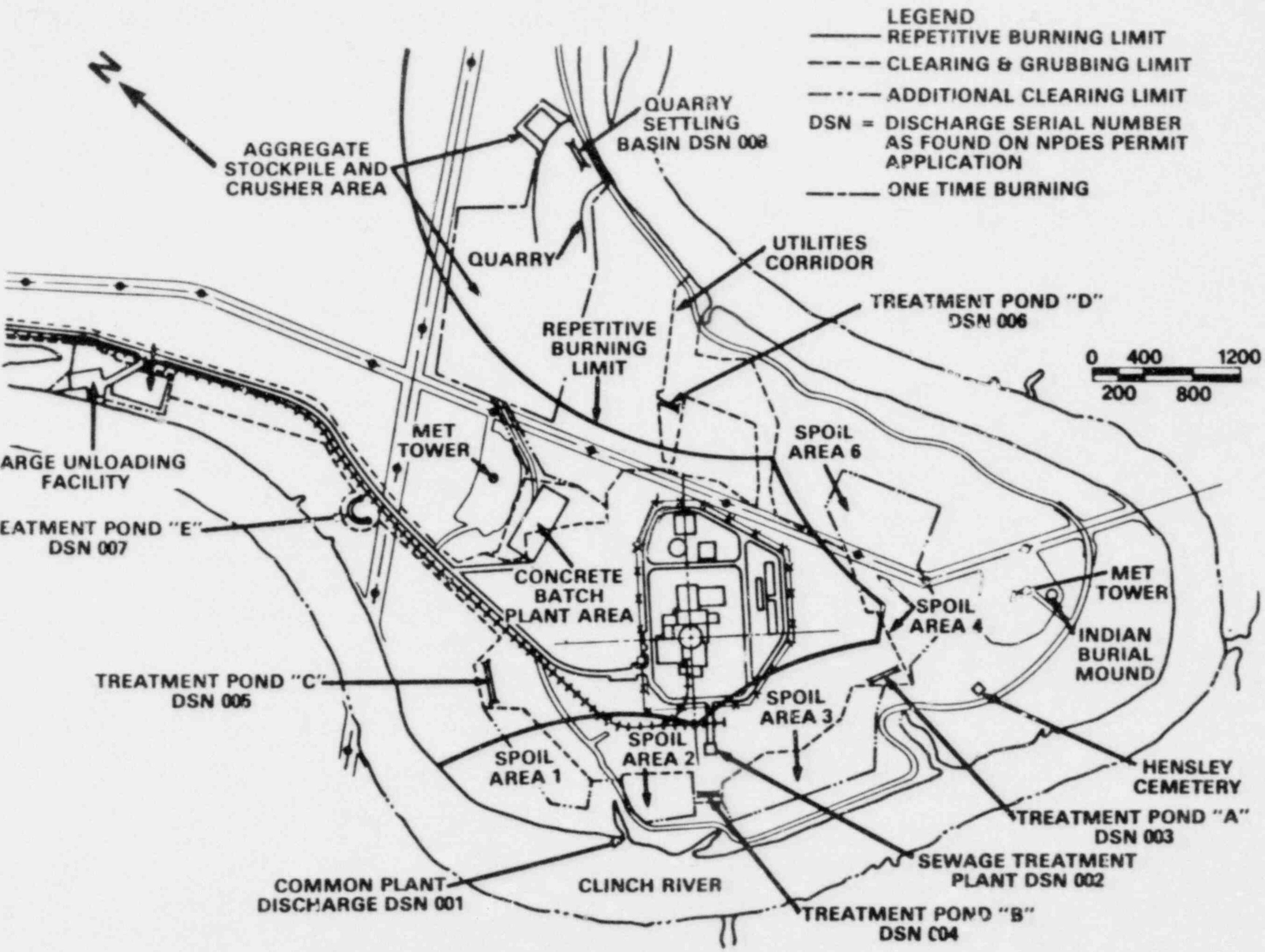

FIGURE 4.1-1 **Site Construction Layout**

AMENDMENT XV
JULY 1982

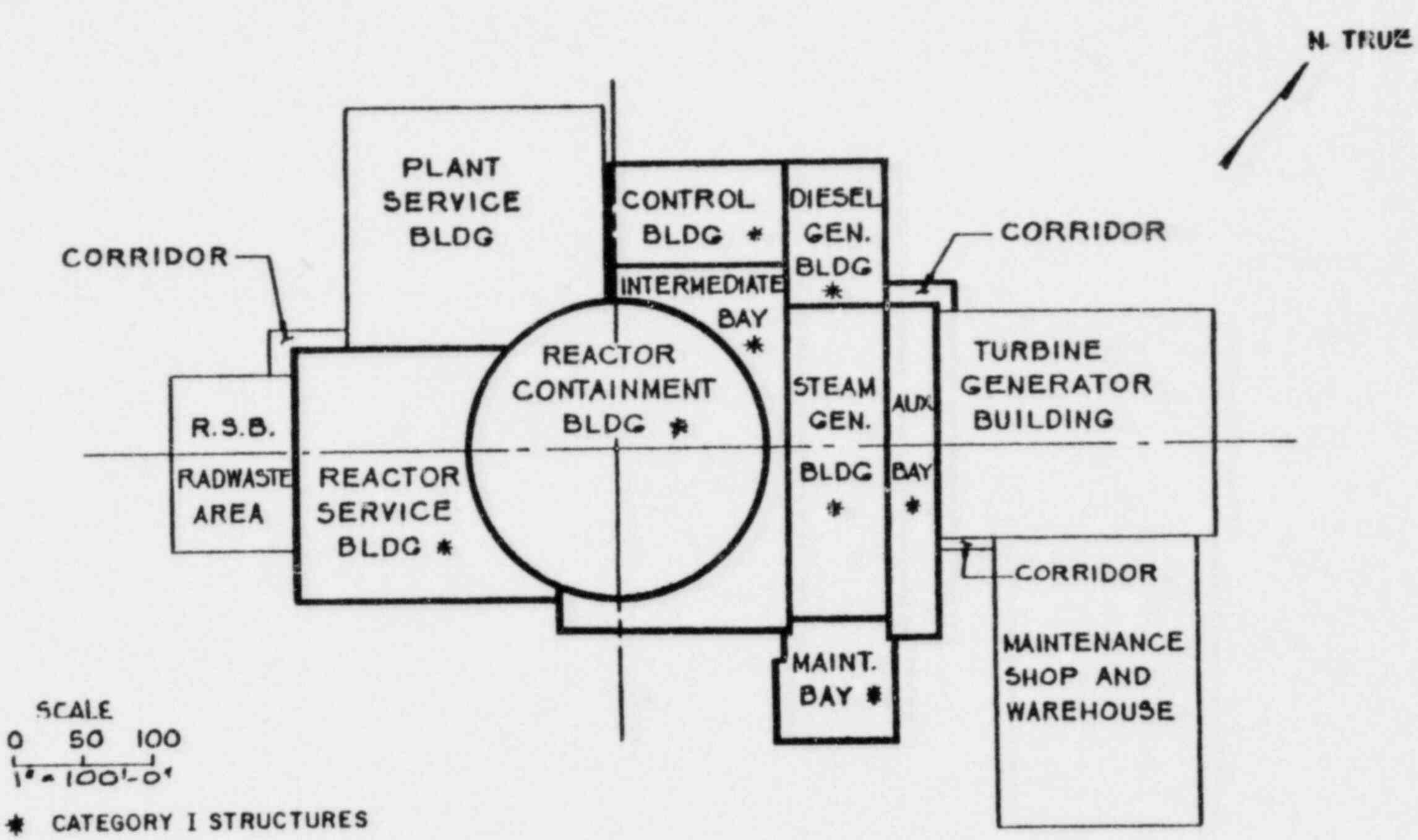

Figure 4.1-2 ARRANGEMENT OF PLANT STRUCTURES

9

AMEND. IX
OCT. 1981

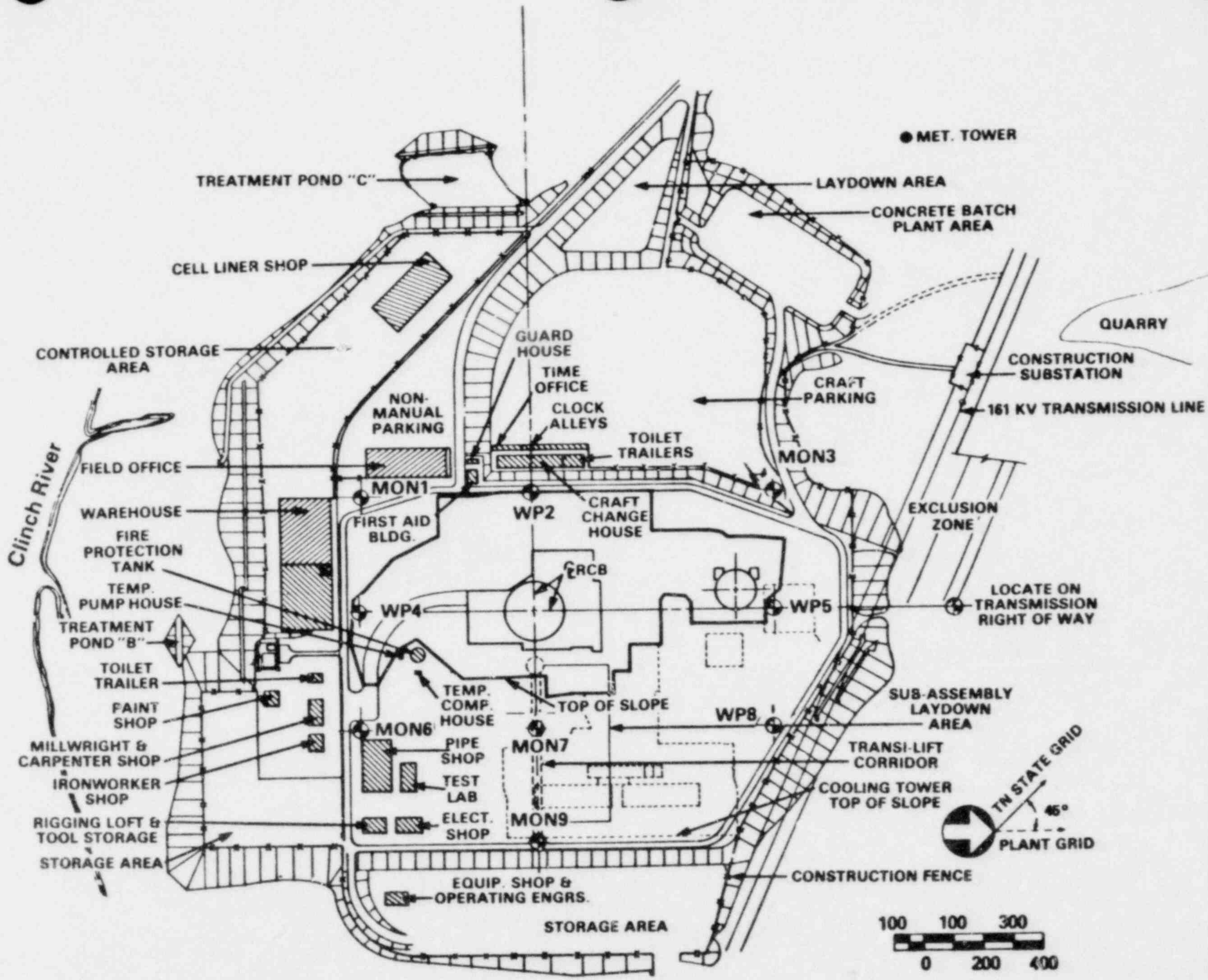

Figure 4.1-3 **Temporary Construction Facility Layout**

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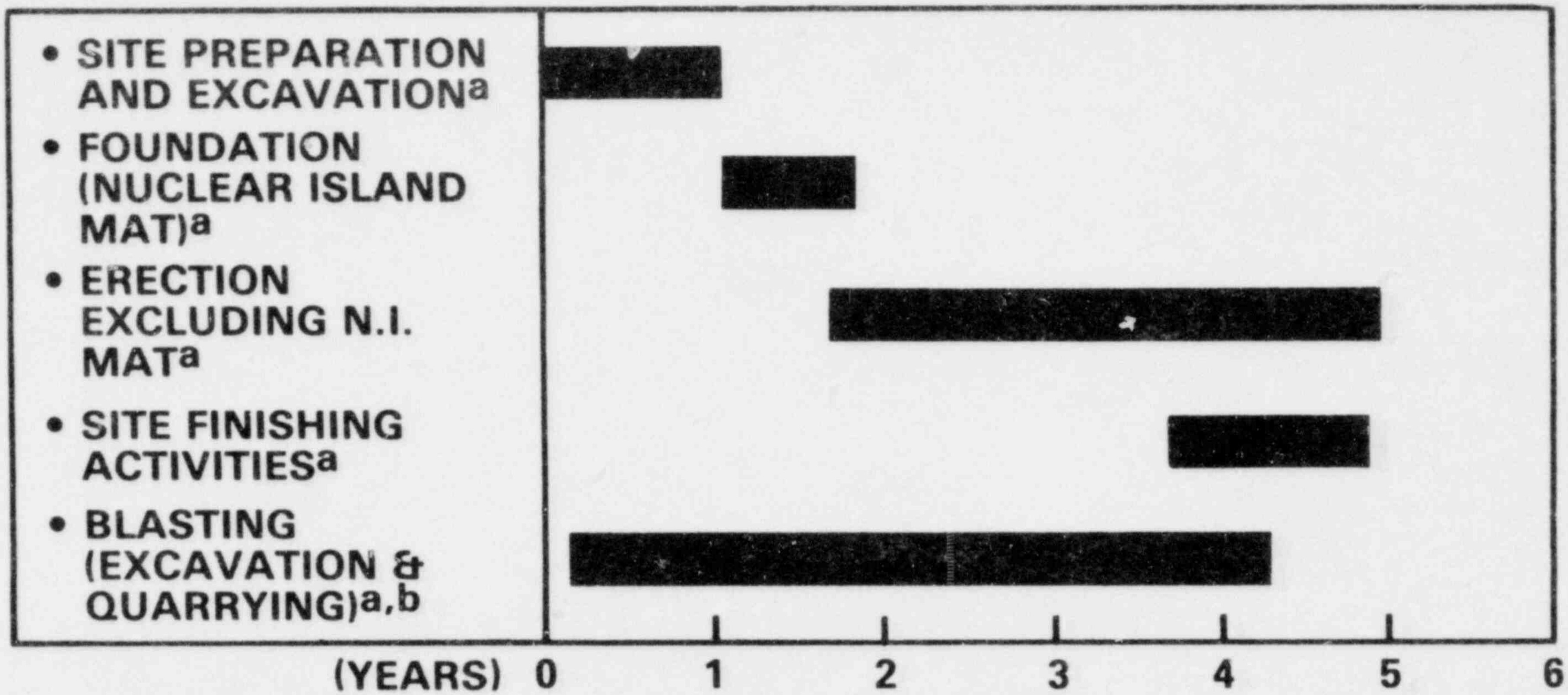
4.1-25

AMENDMENT XIII
APRIL 1982



a. ALL PHASES OF CONSTRUCTION ARE SCHEDULED ACCORDINGLY. 7:00 A.M. TO 3:30 P.M. AND 3:30 P.M. TO 11:00 P.M. (WITH ALLOWANCE OF ± 1/2-HOUR FOR STAGGERED SHIFTS TWO SHIFTS PER DAY; ESTIMATED 5 DAYS PER WEEK AT THIS TIME, USING A 5-8 DOUBLE SHIFT SCHEDULE, NO SATURDAY OR SUNDAY WORK IS SCHEDULED.

b. THE PRESENT SCHEME IS TO DRILL AND LOAD DURING THE FIRST SHIFT (DAY) AND BLAST DURING THE EARLY PART OF THE SECOND SHIFT.

NOTE: UNUSUAL SHIFT ACTIVITIES THAT MAY CONTINUE FOR A PERIOD OF 24-HOURS COULD INCLUDE LARGE CONCRETE POURS OR SPECIAL EQUIPMENT INSTALLATION ACTIVITIES (I.E. REACTOR VESSEL, CONTAINMENT DOME). NO ACTIVITIES SHOULD LAST MORE THAN 24-HOURS, CONSECUTIVELY.

Figure 4.1-4 General Construction Phases

AMENDMENT XV
JULY 1982

NRC QUESTIONS ABOUT SECTION 5

NRC Letter November 19, 1974 - Giambusso

Item 322.14 (5.1) - Amendment I, Part I, pages A1-50 to 53
Item 322.12 (5.1) - Amendment I, Part I, page A1-70
Item 322.13 (5.1) - Amendment I, Part I, page A1-71
Item 350.19 (T5.1) - Amendment I, Part I, page A1-89
Item 350.10 (5.4) - Amendment II, Part I, page AII-40
Item 350.12 (5.1) - Amendment II, Part I, page AII-41
Item 350.19 (T5.1) - Amendment II, Part I, page AII-42

NRC Letters February 13, 1975 and April 23, 1975 - Dicker

Question C15 (5.1) - Amendment I, Part II, pages A1-153 and 154
*Question D1 (5.1) - Amendment I, Part II, pages A1-161 to 168
Question D6 (5.4) - Amendment I, Part II, pages A1-175 and 176
*Question D8 (5.1) - Amendment I, Part II, pages A1-178 to 201
Question D10 (5.1) - Amendment I, Part II, pages A1-203 to 206
Question D11 (5.1) - Amendment I, Part II, pages A1-207 to 209
Question D17 (5.1) - Amendment I, Part II, page A1-219 to 221
Question D22 ( ) - amendment I, Part II, pages A1-233 to 235
Question D25 (5.1 & 5.4) - Amendment I, Part II, pages A1-241 and 242
Question E6 (5.1) - Amendment I, Part II, page A1-262
Question G6 (5.8) - Amendment I, Part II, pages A1-301 and 302
Question G9 (5.6) - Amendment I, Part II, page A1-305 15

NRC Letter October 26, 1981

Question 290.1R (All Sections) - Amendment XV
Question 750.1R (5.7) - Amendment XV 15

5.2 RADIOLOGICAL IMPACT FROM ROUTINE OPERATION

This section includes both the Radiological impact on biota other than man and the Radiological impact on man which had previously been discussed separately in Sections 5.2 and 5.3, respectively. The radiological impact from routine releases, previously discussed in Section 14.4, is also presented in this section.

5.2.1 EXPOSURE PATHWAYS

Extensive waste treatment systems included in the CRBRP design will assure that the amounts of radioactivity released to the environs during normal operation of the plant will be as low as reasonably achievable. Potential doses to man, and biota other than man, from both external and internal sources have been estimated for routine releases and are presented in this Section.

5.2.1.1 EXPOSURE PATHWAYS FOR ORGANISMS OTHER THAN MAN

13

These pathways originate with either liquid or gaseous effluent release and result in doses from external and internal routes. External pathways include submersion in air and water and exposure to soil and sediment. Internal exposure results from the ingestion of food or water and the inhalation of air. The primary exposure pathways for organisms other than man are shown in Figure 5.2-1.

Doses to aquatic organisms from radionuclides deposited internally are generally of greater magnitude than the doses they receive from external sources of radiation. Radionuclides are incorporated into tissues of aquatic organisms either through the assimilation of food or through the direct penetration of dermal tissue. External radiation exposures to aquatic organisms are due primarily to radioactivity in solution or associated with suspended particulates. Benthos receive an additional external dose from radionuclides adsorbed onto or concentrated in the benthic substrate.

Internal doses to terrestrial animals are generally of greater magnitude than the doses they receive from external sources. These internal exposures result primarily from radionuclides ingested with food and water and from the inhalation of airborne radioactivity. Terrestrial organisms and plants receive an external exposure from submersion in air containing concentrations of radionuclides. Radionuclide concentrations in soil and vegetation, due to deposition from the atmosphere and to radionuclides entering through the water supply, are minor contributors to the external dose. An additional external exposure is attributable to direct radiation from radioactivity contained within the plant. 13

5.2.1.2 EXPOSURE PATHWAYS TO MAN

The most significant exposure pathways to man are diagrammed in Figure 5.2-2.

5.2.1.2.1 LIQUID EFFLUENTS

Radiation exposures from liquid effluents generally arise from recreational activities or dietary intake. External exposures occur as a result of swimming, boating, and fishing in waters containing radioactivity; and persons involved in shoreline activities may be exposed from radionuclides accumulated in sediment. These external doses are proportional to radionuclide 15 concentrations in water and sediment. Internal doses result from the ingestion of water, the consumption of fish that contain radionuclides, and ingestion of waterfowl which feed on aquatic organisms. Swimmers receive an internal dose from tritium accumulated in the body as a result of exchange processes.

5.2.1.2.2 GASEOUS EFFLUENTS

Individuals are exposed to gaseous effluents via the following pathways: (1) external radiation from radioactivity in the air and on the ground; (2) inhalation; (3) ingestion of beef, vegetables, and milk; and (4) tritium transpiration. No other additional exposure pathway has been identified which would contribute ten percent or more to either individual or population doses.

External air exposures are evaluated at points of potential maximum exposure (i.e., points at the site boundary and sector peaks given in Table 5.2-1). External skin exposure, total body exposure and the internal dose from tritium are calculated at the site boundary and sector peak locations.

The contribution to the internal dose from tritium includes inhalation, milk ingestion (with cow assumed to obtain 100% of feed from pasture), beef ingestion and vegetable ingestion. 13

It is assumed that enough fresh vegetables are produced at each residence to provide for annual consumption by all members of that household. Data on annual meat production are not available for a 50-mile radius from the plant center. It is assumed that enough milk and meat is produced in each sector annulus to supply the needs of that region. The CRBRP population distribution is given in Table 5.2-2.

5.2.1.2.3 DIRECT RADIATION

The shielding design criteria for the CRBRP specifies that, during normal operation, the dose rate at the surface of that part of the containment vessel which is above grade will be no more than 0.2 mrem/hr. An estimated 90 percent of the containment building that is above grade is shielded from the Site boundary by buildings and is enclosed by the Reactor Confinement Structure consisting of four feet of concrete.

Radwaste tanks are housed in buildings protected with concrete 15
walls. In addition, sodium storage tanks, the Radioactive Argon 13
Processing System (RAPS) and the Cell Atmosphere Processing System (CAPS) are located below grade.

As described in Section 3.2, the probability of radioactive sodium leaking from the primary to the intermediate loop of the Heat Transport System is very small.

Because of the above design and shielding characteristics, direct radiation doses at the site boundary are calculated to be much less than 1% of natural background. Therefore, these doses have not been included in the summary tables.

5.2.2 RADIOACTIVITY IN THE ENVIRONMENT

5.2.2.1 LIQUID EFFLUENTS

Estimated average annual quantities of radionuclides released in liquid effluents are listed in Section 3.5. The assumption is made that aquatic biota are exposed to radionuclide concentrations in the river near the liquid effluent discharge port. These concentrations are calculated assuming one part of liquid effluent is diluted by nineteen equal parts of river water. The average blowdown rate from the plant is assumed to be 2,306 gallons per minute. To calculate the exposure to man, the

green algae. Long-lived radionuclides such as Cs-137 can deliver significant portions of the total dose commitment long after the time of ingestion. Therefore, a life span of five years is assumed for the integration interval T. In the absence of data applicable specifically to ducks and muskrats, International Commission on Radiological Protection (ICRP) data[2] are used for 15
the fractional uptake and for the biological half-life of parent radionuclides. The use of human data for biological half-lives is considered to be conservative because warm-blooded vertebrates smaller than man exhibit more rapid elimination rates.[3]

The duck and muskrat are assumed to be exposed continuously by full immersion in the water. External dose rates are estimated using the equation:

$$R_i = 51.2 \times 10^3 \, C_{wi} E_i, \text{ mrad/d,} \qquad (5.2\text{-}2)$$

where 13

E_i = average effective energy emitted by the i^{th} radionuclide per disintegration, MeV/dis.

Doses to this hypothetical mammal (muskrat) are given in Table 5.2-9.

AQUATIC PLANTS, INVERTEBRATES, AND FISH

Radioactivity desposited internally in these organisms is estimated by multiplying the average water concentration contributed from the CRBRP releases in the Clinch River near the point of discharge by the applicable concentration factors[1, 3, 4, 12, 13] listed in Table 5.2-7. Internal doses are estimated (Table 5.2-8) for organisms having effective radii of 3 cm and 30 cm. In the absence of detailed knowledge of the dynamic behavior of radioactive daughter products that are produced internally, all daughter products are assumed to be bound permanently in the organisms; and every daughter in a decay chain is assumed to decay at an equilibrium disintegration rate equal to the disintegration rate of the parent nuclide. The annual dose from i^{th} radionuclide is calculated using the equation:

$$D_i = 51.2 \times 10^3 \, C_{fi} \, \epsilon_i \times 365, \text{ mrad/yr} \qquad (5.2\text{-}3)$$

where 13

C_{fi} = radioactivity concentration in the organism
= $C_{wi} \times F_i$, μCi/g,

F_i = concentration factor, dimensionless.

ϵ_i = effective energy absorbed per disintegration of the i^{th} radionuclide including daughter product, Mev/dis.

External doses for organisms immersed in water (Table 5.2-7) are calculated using Equation 5.2-2. Benthic organisms such as mussels, worms, and fish eggs receive additional external doses from radioactivity associated with bottom sediments. Accurate prediction of the accumulation of radioactivity in sediment and the resultant doses to benthic organisms requires detailed knowledge of a number of factors, including mineralogy, particle size, exchangeable calcium in the sediment, channel geometry, waterflow patterns, chemical form of the radiocompounds, and behavioral characteristics of the organism. In the absence of this detailed knowledge, external doses from radioactivity associated with bottom sediment are calculated assuming a 4-π geometry for beta doses and a 2-π geometry for gamma doses.

5.2.3.2 GASEOUS EFFLUENTS

In the evaluation of the potential impact of gaseous effluents on terrestrial organisms, biota are assumed to be located at the point of maximum offsite exposure. External doses to terrestrial organisms from air submersion and ground contamination are 13
estimated using dose factors derived for humans. It is assumed that total body dose factors for humans are applicable to terrestrial vertebrates and that skin dose factors for humans are applicable to terrestrial plants and small fauna.

Internal exposures vary for each type of organism and tissue. For this estimate, biota are assumed to be located at the point of maximum offsite exposure. The equation used to calculate the annual total body dose to an animal from the inhalation and ingestion exposure pathway is:

$$D_i = (C_{ai} \times DF_{ai}) + (C_{gi} \times DF_{gi}), \text{ mrad/yr} \qquad (5.2\text{-}4)$$

where

C_{ai} = average air concentration, $\mu Ci/cm^3$,
C_{gi} = average ground concentration, $\mu Ci/m^2$. 15
DF_{ai} = dose factor for inhalation, mrad per year per $\mu Ci/cm^3$,
DF_{gi} = dose factor for ingestion, mrad per year per $\mu Ci/m^2$. 15

Dose estimates for biota which could result from CRBRP plant released radioactivity are listed in Table 5.2-9. These estimated doses are less than the dose limits established for occupational workers in the nuclear industry.[5, 6] In the "BEIR" report,[7] it is stated that ". . . probably no other living organisms are very much more radiosensitive than man, so that if man as an individual is protected, then other organisms as populations would be most unlikely to suffer harm."

5.2.4 DOSE RATE ESTIMATES FOR MAN

5.2.4.1 LIQUID PATHWAYS

Estimated average annual activities of radionuclides released in liquid effluents are listed in Section 3.5. Data listed in Table 5.2-5 for potable water supply systems [17] and appropriate ingestion dose factors [11,12,13] are combined to calculate dose commitments from the ingestion of Tennessee River water (Table 5.2.10). Dilution of the radionuclide concentrations in the Clinch and Tennessee Rivers is calculated using flow data listed in Table 5.2-3. The plant effluent is assumed to be mixed with one-fifth of the Clinch River flow in the reach between the CRBRP plant and the river mouth. Water from the Clinch River is 13

4. The stored vegetable and beef ingestion pathways have been modeled to reflect more accurately the actual dietary characteristics of individuals. For stored vegetables the assumption is made that home grown stored vegetables are consumed when fresh vegetables are not available, i.e., during the 9 months of fall, winter, and spring. Rather than use a constant storage period of 60 days, radioactive decay is accounted for explicitly during the 275-day consumption period. The radioactive decay correction is calculated by:

$$\frac{1}{275} \int_0^{275} \exp(-\lambda_i t)\,dt = \frac{1 - \exp(-\lambda_i\ 275)}{275\,\lambda_i}$$ 13

This replaces the term $\exp(-\lambda_i t_h)$ in equation C-7 of Regulatory guide 1.109.

5. The beef consumption pathways can be divided into either commercial sales or home use pathways. Dose calculations are made for individuals consuming meat produced for home use.

The normal processing route is for an individual to slaughter the beef animal, package and freeze the meat, and then consume the meat during the next 3-month period. Radioactive decay is calculated during the 3-month period 15 by

$$\frac{1}{90}\int_{0}^{90} \exp(-\lambda_i t)dt = \frac{1 - \exp(-\lambda_i 90)}{90 \lambda_i}$$

This term is multiplied into equation C-14 in Regulatory Guide 1.109. If the beef animals are sold commercially, then individuals would not be exposed continuously to meat containing radioactivitiy from the same farm. It is 13 expected that this pathway will not cause significant individual exposures.

Calculations of wet deposition based on a washout model and recommendations of Engelmann[9] indicate that wet deposition is not a significant portion of total deposition. All doses related to deposition pathways (ground exposure and food ingestion) are estimated using dry deposition.

The basic data for individual and population dose calculations are contained in Tables 5.2-1 and 5.2-2. Included are distances and elevations at the site boundary and

5.2.5 SUMMARY OF ANNUAL RADIATION DOSES

The radiological impact to regional population groups in the year
2020 from the normal operation of the CRBRP are estimated. Table
5.2-15 summarizes these population doses. The total body dose
from background to individuals within the United States ranges 13
from approximately 100 mrem to 250 mrem per year. The annual
total body dose due to background for a population of 921,200
persons expected to live within a 50-mile radius of the CRBRP in
the year 2020 is calculated to be approximately 128,968 man-rem
assuming 140 mrem/year/individual. By comparison, the same
population will receive a total body dose of approximately 0.03 15
man-rem from effluents released from the CRBRP. Based on these
results, it is concluded that the normal operation of the CRBRP
will present minimal risk to the health and safety of the public.

TABLE 5.2-1

DATA ON POINTS OF INTEREST NEAR THE CRBRP

	POINT	SECTOR	DISTANCE (m)	ELEVATION* (m)	CHI-OVER-Q** (s/m^3)	D-OVER-Q** ($1/m^2$)
1	LAND SITE BOUNDARY	N	2060.	87.	1.01E-06	1.31E-09
2	LAND SITE BOUNDARY	NNE	2440.	87.	6.43E-07	8.11E-10
3	LAND SITE BOUNDARY	NE	880.	-5.	5.06E-06	1.25E-08
4	LAND SITE BOUNDARY	ENE	820.	20.	8.33E-06	1.80E-08
5	LAND SITE BOUNDARY	E	820.	2.	9.69E-06	1.46E-08
6	LAND SITE BOUNDARY	ESE	980.	-5.	7.45E-06	1.42E-08
7	LAND SITE BOUNDARY	SE	1200.	-23.	3.83E-06	6.20E-09
8	LAND SITE BOUNDARY	SSE	820.	-23.	5.65E-06	7.35E-09
9	LAND SITE BOUNDARY	S	700.	-23.	6.08E-06	8.04E-09
10	LAND SITE BOUNDARY	SSW	670.	-23.	6.66E-06	9.38E-09
11	LAND SITE BOUNDARY	SW	670.	-23.	8.10E-06	1.34E-08
12	LAND SITE BOUNDARY	WSW	700.	-23.	1.10E-05	1.71E-08
13	LAND SITE BOUNDARY	W	750.	-23.	1.57E-05	1.57E-08
14	LAND SITE BOUNDARY	WNW	810.	-23.	9.77E-06	8.38E-09
15	LAND SITE BOUNDARY	NW	820.	-23.	1.80E-05	1.31E-08
16	LAND SITE BOUNDARY	NNW	1000.	-23.	1.00E-05	1.10E-08
17	SECTOR PEAK	N	1900.	93.	1.14E-06	1.51E-09
18	SECTOR PEAK	NNE	1900.	93.	9.16E-07	1.24E-09
19	SECTOR PEAK	NE	6500.	123.	2.78E-07	4.20E-10
20	SECTOR PEAK	ENE	6500.	166.	4.24E-07	5.39E-10
21	SECTOR PEAK	E	1700.	99.	3.20E-06	4.45E-09
22	SECTOR PEAK	ESE	2700.	93.	1.71E-06	2.65E-09
23	SECTOR PEAK	SE	3300.	117.	9.07E-07	1.14E-09
24	SECTOR PEAK	SSE	1000.	75.	4.14E-06	5.31E-09
25	SECTOR PEAK	S	1200.	93.	2.70E-06	3.33E-09
26	SECTOR PEAK	SSW	1300.	105.	2.40E-06	3.17E-09
27	SECTOR PEAK	SW	2700.	93.	9.95E-07	1.34E-09
28	SECTOR PEAK	WSW	1400.	69.	3.77E-06	5.53E-09
29	SECTOR PEAK	W	1400.	75.	5.85E-06	5.68E-09
30	SECTOR PEAK	WNW	1200.	69.	5.25E-06	4.41E-09
31	SECTOR PEAK	NW	7500.	93.	8.22E-07	3.02E-10
32	SECTOR PEAK	NNW	6900.	81.	6.87E-07	4.09E-10

* reference with respect to plant grade (Plant grade has been established at 816 feet above mean sea level)

** normalized air concentrations and deposition rates were generated using a constant wind direction model and the joint frequency distributions of meteorological data given in Section 2.6.2.2 (Tables 2.6-5 through 2.6-11)

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TABLE 5.2-6

CRBRP - NORMALIZED CONCENTRATIONS AND DEPOSITION RATES AT SECTOR ANNULI+

AVERAGES ANNUAL CHI-OVER-Q VALUES (s/m^3)

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SECTOR*	1305.	2414.	4023.	5633.	7242.	12070.	24140.	40234.	56327.	72420.
N	2.03E-6	8.10E-7	4.07E-7	2.60E-7	1.87E-7	9.51E-8	3.87E-8	2.01E-8	1.31E-8	9.53E-9
NNE	1.61E-6	6.52E-7	3.29E-7	2.10E-7	1.51E-7	7.73E-8	3.15E-8	1.64E-8	1.07E-8	7.83E-9
NE	2.76E-6	1.09E-6	5.36E-7	3.37E-7	2.40E-7	1.20E-7	4.80E-8	2.46E-8	1.60E-8	1.16E-9
ENE	4.09E-6	1.64E-6	8.10E-7	5.13E-7	3.66E-7	1.85E-7	7.43E-8	3.83E-8	2.49E-8	1.81E-8
E	4.76E-6	1.93E-6	9.71E-7	6.20E-7	4.46E-7	2.27E-7	9.27E-8	4.82E-8	3.15E-8	2.30E-8
ESE	4.89E-6	1.99E-6	9.93E-7	6.31E-7	4.52E-7	2.29E-7	9.28E-8	4.81E-8	3.14E-8	2.29E-8
SE	3.40E-6	1.40E-6	6.93E-7	4.40E-7	3.14E-7	1.59E-7	6.43E-8	3.33E-8	2.17E-8	1.58E-8
SSE	2.80E-6	1.14E-6	5.69E-7	3.62E-7	2.59E-7	1.31E-7	5.33E-8	2.76E-8	1.80E-8	1.31E-8
S	2.39E-6	9.79E-7	4.81E-7	3.03E-7	2.16E-7	1.08E-7	4.33E-8	2.23E-8	1.45E-8	1.05E-8
SSW	2.39E-6	9.63E-7	4.80E-7	3.05E-7	2.18E-7	1.10E-7	4.47E-8	2.31E-8	1.51E-8	1.10E-8
SW	2.88E-6	1.16E-6	5.79E-7	3.68E-7	2.64E-7	1.34E-7	5.41E-8	2.80E-8	1.83E-8	1.33E-8
WSW	4.19E-6	1.69E-6	8.48E-7	5.40E-7	3.88E-7	1.97E-7	7.99E-8	4.15E-8	2.70E-8	1.97E-8
W	6.52E-6	2.61E-6	1.34E-6	8.66E-7	6.27E-7	3.24E-7	1.34E-7	7.01E-8	4.60E-8	3.37E-8
WNW	4.62E-6	1.87E-6	9.62E-7	6.23E-7	4.51E-7	2.34E-7	9.67E-8	5.08E-8	3.34E-8	2.44E-8
NW	8.66E-6	3.50E-6	1.82E-6	1.18E-6	8.60E-7	4.48E-7	1.87E-7	9.83E-8	6.48E-8	4.75E-8
NNW	6.69E-6	2.69E-6	1.38E-6	8.93E-7	6.46E-7	3.34E-7	1.38E-7	7.22E-8	4.74E-8	3.47E-8

AVERAGE ANNUAL D-OVER-Q VALUES ($1/m^2$)

SECTOR*	1305.	2414.	4023.	5633.	7242.	12070.	24140.	40234.	56327.	72420.
N	2.78E-9	1.00E-9	4.16E-10	2.30E-10	1.46E-10	6.02E-11	1.84E-11	7.51E-12	4.07E-12	2.47E-12
NNE	2.29E-9	8.26E-10	3.42E-10	1.89E-10	1.20E-10	4.95E-11	1.52E-11	6.18E-12	3.35E-12	2.03E-12
NE	6.58E-9	2.37E-9	9.84E-10	5.43E-10	3.46E-10	1.42E-10	4.35E-11	1.78E-11	9.62E-12	5.84E-12
ENE	8.44E-9	3.04E-9	1.26E-9	6.97E-10	4.43E-10	1.83E-10	5.59E-11	2.28E-11	1.23E-11	7.50E-12
E	6.83E-9	2.46E-9	1.02E-9	5.64E-10	3.59E-10	1.48E-10	4.52E-11	1.84E-11	9.99E-12	6.07E-12
ESE	8.90E-9	3.21E-9	1.33E-9	7.35E-10	4.68E-10	1.93E-10	5.89E-11	2.40E-11	1.30E-11	7.91E-12
SE	5.41E-9	1.95E-9	8.10E-10	4.47E-10	2.84E-10	1.17E-10	3.58E-11	1.46E-11	7.92E-12	4.81E-12
SSE	3.44E-9	1.24E-9	5.15E-10	2.85E-10	1.81E-10	7.45E-11	2.28E-11	9.30E-12	5.04E-12	3.06E-12
S	2.91E-9	1.05E-9	4.35E-10	2.40E-10	1.53E-10	6.29E-11	1.92E-11	7.84E-12	4.25E-12	2.58E-12
SSW	3.15E-9	1.14E-9	4.72E-10	2.60E-10	1.66E-10	6.82E-11	2.09E-11	8.51E-12	4.61E-12	2.80E-12
SW	4.51E-9	1.63E-9	6.74E-10	3.72E-10	2.37E-10	9.75E-11	2.98E-11	1.22E-11	6.59E-12	4.00E-12
WSW	6.19E-9	2.23E-9	9.26E-10	5.11E-10	3.25E-10	1.34E-10	4.10E-11	1.67E-11	9.06E-12	5.50E-12
W	6.36E-9	2.30E-9	9.52E-10	5.26E-10	3.34E-10	1.38E-10	4.21E-11	1.72E-11	9.31E-12	5.65E-12
WNW	3.85E-9	1.39E-9	5.76E-10	3.18E-10	2.02E-10	8.32E-11	2.55E-11	1.04E-11	5.63E-12	3.42E-12
NW	6.12E-9	2.21E-9	9.15E-10	5.05E-10	3.21E-10	1.32E-10	4.05E-11	1.65E-11	8.95E-12	5.43E-12
NNW	7.14E-9	2.58E-9	1.07E-9	5.90E-10	3.75E-10	1.54E-10	4.73E-11	1.93E-11	1.04E-11	6.34E-12

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* Distance in meters from the center of the plant site to the center of the sector annulus

+ Normalized air concentrations and deposition rates were generated using a constant wind direction model and the joint frequency distributions of meteorological data given in Section 2.6.2.2 (Tables 2.6-5 through 2.6-11)

TABLE 5.2-7

CONCENTRATION FACTORS FOR AQUATIC ORGANISMS

NUCLIDE	RADIOLOGIC HALF-LIFE (DAYS)	RADIONUCLIDE CONCENTRATION FACTORS FISH	BIOTA	PLANT
H-3	4.48E3	1.00	1.00	1.00
C-14	2.09E6	4.55E3	9.09E3	4.55E3
Na-22	9.50E2	1.00E2	2.00E2	5.00E2
Na-24	6.33E-1	1.00E2	2.00E2	5.00E2
P-32	1.43E1	1.00E5	2.00E4	5.00E5
K-40	4.60E11	2.50E3	8.33E2	6.70E2
Cr-51	2.78E1	2.00E2	2.00E3	4.00E3
Mn-54	3.03E2	4.00E2	1.40E5	3.50E4
Mn-56	1.07E-1	4.00E2	1.40E5	3.50E4
Fe-55	9.50E2	1.00E2	3.20E3	1.00E3
Fe-59	4.56E1	1.00E2	3.20E3	1.00E3
Co-57	2.71E2	3.65E1	1.93E2	6.20E3
Co-58	7.13E1	2.08E1	1.75E2	6.20E3
Co-60	1.92E3	4.75E1	1.99E2	6.20E3
Ni-65	1.07E-1	1.00E2	1.00E2	5.00E1
Cu-64	5.31E-1	5.00E1	4.00E2	2.00E3
Zn-65	2.45E2	1.42E3	9.61E3	2.00E4
Zn-69m	5.75E-1	1.14E1	5.44E2	2.00E4
Zn-69	3.96E-2	7.92E-1	3.94E1	2.00E4
Br-82	1.48	4.20E2	3.33E2	5.00E1
Br-83	1.00E-1	4.20E2	3.33E2	5.00E1
Br-84	2.21E-2	4.20E2	3.33E2	5.00E1
Br-85	2.08E-3	4.20E2	3.33E2	5.00E1
Kr-83m	7.75E-2	1.00	1.00	1.00
Kr-85m	1.83E-1	1.00	1.00	1.00
Kr-85	3.93E3	1.00	1.00	1.00
Rb-86	1.87E1	2.00E3	1.00E3	1.00E3
Rb-88	1.24E-2	2.00E3	1.00E3	1.00E3
Rb-89	1.07E-2	2.00E3	1.00E3	1.00E3
Sr-89	5.27E1	1.04E1	3.99E3	3.00E3
Sr-90	1.01E4	2.97E1	4.00E3	3.00E3
Sr-91	4.03E-1	1.20E-1	3.20E3	3.00E3
Sr-92	1.13E-1	3.39E-2	2.12E3	3.00E3
Sr-93	5.56E-3	1.67E-3	2.11E2	3.00E3
Y-90	2.67	2.50E1	1.00E3	5.00E3
Y-91m	3.47E-2	2.50E1	1.00E3	5.00E3
Y-91	5.88E1	2.50E1	1.00E3	5.00E3
Y-92	1.47E-1	2.50E1	1.00E3	5.00E3
Y-93	4.29E-1	2.50E1	1.00E3	5.00E3

TABLE 5.2-7 (Continued)

CONCENTRATION FACTORS FOR AQUATIC ORGANISMS

NUCLIDE	RADIOLOGIC HALF-LIFE (DAYS)	RADIONUCLIDE CONCENTRATION FACTORS FISH	BIOTA	PLANT
Th-228	6.99E2	3.00E1	5.00E2	1.50E3
Th-230	2.81E7	3.00E1	5.00E2	1.50E3
Th-232	5.20E12	3.00E1	5.00E2	1.50E3
Th-234	2.41E1	3.00E1	5.00E2	1.50E3
U-234	8.91E7	2.00	6.00E1	5.00E-1
U-238	1.60E12	2.00	6.00E1	5.00E-1
Np-238	2.12	1.00E1	4.00E2	3.00E2
Np-239	2.35	1.00E1	4.00E2	3.00E2
Pu-238	3.21E4	3.50	1.00E2	3.50E2
Pu-239	8.91E6	3.50	1.00E2	3.50E2
Pu-240	2.40E6	3.50	1.00E2	3.50E2
Pu-241	5.48E3	3.50	1.00E2	3.50E2
Pu-242	1.41E8	3.50	1.00E2	3.50E2
Am-241	1.58E5	2.50E1	1.00E3	5.00E3
Am-242	6.68E-1	2.50E1	1.00E3	5.00E3
Am-243	2.70E6	2.50E1	1.00E3	5.00E3
Cm-242	1.63E2	2.50E1	1.00E3	5.00E3
Cm-243	1.02E4	2.50E1	1.00E3	5.00E3
Cm-244	6.54E3	2.50E1	1.00E3	5.00E3

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TABLE 5.2-8

ANNUAL DOSES TO AQUATIC ORGANISMS LIVING IN THE CLINCH RIVER NEAR THE CRBRP

	Dose Estimates			
	Internal (mrad/yr)		External (mrad/yr)	
Organism	3-cm	30-cm		
Plants	2.6E-2*	1.1E-1	3.4E-5	
Invertebrates	1.7E-2	9.6E-2	3.4E-5	suspended
			3.0E-1	benthic
Fish	1.3E-2	3.3E-2	3.4E-5	

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*2.6E-2 = 2.6×10^{-2}

TABLE 5.2-13

CRBRP - INDIVIDUAL DOSES FROM GASEOUS EFFLUENTS

Noble Gas Exposures 15

Pathway	Point	Dose
Gamma air dose	Max. Exp.[1]	0.076 mrad/yr
Beta air dose	Max. Exp.[1]	1.4 mrad/yr
Total Body	Max. Exp.[1]	0.069 mrem/yr
Skin	Max. Exp.[1]	0.55 mrem/yr

Particulate Exposures - Total Body 15

Tritium	Max. Exp.[1]	5.3E-4 mrem/yr

Breakdown of Particulate Exposures - Total Body (mrem/yr) 15

	Child	Adult
Vegetable Ingestion	2.6E-4	1.9E-4
Beef Ingestion	2.7E-5	4.8E-5
Inhalation	8.3E-5	1.6E-4
Ground Contamination	1.6E-5	1.6E-5
Milk Ingestion	1.4E-4	8.4E-5
Total	5.3E-4	5.0E-4

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1. Maximum exposure point is at 820 meters in the NW sector.

TABLE 5.2-14

CRBRP - POPULATION DOSES FROM GASEOUS EFFLUENTS

	Thyroid					Total Body				
	Infant	Child	Teen	Adult	Totals	Infant	Child	Teen	Adult	Totals
Submersion	9.94E-4	6.19E-3	3.94E-3	1.83E-2	2.94E-2	9.94E-4	6.19E-3	3.94E-3	1.83E-2	2.94E-2
Ground	3.76E-7	2.34E-6	1.49E-6	6.91E-6	1.11E-5	3.76E-7	2.34E-6	1.49E-6	6.91E-6	1.11E-5
Inhalation	3.00E-6	4.86E-5	2.35E-5	1.39E-4	2.15E-4	3.00E-6	4.86E-5	2.35E-5	1.68E-4	2.43E-4
Cow Milk	9.88E-6	4.07E-5	1.59E-5	5.13E-5	1.18E-4	9.88E-6	4.07E-5	1.59E-5	5.13E-5	1.18E-4
Beef Ingestion	0.0	1.43E-5	7.57E-6	7.14E-5	9.32E-5	0.0	1.43E-5	7.57E-6	7.14E-5	9.32E-5
Veg Ingestion	0.0	9.57E-6	5.14E-6	4.58E-5	6.05E-5	0.0	9.57E-6	5.14E-6	4.58E-5	6.05E-5
Total Man-Rem	1.01E-3	6.31E-3	4.00E-3	1.86E-2	2.99E-2	1.01E-3	6.31E-3	4.00E-3	1.86E-2	2.99E-2

TABLE 5.2-15

SUMMARY OF ANNUAL RADIATION DOSES TO POPULATION FROM CRBRP

	Thyroid (man-rem/yr)	Total Body (man-rem/yr)	
I. Internal			
Ingestion (water)	9.9E-5	5.4E-5	
(fish)	2.6E-4	2.4E-4	
(milk)	1.2E-4	1.2E-4	
(meat)	9.3E-5	9.3E-5	
(vegetables)	6.1E-5	6.1E-5	
Inhalation	2.1E-4	2.4E-4	13
II. External			
In-water sports	5.7E-8	5.7E-8	
Above-water sports	5.4E-8	5.4E-8	
Shoreline activities	6.2E-5	6.2E-5	
Submersion in air	2.9E-2	2.9E-2	
Ground contamination	1.1E-5	1.1E-5	15
III. Transportation of radioactive material			
Unirradiated fuel	0.45	0.45	
Irradiated fuel	0.92	0.92	
Wastes	0.43	0.43	
Total	1.83	1.83	

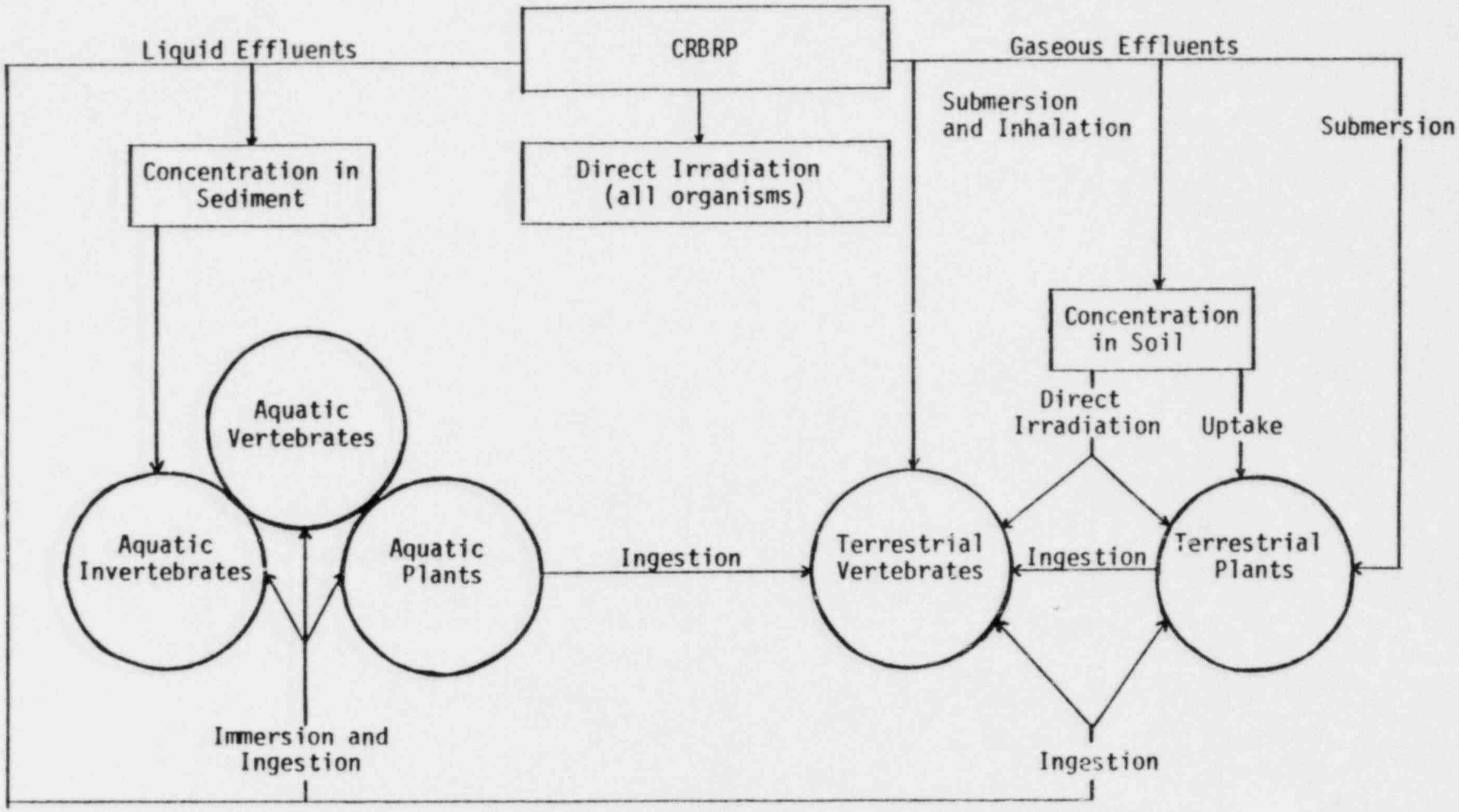

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Figure 5.2-1

EXPOSURE PATHWAYS TO ORGANISMS OTHER THAN MAN

13

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Oil will be stored in accordance with the Environmental 9
Protection Agency Regulations on Oil Pollution Prevention(3) which will minimize the potential impacts of oil contamination on the local surface and groundwater systems. Chemicals will be stored in accordance with the Environmental Protection Agency Proposed Hazardous Substance Pollution Prevention Regulations.(3a) A list of the on-site chemical storage tanks and a 11
description of the Secondary Containment Systems are found in Section 7.2. No environmental impact is anticipated under normal conditions from the stored chemicals.

Storm water collected by the roof and yard drains is sent via the 11
storm drainage system to the runoff treatment ponds for settle- 15
ment. Runoff treatment pond effluents are filtered and released 6
from a controlled pond discharge and are transported to the Clinch River via existing natural water courses. A portable oil skimmer will be available should a visible oil slick appear on the surface of a runoff treament pond. Any collected oil would 15
be disposed of off-site by a licensed contractor.

5.4.4 EFFECTS ON GROUNDWATER

A total of 110 wells and springs are located within a 2-mile radius of the Site. Nearly all of the wells are of limited capacity and serve as small domestic wells as shown in Figure 2.5-12. All of these wells are located to the south of the Clinch River which serves as a "barrier" between the Site and these wells. There are no wells or springs on the Site. Within a 20-mile radius of the Site there are 13 public water supplies that use groundwater as listed in Table 2.2-14. 11

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TABLE 5.4-6

PERMISSIBLE CHLORINE CONCENTRATIONS IN CRBRP EFFLUENTS

Effluent Characteristic	Instantaneous Maximum Concentration	
Total Residual chlorine	0.14 mg/l	15

The quantity of pollutants discharged in cooling tower blowdown shall not exceed the quantity determined by multiplying the flow of cooling tower blowdown sources times the concentration listed in the above table.

A program to minimize the discharge of total residual chlorine shall be implemented prior to the start of cooling tower chlorination. Reduction of makeup and discontinuation of 15
blowdown subsequent to chlorination shall be specifically evaluated. Reports shall be submitted quarterly with DMR's after the start of chlorination. At such time as the permittee determines that reasonable minimization has been achieved, he may request that this program be elimated.

15

TABLE 5.4-7
AVERAGE AND MAXIMUM VALUES OF SOME CHEMICAL
CONSTITUENTS IN CLINCH RIVER*
AT COMMON PLANT DISCHARGE

	Max. Conc. (mg/l)	Avg. Conc. (mg/l)	
Total Alkalinity (as $CaCO_3$)	110.0	87.0	
Ammonia Nitrogen (as N)	0.12	0.02	
BOD	1.3	<1.0	
Calcium	33.0	27.0	
Chloride	4.0	3.0	
Chloride Residual	Not Reported		
COD	8.0	4.0	
Copper (g/l)	110.0	40.0	
Total Dissolved Solids (TDS)	240.0	125.0	
Total Iron (g/l)	560.0	270.0	15
Lead (g/l)	24.0	<11.0	
Magnesium	8.8	7.6	
Manganese (g/l)	50.0	30.0	
Nickel (g/l)	<50.0	<50.0	
Nitrate (NO_3)	0.64	0.42	
pH	8.2	7.6	
Total Phosphate	Not Reported		
Potassium	1.5	1.2	
Silica (SiO_2)	6.0	4.5	
Sodium	6.9	3.5	
Sulfate (SO_4)	21.0	15.0	
Total Suspended Solids (TSS)	46.0	9.0	
Zinc (g/l)	130.0	30.0	

*Values taken from E.R. Table 2.5-14a; CRM 15.4

TABLE 5.4-8 6

CONCENTRATIONS OF CHEMICAL CONSTITUENTS IN THE CRBRP DISCHARGE AND THE

SIX PERCENT ISOPLETH OF THE SUMMER SHORT DURATION NO-FLOW PLUME* 6

	Concentrations in CRBRP Discharge**		Concentrations in Six Percent Isopleth		
	Average (mg/l)	Maximum (mg/l)	Average (mg/l)	Maximum (mg/l)	6
Total Alkalinity (as $CaCO_3$)	239.0	286.0	104.58	126.20	
Ammonia Nitrogen (as N)	0.7	2.5	0.31	1.09	
BOD	5.3	15.0	2.29	6.54	
Calcium	85.0	108.0	37.06	46.90	
Chloride	11.8	32.3	5.13	14.16	
Chlorine Residual	0.14	0.14	0.01	0.03	15
COD	16.8	40.0	7.31	17.44	
Copper+	0.2	0.93	0.02	0.07	
Total Dissolved Solids (TDS)	373.0	582.0	155.86	198.48	6
Total Iron+	0.95	1.72	0.41	0.74	
Lead+	<0.03	<0.03	<0.03	<0.03	
Magnesium	19.6	21.4	8.51	9.27	
Manganese	0.13	0.18	0.05	0.08	
Nickel	0.02	0.11	0.01	0.02	
Nitrate (NO_3)	3.4	5.6	1.43	2.40	

(Continued)

TABLE 5.4-8 (Continued) 6

	Concentrations in CRBRP Discharge**		Concentrations in Six Percent Isopleth	
	Average (mg/l)	Maximum (mg/l)	Average (mg/l)	Maximum (mg/l)
pH	6.5 - 8.5	6.5 - 8.5		
Total Phosphate	0.14	1.0	0.06	0.44
Potassium	3.5	4.8	1.53	2.07
Silica (SiO_2)	9.8	15.3	4.25	6.65
Sodium	13.2	107.3	2.77	8.79
Sulfate (SO_4)	48	106	16.98	27.98
Total Suspended Solids (TSS)	33	114	14.20	50.08
Zinc+	0.05	0.08	0.02	0.03

6

*Based on Iowa Institute physical model study

**From Table 10.3A-2 6

+Includes contribution to effluent quantities from condenser erosion/corrosion.

TABLE 5.4-9 | 6

SURFACE AREA AFFECTED BY CHEMICAL PLUMES AND INCREASES IN CHEMICAL CONCENTRATIONS*

Mixing Conditions	Chemical Isopleth** (%)	Area (acres)
Typical Cases		
Winter	3	0.05
	4	0.01
	5	0.01
Summer	3	0.07
	4	0.02
	5	<0.01
Extreme Case-Short Duration No Flow		
Winter	2	3.92+
	5	0.06
Summer	4	0.07
	6	0.02

*Based on Iowa Institute physical model study

**Percent difference between initial blowdown and ambient concentrations in river

+Estimated, based on extrapolations of model plume boundaries to achieve closure of 0.9 °F isotherm (see Figures 10.3A-6 and 10.3A-10). | 6

TABLE 5.4-10

CONCENTRATION OF DISCHARGED CHEMICALS IN THE EXTENDED NO FLOW PLUMES

	Average Ambient-River Concentration* (mg/l)	Average Plant Discharge Concentration** (mg/l)	Extended No Flow Maximum Plume Concentrations — Winter Case: @ End of 15 Days (mg/l)	Winter Case: @ End of 30 Days (mg/l)	Summer Case: @ End of 18 Days (mg/l)	Summer Case: @ End of 31 Days (mg/l)
Total Alkalinity	87.0	239.0	117.0	135.0	106.0	107.0
Ammonia Nitrogen (as N)	0.02	0.70	0.34	0.39	0.31	0.31
BOD	<1.0	5.3	2.6	3.0	2.3	2.3
Calcium	27.0	85.0	41.0	47.0	37.0	38.0
Chloride	3.0	11.8	5.7	6.6	5.2	5.3
Chlorine Residual	Not Reported	0.14	0.03	0.05	0.01	0.01
COD	4.0	16.8	8.2	9.5	7.4	7.5
Copper (μg/l)	40.0	0.20	0.03	0.05	0.02	0.02
Total Dissolved Solids (TDS)	125.0	377.0	176.0	205.0	158.0	160.0
Total Iron (μg/l)	270.0	0.95	0.46	0.53	0.42	0.43
Lead (μg/l)	<11.0	<0.03	<0.03	<0.03	<0.03	<0.03
Magnesium	7.6	19.6	9.5	11.0	8.6	8.7
Manganese (μg/l)	30.0	0.13	0.06	0.07	0.06	0.06
Nickel (μg/l)	<50.0	0.02	0.01	0.01	0.01	0.01
Nitrate	0.42	3.4	1.6	9.9	1.4	1.5
pH	7.6	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5
Total Phosphate	Not Reported	0.14	0.06	0.07	0.06	0.06
Potassium	1.2	3.5	1.7	2.0	1.5	1.6
Silica (SiO_2)	4.5	9.8	4.8	5.5	4.3	4.4
Sodium	3.5	15.0	4.0	5.6	3.0	3.0
Sulfate	15.0	50.0	20.0	24.0	17.0	18.0
Total Suspended Solids (TSS)	9.0	33.0	16.0	18.0	14.0	14.0
Zinc (μg/l)	30.0	0.05	0.02	0.02	0.02	0.02

*From Table 2.5-14a; CRM 15.4

**From Table 3.6-1

15

cover changes from grassland to heavy brush, such species as the bobwhite quail will decline in numbers. Clearing will return the area to shrubby habitat areas. This cycle will continue as long as the area is maintained by regular clearing operations.

The presence of 85-foot high transmission towers, approximately 15 feet taller than the bordering forest, is not expected to effect the Canada goose migration across the CRBRP site.

5.6.2.3 ACCESS ROADS

Existing area roads will suffice for maintenance work; the majority of these roads are presently surfaced with gravel, regularly maintained and restricted to the public. Any rutting caused by maintenance vehicles on these roads will be repaired by grading and reseeding or graveling as necessary. Some routine maintenance work or emergency work will require vehicular traffic on the ROW. Rutting will be repaired by hand or machine, and any drainage disturbed will be restored.

5.6.2.4 AESTHETICS

Visual impacts considered during plant operation included views of the site, containment building, and cleared transmission line corridors. The CRBRP site will be visible from various vantage points near the plant site. Both the site and the containment building will be visible from portions of both I-40 and S.R. 58. Both the site and the containment building will be visible from recreation sites 1 and 2 listed on Table 2.2-8. The site will 15
not be visible from any housing development within the study area but will be easily seen from many of the single-family homes from across the Clinch River. Neither the containment building nor the plant site will be visible from any significantly offsite historical site or structure within the study area.

Cleared rights-of-way can also have a profound visual impact on the environment. Usually this impact is most noticeable when the lines pass through scenic, recreational or historical areas or where the public is afforded extensive views of the facilities. Only a short expanse of the proposed corridor is visible from White Wing Road and it is visible for only a few seconds to 15
motorists, as discussed in Section 4.2. Although a newly cleared transmission line is not generally an aesthetically pleasing sight, public viewing of corridors in this condition will be insignificant in terms of time and amount of line observable. Natural buffers of vegetation will be maintained where public viewing of such maintenance conditions would be possible. The remainder of the proposed transmission facilities are out of sight of public view as access to the ROW is controlled by locked gates at all times. In summary, aesthetic impacts during plant operation are considered insignificant because of the limited 15
amount of time when either the site, containment building, or transmission line corridors are visible to the observers during each year.

from an average low flow of 4339 cfs in the spring to an average high flow of 6,772 cfs in the winter. For maximum power operation, the anticipated average water makeup requirement is 13.4 cfs. An average of 5.1 cfs will be returned to the river as blowdown and approximately 8.3 cfs will be consumed during plant operation. The consumptive use of 8.3 cfs is only 0.15% of the annual average Clinch River flow rate of about 5,380 cfs. The amount of water lost to the atmosphere through evaporation is not actually an irretrievable loss, however, as the water eventually will be returned to the earth as precipitation.

Considering aquatic life as a resource, the loss of fish, zooplankton, benthos, macrophytes and the like will be a commitment of resources directly attributable to operation of the CRBRP. Discharges to the Clinch River will be continuously monitored to prevent introduction of deleterious effects to the aquatic life by excessive temperature, chemicals or turbulence. A preconstruction survey conducted on the Clinch River will establish a reference framework for assessing the degree to which this resource is committed.

5.8.3 COMMITMENT OF FUEL RESOURCES

Initial fuel assembly loading of the Clinch River Breeder Reactor will consist of approximately 5.2 Metric Tons (MT) of uranium and plutonium metal in a 36-inch high core. The fuel consists of sintered mixed-oxide pellets of PuO_2 and UO_2 encapsulated in the sealed stainless steel tubing (rods). Plutonium enrichment is 33.2 weight percent. In later cycles the plutonium enrichment will be approximately 33 weight percent. Each of the 156 fuel subassemblies in the reactor core contains 217 fuel rods. The reactor core fuel contains 20.7 MT of stainless steel.

The isotopic composition of the feed plutonium metal in the core is 0.1 percent Pu-238, 86.0 percent Pu-239, 11.7 percent Pu-240, 2.0 percent Pu-241 and 0.2 percent Pu-242. The isotopic split is similar to FFTF-grade plutonium.

An additional 25.2 MT of depleted uranium metal is committed in 14
the inner radial and axial blankets. Inner and radial blankets,
consisting of 208 assemblies, each containing 61 rods, contain 14
21.0 MT of depleted uranium metal and 26.8 MT of stainless steel.
Each of the two axial blankets, which are an integral part of the fuel assemblies, contains 2.1 MT of depleted uranium metal.

An estimated 2427 fuel assemblies and 2106 blanket assemblies 9 14
will be committed during the 30-year life of the plant. Operated on the once-through fuel cycle, the total requirement of the
plant could be as high as 27 MT of plutonium metal, 332 MT of 14
uranium and 595 MT of stainless steel over 30 years. However, it is expected that the burned fuel will be recycled to the plant after reprocessing and refabrication so that the actual heavy metal commitment to the plant from virgin ore (natural uranium) will be only a fraction of the aforementioned values.

If one assumes recycle with CRBRP operating by itself, requiring one full core load in the reactor and an additional reload core in reprocessing and fabrication, then the commitment from resources is only on the order of 3.5 MT of plutonium plus 58.0 MT of uranium.

Uranium burnup and an assumed one percent heavy metal loss of each batch through the reprocessing-refabrication cycle raises the plant lifetime total heavy metal commitment to 72.2 MT of uranium. The 3.5 MT plutonium commitment, which is required for initial startup, does not increase since the plutonium burnup is more than made up by the reactor breeding. An additional net of 3.2 MT of plutonium, in excess of that originally committed, will be produced over the life of the plant.

At the time of decommissioning, 2.1 MT of plutonium and 27.6 MT of uranium can be recovered from the core, leaving a total irreversible consumption of depleted uranium reserves of 14.2 MT and a net gain of 3.2 MT of bred plutonium. All of the stainless steel in the burned fuel and in the blanket assemblies (nominally 595 MT over the life of the plant) must be considered as permanently consumed due to radioactive contamination which precludes its reuse.

5.8.4 IRRETRIEVABLE COMMITMENT OF OTHER RESOURCES

Irretrievable commitments of resources include those resources consumed during plant operation. Operation of the CRBRP will involve the direct use of substantial quantities of consumable supplies including: (1) chemicals for treatment of water for the cooling and sanitary systems; (2) oils and lubricants; (3) decontamination and cleansing agents; (4) minor quantities of sodium; and (5) other consumable items such as paper supplies, spare parts, etc. The amount consumed during plant operation is only a fraction of the supply available and therefore would not constitute a major commitment.

5.9 DECOMMISSIONING AND DISMANTLING

The Clinch River Breeder Reactor Plant (CRBRP) is being designed for a 30-year operating life, thereby placing the plant's final operation at about the year 2020, assuming no premature termination. At that time, 9
a detailed plan to decommission will be prepared for approval by the appropriate licensing agency with criteria comparable to Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors". A number of alternative approaches will be evalutaed in terminating the operating license of the plant; the approach chosen will not affect use of the remaining portions of the Site in any more adverse manner than continued operation of the plant would have. Length of operating history, after some initial activation, will not significantly affect the approach chosen. The final condition will provide for protection of the public safety and will be environmentally suitable.

A wide choice of experience in decommissioning reactors is available from the AEC civilian power program and civilian reactors.[1-8] These experiences range from removal of fuel and minor decontamination to total removal, including some subgrade structures. None of the approaches to date have presented safety or environmental problems of substantative difference than those which have occurred during normal operation of a plant.

The land committed to the CRBRP plant buildings, inside the security fence, occupies 8.6 acres as seen on Figure 2.1-4. The sludge lagoon equalization basin, sewage treatment plant and river water pump house occupy an additional 2.7 acres outside the security fence. Depending 9
upon the chosen plan, the termination of the plant could commit up to 11.3 acres of the Site. It is noteworthy that the less extensive 10
approaches to termination do not irretrievably commit the Site; that is, should a decision be reached at some date after termination that justification exists to reduce the land commitment, the cost of recover versus the initial decommissioning cost would be negligible. If the decision

NRC QUESTIONS ABOUT SECTION 6

NRC Letter November 19, 1974 - Giambusso

Item 322.15 (6.1) - Amendment I, Part I, page A1-72
Item 350.13 (6.1) - Amendment I, Part I, pages A1-83 and 84
Item 350.20 (F6.1) - Amendment I, Part I, page A1-90
Item 321.2 (6.1) - Amendment III, Part I, page AIII-5
Item 321.3 (6.1) - Amendment III, Part I, page AIII-6

NRC Letters February 13, 1975 and April 23, 1975 - Dicker

Question C6 (6.1) - Amendment I, Part II, page AI-135
Question C7 (6.1) - Amendment I, Part II, pages AI-136 to 141
Question C8 (6.1) - Amendment I, Part II, pages AI-142 and 143
Question C9 (6.1) - Amendment I, Part II, pages A1-144 to 146
Question C10 (6.1) - Amendment I, Part II, page AI-147
Question C12 (6.1) - Amendment I, Part II, page AI-150
Question C13 (6.1) - Amendment I, Part II, page AI-151
Question C14 (6.1) - Amendment I, Part II, page AI-152
Question D12 (6.2) - Amendment I, Part II, pages A1-210 and 211

NRC Letter October 26, 1981
Question 290.1R (All Sections) - Amendment XV

NRC Letter December 29, 1981 15
Question 310.3R-7 (6.1) - Amendment XV

6.1.4.3 ECOLOGICAL MONITORING 15

The terrestrial monitoring program is designed to evaluate the impact of operational and construction activities on the structure and function of the terrestrial ecosystem.

6.1.4.3.1 BASELINE STUDIES

A terrestrial baseline study program was conducted on the Clinch River Site to document preexisting conditions and stresses and to identify food chains. Preexisting conditions and stresses are those presently existing on the Site, whether naturally occuring or man-made.

Purpose of the baseline study program was to evaluate, both qualitatively and quantitatively, the specific aspects of the terrestrial environment that will be affected by the construction of the breeder reactor facility. Three major study objectives have been identified:

1. Evaluation of the biotic components of areas subject to construction activity for the plant and associated facilities and assessment of possible environmental effects of plant construction and operation;

2. Observation of seasonal fluctuations in the biological diversity represented within the Site area; and

3. Identification of significant parameters to be measured or monitored in later studies which will provide a more precise estimate of real and potential impact.

The study period included seasonal surveys, shown in Table 6.1-5, which began in the winter of 1974 and ended with the completion of the fall survey of 1975. 6

A two-day reconnaissance field survey was conducted August 27 and 28, 1980 to evaluate site changes since the 1974 baseline surveys and to sample a shortleaf pine plantation that was established in 1976. Results of this reconnaissance survey are reported in Section 2.7. 9

6.1.4.3.2 METHOD FOR ACQUIRING BASELINE DATA - SITE AND ENVIRONS

Terrestrial ecology field investigations of the Clinch River Site included four seasonal surveys conducted during 1974 as indicated in Table 6.1-5. Investigations involved floristic, vegetation, mammal, avifauna and herpetofauna evaluations in 12 communities as discussed below and in Section 2.7. Vegetation types and sampling communities are shown in Figure 2.7-6. Vegetation sampling plot locations, mammal sampling grids and transects and avifauna quantitative transects are shown in Figures 2.7-7, 2.7-A and 2.7-B, respectively. Sampled communities were chosen to include major forest cover types on the site to adequately characterize the site. Sampled communities included mixed hardwood, successional pine, pine plantation, cedar-pine and hardwood-cedar-pine forest cover types. In addition to surveys on plots, general observations of flora, migratory wildlife and herpetofauna were made when traveling from one 9 sampling location to another, systematically driving site roads in early morning and late evening times and searching in suitable habitat. Simultaneous surveys were conducted whenever possible.

The floristic sampling program was designed to determine the presence or absence of plant species that were either listed as rare or that were eligible for listing as threatened or endangered by the U.S. Fish and Wildlife Service. Discussions with Dr. A. J. Sharp of the University of Tennessee had indicated that flora of the Site area was poorly known so an intensive specimen collection and preservation program was conducted. Mounted specimens were deposited at the University of Tennessee Herbarium.

NRC QUESTIONS ABOUT SECTION 7

7

NRC QUESTIONS ABOUT SECTION 7 (Continued)

Item 000.27 (7.1.2.8.2) - Amendment IV, Part I, pages AIV 25 to 28
Item 000.28 (7.1) - Amendment IV, Part I, pages AIV 29 to 36
Item 000.29 (7.1) - Amendment IV, Part I, pages AIV-37 and 38 7
Item 000.30 (7.1) - Amendment IV, Part I, pages AIV-39 to 42
Item 000.31 (7.1) - Amendment IV, Part I, pages AIV-43 to 45

NRC Letter October 26, 1981
Question 290.1R (All Sections) - Amendment XV 15

The accident was evaluted in terms of the total excess cover gas activity released to the environment as a result of the transient compared to that normally released, assuming continuous plant operation with 0.5 percent failed fuel. 11 Excess activity leakage will continue until the cover gas system returns to its normal steady-state condition. The inventory of each xenon and krypton isotope will asymptotically approach a steady-state condition. For the evaluation, the recovery time required for the inventory of each isotope to reach a value within one percent of its steady-state value was determined. The recovery time for each isotope is dependent on the isotope's half-life, the purge rate of the reactor cover gas to RAPS and the decontamination factor for the isotope in RAPS. The longest recovery time for any of the xenon or krypton isotopes is 15 hours (for Kr-85).

Total excess cover gas leakage during the 15-hour recovery time is only 0.0014 Curies (see Table 7.1-17). 11 More than 75 percent of this activity leaks in the first two hours following the postulated transient. Major leak paths from the cover gas system are reactor head seal leakage and leakage of recycle cover gas through buffer seals in the reactor head. For conservatism, no delay factors in the movement of gases to or through these seals were included in the analysis. Delays in gas movement through these seals resulting in radioactive decay and reduced releases are expected. Further, all seal leakage was assumed released directly to the atmosphere via the Reactor Containment Building ventilation system.

The maximum off-site whole body dose from this postulated 4 8 11 accident is 8.4×10^{-5} mrem. Doses at specific downwind distances and estimates of the potential population dose are provided in Tables 7.1-5 through 7.1-13.

7.1.2.5.2 ACCIDENT 5.2 - STEAM GENERATOR TUBE FAILURE

The steam generator modules are designed and will be manufactured to the highest quality industrial standards. Furthermore, a 6 11 15 broad base DOE development program supported the design and manufacture of the CRBRP units and the water-sodium boundary has been designed and will be fabricated to have a high degree of integrity. Consequently, probability of failure of the boundary is expected to be small. However, over the plant lifetime, the possibility of leaks of water into sodium must be considered. to address this potential condition, the steam generators are continuously monitored by a leak detection system which provides early detection of water-to-sodium leaks to allow subsequent operator corrective action to limit their consequences while they are still small.

The water-to-sodium leak detection system is designed to alert the operator to the existence of a leak rate as small as approximately 2×10^{-5} lb. water/sec. For initial leak sizes which can be realistically expected (up to about 10^{-2} lb. water/sec.) the alarm is given in sufficient time for the operator to take action to prevent a significant increase of the leak rate.

For these small leaks, the reactor will be shut down followed by a controlled cooldown and depressurization of the affected steam generator. The affected IHTS loop would then be drained to allow repair of the steam generator. However, as a limiting case it is assumed that the leak indication is such that the operator elects to manually scram the reactor and isolate and blowdown all three steam generator modules in the affected loop. The operator would then drain the affected IHTS loop resulting in flow stoppage in the loop. 15

Under these conditions, the radiological release will be insignificant even if it is assumed that this event occurs following operation with the maximum undetected intermediate-to-primary sodium leak rate. Leakage of primary sodium into the IHTS is prevented by pressurizing the IHTS such that a pressure differential across the IHX (intermediate-to-primary) of at least 10 psi exists during plant operation. This pressure differential could be lost during the sodium dumping process and it is possible that small quantities of primary sodium could enter the IHTS. Leak rates of approximately 6 gph will be detected during normal operation and, therefore, only a small amount of primary sodium could be introduced into the IHTS during the pump coast down. This small amount of primary sodium would mix with the intermediate sodium and either remain in the non-drainable sections of the IHTS, steam generators, and IHX, or be drained to the sodium dump tank. Over-pressurization of this tank is prevented by either the equalization line or the pressure relief valve. The gases vented through this system will be the inert gas displaced by the sodium entering the dump tank. No sodium will be released in this process and, accordingly, there are no associated radiological consequences with this event.

There is a small probability that a leak may progress rapidly into the intermediate size range (greater than 0.1 lb/sec of water) before operator corrective actions could be implemented. In this event, the expansion tank vent line duplex rupture disk assembly will burst. Sodium flow through the disc assemblies will initiate automatic isolation and blowdown of the water and steam from the steam generator modules in the affected loop.

In the unlikely event that a larger leak occurs, the sodium/water reaction (SWR) will generate sodium compounds as well as hydrogen gas. To provide protection for this event with its 15 attendant hydrogen gas generation, each of the three heat transport loops include rupture disks and a Sodium/Water Reaction Pressure Relief Subsystem (SWRPRS) which acts as an overpressure protection system and also stores SWR products.

The operation of the SWRPRS is initiated by the rupturing of one or more of the duplex rupture disk assemblies. These assemblies are located adjacent to the superheater sodium inlet nozzle, and each evaporator sodium outlet nozzle. A rupture releases sodium into the SWRPRS piping and the reaction products separator tanks. Following this sodium is a mixture of sodium, solid reaction products and gaseous hydrogen. Within the reaction products separator tanks, separation of the liquid sodium and solid reaction products from the gases takes place. The gases are exhausted through an atmospheric seal, to the flare stack and igniter, which ignites any combustible hydrogen/air mixture as it discharges to the atmosphere.

When the pressure in the isolated evaporators and superheater has been reduced to 300 psig, the plant operator then controls the opening of four sets of double isolation valves in the affected IHTS loop, which initiates draining of the residual sodium in the affected loop to the sodium tank. The other two loops, which were not subjected to a large sodium/water reaction, will then provide for shutdown heat removal. In this manner the reactor decay heat and the primary and intermediate sodium systems' sensible heat will be removed.

The SWRPRS is designed to accommodate steam generator leaks whose consequences cannot be limited by operator action. The design basis leak (DBL) for the system is a postulated equivalent double-ended guillotine break (EDEG) of a single tube that is followed by two additional EDEG tube failures. The basis for the selection of DBL is presented in detail in PSAR Section 5.5.3.6. 15

As a result of this postulated DBL, approximately 669 pounds of reaction products and entrained sodium would be carried into the reaction products separator tank where the gaseous products are separated and vented. During tha short time period (28 seconds) while the SWRPRS is venting to the atmosphere during the design basis leak (DBL) and the SGS is blowing down, small amounts of primary sodium might leak into the intermediate sodium. However, this sodium would not be transported to the superheater inlet during the period of time that this steam generator system is being blown down, due to the length of the piping between the IHX and the superheater inlet and the reduced sodium flows during this event. Therefore, no allowance has been made for venting of primary sodium to the atmosphere. 15

The dose resulting from the Tritium within the IHTS sodium that 13
is released with the reaction products has been evaluated. The Tritium concentration in the Steam Generator System at the end of plant life (30 years) is 0.62 uCi/g and the Tritium concentration in the IHTS sodium is 0.13 uCi/g for a hydrogen background level 11
in the IHTS of 200 ppb of hydrogen. During a DBL, 204 pounds of water combines with 465 pounds of sodium and the conservative assumption is made that all the sodium-water reaction products are discharged to the atmosphere.

Depressurization of the isolated loop by opening the Power Relief Valves will result in the release of all water/steam in the loop to the atmosphere. The total mass released is 5,040 pounds. Using the end of life (30 years) tritium concentration, 0.62 uCi/g for the steam system, the total tritium release through the 11
Power Relief Valves for this postulated accident is 1.417 Curies.

Thus, the total radioactivity released to the atmosphere as a result of the postulated steam generator tube failure is 1.50 11
Curies of tritium, 0.083 released through SWRPRS and 1.417 8
released through the Power Relief Valves.

The maximum off-site whole body dose for this postulated release is 8.3 x 10^{-2} mrem. Doses at specific downwind distances and 4 11
estimates of the potential population dose are provided in Tables 8
7.1-5 through 7.1-13.

7.1.2.6 ACCIDENT 6.0 - REFUELING ACCIDENTS

In accordance with Regulatory Guide 4.2, the refueling accident evaluations used in connection with light-water reactor environmental reports are generally analyses of radioactivity releases caused by dropping a spent fuel bundle into the open reactor vessel or the open spent fuel storage pool, dropping a

NRC QUESTIONS ABOUT SECTION 8

NRC Letter November 19, 1974 - Giambusso

Item 340.2, (8.2.2) - Amendment III, Part I, AIII-2

NRC Letters February 13, 1975 and April 23, 1975 - Dicker

Question FI (8.2) - Amendment I, Part II, Page Al-270
Question F2 (8.3.1) - Amendment I, Part II, Page Al-271
Question F3 (8.3) - Amendment I, Part II, Pages Al-272 and 273
Question F4 (8.) - Amendment I, Part II, Page Al-274
Question F5 (8.) - Amendment I, Part II, Page Al-275
Question F8 - Amendment I, Part II, Page Al-281
Question F10 (8.)- Amendment 1, Part II, Page Al-283
Question F11 (8.)- Amendment 1, Part II, Page Al-284 and 285
Question F12 - Amendment 1, Part II, Page Al-286 and 287
Question G11 (8.3) - Amendment 1, Part II, Page Al-308

NRC Letter October 26, 1981

Question 290.1R (All Sections) - Amendment XV
Question 290.4R (8.1) - Amendment XV

NRC Letter December 29, 1981 15

Question 310.1R (8.3) - Amendment XV
Question 310.2R (8.3) - Amendment XV
Question 310.3R-8 (8.1) - Amendment XV
Question 310.3R-9 (8.1) - Amendment XV
Question 310.3R-10 (8.1) - Amendment XV
Question 310.3R-11 (8.1) - Amendment XV
Question 310.3R-12 (8.1) - Amendment XV
Question 310.3R-13 (8.1) - Amendment XV
Question 310.3R-14 (8.2) - Amendment XV
Question 310.3R-15 (8.2) - Amendment XV
Question 310.3R-16 (8.2) - Amendment XV
Question 310.3R-17 (8.2) - Amendment XV

NRC QUESTIONS ABOUT SECTION 8 (Continued)

Question 310.3R-18 (8.3) - Amendment XV

Question 310.3R-19 (8.3) - Amendment XV

Question 310.3R-20 (8.3) - Amendment XV 15

Question 310.3R-21 (8.3) - Amendment XV

Question 310.3R-22 (8.3) - Amendment XV

Question 310.3R-23 (8.3) - Amendment XV

Question 310.3R-24 (8.3) - Amendment XV

Question 320.5R (8.3) - Amendment XV

Question 320.7R (8.3) - Amendment XV

NRC QUESTIONS ABOUT SECTION 9

NRC Letter November 19, 1974 - Giambusso

Item 340.1 (9.2) - Amendment I, Part I, page AI-54

Item 350.14 (9.2.4) - Amendment I, Part I, page Al-85

NRC Letters February 13, 1975 and April 23, 1975 - Dicker

Question F6 (T9.2-5) - Amendment I, Part II, Page Al-276

Question F7 (T9.2-5) - Amendment I, Part II, Pages Al-277 to 280

NRC Letter April 10, 1975

Question 1 (9.1 and 9.2) - Amendment I, Part III, Pages Al-312 and 313

Question 5 (9.2) - Amendment I, Part III, Page Al-317

NRC Letter October 15, 1976

Amendment VIII, Part I, Pages AVIII-2 to AVIII-9, and ER App. D.

NRC Letter December 22, 1976

Question 1 - Amendment VIII, Part I, Pages AVIII-11 to AVIII-15

Question 2 - Amendment VIII, Part I, Pages AVIII-16 to AVIII-22

Question 3 - Amendment VIII, Part I, Page AVIII-23

Question 4 - Amendment VIII, Part I, Pages AVIII-24 and AVIII-25

Question 5 - Amendment VIII, Part I, Page AVIII-26

NRC Letter October 26, 1981

Question 230.5R (9.2) - Amendment XV

Question 290.1R (All Sections) - Amendment XV 15

Question 320.1R (9.2) - Amendment XV

Question 320.2R (9.2) - Amendment XV

Question 320.6R (9.1) - Amendment XV

Question 320.8R (9.1) - Amendment XV

9.2.5.3.4 GEOLOGY

Geology of the Clinch River site has been discussed in Section 2.4. 15

9.2.5.3.5 SEISMOLOGY

Seismology for the Clinch River site has been discussed in Section 9.2.5.1.5.

9.2.5.3.6 HYDROLOGY

Watts Bar Dam on the Tennessee River at TRM 529.9 is located 55 river miles downstream from the Clinch River site. In the vicinity of the site the reservoir ranges in width from about 300 feet to 600 feet with depths between 22 and 24 feet at the Watts Bar normal full-pool elevation of 741 feet. Based upon stream gage measurements by the U. S. Geological Survey at three locations near the site area, the average discharge is estimated to be 4,600 cfs. The Melton Hill Dam, located about five miles upstream of the site, was closed in May 1963. Since the closure of the dam, there has been an average of 50 days per year during which there were no releases from the dam, resulting in practically zero flow at the Clinch River site. The drainage area between Melton Hill Dam and the plant site is 25 square miles. The longest period with no release from the dam occurred in February and March 1966 when there was no flow below the dam for 29 consecutive days. These conditions resulted from special reservoir operations in an effort to reduce the growth of Eurasian water milfoil in the reservoir.[17] Such extended periods of zero flow from Melton Hill Dam are not anticipated in the future. During days when there are no releases from Melton Hill Dam, upstream flow at the site is possible, depending upon the operation of Watts Bar and Fort Loudoun Reservoirs.

Use of the Clinch River site would require the installation of supplemental cooling facilities. Makeup water requirements from the reservoir for cooling towers are expected to be approximately 14 cfs with discharges from the cooling facilities to the reservoir of about 7 cfs. Adequate treatment of this limited amount of water can be provided to meet applicable Federal and state water quality standards. State water quality standards are in Section 2.5.

9.2.5.3.7 FLOOD ELEVATION

The maximum flood levels expected at the Clinch River site were determined using preliminary estimates. The maximum possible hydraulic conditions without dam failure could cause the river to reach an elevation of 785 feet. Nonconcurrent seismic failure of Norris Dam could result in an estimated flood elevation of 800 feet at the Clinch River site. The possible contribution from the potential failure of Melton Hill Dam which is located between Norris Dam and the site was not taken into account due to its relatively small size compared to Norris Dam. AEC recommended procedures for considering concurrent flooding and seismic failure of Norris Dam give an estimated elevation of 810 feet.

The Clinch River site plant grade was expected to be at an elevation of approximately 810 feet. Due to the topography at this site, the plant

NRC QUESTIONS ABOUT SECTION 10

NRC Letter November 19, 1974 - Giambusso

Item 340.3 (10.1) - Amendment I, Part I, Page A1-73

Item 340.4 (10) - Amendment I, Part I, Page A1-74 (T10-1, 10.2, 10.7, 10.8)

Item 340.5 (10.5) - Amendment I, Part I, A1-75

NRC Letters February 13, 1975 and April 23, 1975* - Dicker

Question D2 (10.2) - Amendment I, Part II, Page A1-169

Question D6 (10) - Amendment I, Part II, Pages A1-175 and 176

*Question D8 (10) - Amendment I, Part II, Pages A1-78 to 201

C-18 (10) - Amendment I, Part II, Pages A1-157 and 158

NRC Letter October 26, 1981

Question 290.1R (All Sections) - Amendment XV

Question 320.9R (10.1, 10.3, 10.6) - Amendment XV 15 and extreme mixing conditions and ensures a rapid reduction in cooling tower blowdown excess temperature and adequate dilution of chemical effluents.

TABLE 10.3-1

INPUT PARAMETERS FOR MODELING OF THE CRBRP DISCHARGE PLUMES

Mixing Conditions	Plant Discharge: Atmospheric Wet Bulb (°F)	Plant Discharge: Blowdown Temp. (°F)	Plant Discharge: Blowdown (gpm)	Plant Discharge: Flow[e] (cfs)	Ambient River Conditions: Water Temp. (°F)	Ambient River Conditions: Flow Rate (cfs)	Ambient River Conditions: Velocity (fps)	Ambient River Conditions: Pool Elevation[h] (ft MSL)	Initial Jet Parameters: T_o (°F)	Initial Jet Parameters: V_o (fps)	Initial Jet Parameters: F_o	Initial Jet Parameters: Z/D	
Typical Cases													
Average Winter (Jan/Feb/Mar)	43.3[a]	74.9[c]	2,500	5.57	43.9[c]	5,338[g]	1.39	736	31.0	15.96	67.8	7.5	15
Average Summer (July/Aug/Sep)	73.2[a]	89.3[c]	3,240	7.22	65.7[c]	4,777[g]	0.63	741	23.6	20.68	77.1	15.0	
Thermal Worst Cases													
Hypothetical Winter (Jan)	56.2[b]	79.8[d]	2,810	6.26	33[f]	0	0	735	46.8	17.93	68.2	6.0	
Hypothetical Summer (June)	74.4[b]	89.6[d]	3,280	7.31	78[f]	0	0	739	11.6	20.94	84.3	12.0	
Chemical Worst Cases													
Short Duration No Flow													
Winter (Jan)	56.2[b]	79.8[d]	2,810	6.26	33[f]	0	0	735	46.8	17.93	68.2	6.0	
Summer (June)	74.4[b]	89.6[d]	3,280	7.31	78[f]	0	0	739	11.6	20.94	84.3	12.0	

[a] Table 3.4-3

[b] Bull Run Steam Plant Data, 1/70-12/73

[c] Table 10.3A-1

[d] Figure 10.3A-2; account taken of cooling effect of makeup flow

[e] Figure 10.3A-2

[f] Clinch River (m 21.6) Data, 6/62-9/72

[g] Table 2.5-3 (data base May 1963 - Dec. 1973)

[h] Table 2.5-5 (data base Jan. 1964 - Dec. 1973) 15

NRC QUESTIONS ABOUT SECTION 12

NRC Letter June 11, 1975

Item 321.15 (12.0), Amendment II, Part II, Page AII-46

NRC Letter October 26, 1981

Question 290.9R - Amendment XV 15

5.2 REFERENCES

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3. D. E. Reichle, et al., "Turnover and Concentration of Radionuclides in Food Chains," Nuclear Safety _11_, No. 1 (1970).

4. Personal Communications, S. V. Kaye, Oak Ridge National Laboratory, 1972.

5. _ICRP Publication 9_, Pergamon Press, New York, 1966.

6. _Basic Radiation Protection Criteria_, NCRP Report No. 39, 1971.

7. _The Effects on Populations of Exposure to Low-Levels of Ionizing Radiation_, National Academy of Sciences/National Research Council, Washington, 1972. 15

8. "Report of the Task Group on Reference Man," ICRP Publication 23, Pergamon Press, New York, 1975.

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11. Dunning, D. E., Jr. et al., "Estimates of Internal Dose Equivalent to 22 Target Organs for Radionuclides Occurring in Routine Releases from Nuclear Fuel Cycle Facilities." Vol. III, ORNL/NUREG/TM-190/V3, October 1981.

12. G. G. Killough and R. McKay, "A Methodology for Calculating Radiation Doses from Radioactivity Released to the Environment," ORNL-4992, March 1976. 14

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14. "Situation Assessment and Planning Assumptions", Division of Forestry, Fisheries, and Wildlife, TVA, Dec. 1978. 13

15. "Estimated Commercial Fish and Mussel Harvest from The Tennessee Valley", Fisheries and Aquatic Ecology Branch. TVA, 1980.

16. "Observations of Recreation Use of TVA Reservoirs. 1974", Division of Reservoir Properties, Recreation Resources Branch, TVA, Nov. 1975.

17. Unpublished Information from files of TVA Water Quality Branch, 1978.

NRC QUESTIONS ABOUT APPENDIX A

NRC Letter November 30, 1981

Question 750.2R - Amendment XV

Question 750.4R - Amendment XV

NRC QUESTIONS ABOUT APPENDIX C

NRC Letter December 29, 1981

Question 310.3R-25 (Introduction) - Amendment XV
Question 310.3R-26 (Introduction) - Amendment XV
Question 310.3R-27 (2.2) - Amendment XV
Question 310.3R-28 (2.4) - Amendment XV
Question 310.3R-29 (2.5) - Amendment XV
Question 310.3R-30 (2.6) - Amendment XV
Question 310.3R-31 (2.6) - Amendment XV
Question 310.3R-32 (3.2) - Amendment XV
Question 310.3R-33 (3.2) - Amendment XV
Question 310.3R-34 (3.2) - Amendment XV
Question 310.3R-35 (3.2) - Amendment XV
Question 310.3R-36 (3.3) - Amendment XV
Question 310.3R-37 (3.3) - Amendment XV
Question 310.3R-38 (3.3) - Amendment XV
Question 310.3R-39 (2.3) - Amendment XV
Question 310.3R-40 (1.0) - Amendment XV
Question 310.3R-41 (3.3) - Amendment XV

NRC QUESTIONS ABOUT APPENDIX D

NRC Letter November 30, 1981

Question 750.3R - Amendment XV

NRC QUESTONS ABOUT APPENDIX E

NRC Letter October 26, 1981

Question 320.3R - Amendment XV

Question 320.4R - Amendment XV

APPENDIX F

SUPPLEMENTAL ALTERNATIVE SITING ANALYSIS UPDATE
FOR THE
LMFBR DEMONSTRATION PLANT

SUPPLEMENTAL ALTERNATIVE SITING ANALYSIS UPDATE FOR THE LMFBR DEMONSTRATION PLANT

1.0 BACKGROUND AND INTRODUCTION

The primary alternative siting analysis for the LMFBR Demonstration Plant is presented in Section 9.2 of the CRBRP Environmental Report. The choice of the TVA power service area as the region of interest for this analysis was inherent in the selection by AEC of the TVA/Commonwealth Edison proposal for a cooperative AEC/utility arrangement to design, construct, and operate the nation's first large-scale demonstration LMFBR.(1) This choice was also confirmed by the DOE's LMFBR Program Environmental Statement Supplement.(2) The conclusion reached in Environmental Report Section 9.2, after careful consideration of both a hook-on arrangement at an existing TVA plant and an all new plant at a number of undeveloped candidate sites, was that an all new plant located at the Clinch River site was the preferrred choice for the LMFBR Demonstration Plant.

With respect to the alternative siting analysis presented in the CRBRP Environmental Report, it was contended by an intervenor in the CRBRP licensing hearings that:

> Alternative sites with more favorable environmental and safety features are not analyzed and the analysis is defective since:
>
> 1. Sites with more favorable environmental and safety characteristics were not identified and sufficient weight was not given to those values in selecting the site.

(1) See CRBRP Environmental Report Section 9.2 and Appendix D, Section 1.0, for additional information concerning the history of the selection of an AEC/utility arrangement for the design, construction, and operation of the LMFBR Demonstration Plant.

(2) See LMFBR Program Environmental Impact Statement Supplement, DOE/EIS-0085-D, Appendix G.

2. The site selection criteria unduly restricted the range of alternatives. The analysis of alternatives should not be restricted to either the TVA system or the State of Tennessee. The analysis must encompass all land owned by TVA, including land outside its system, and all land owned by ERDA (and the AEC before it).

3. Alternative sites which need to be explored include Hanford Reservation, NRTS Idaho Reservation, Nevada Test Site, co-location with the LMFBR fuel reprocessing plant (e.g., the hot pilot plant) and an LMFBR fuel fabricating plant and underground sites.

Ruling on the acceptability of this contention in the CRBRP hearings, the NRC Commissioners have stated:

> Alternative sites outside the Tennessee Valley Authority service area are also relevant to this proceeding. In considering alternatives, including non-TVA siting alternatives, in the present proceeding, the following general principle should be observed: consideration of alternatives need go no further than to establish whether or not substantially better alternatives are likely to be available.(3)

In accordance with the above NRC Commissioners ruling and in response to NRC requests for additional information, the CRBRP Project provided in Environmental Report Appendix D, "Supplemental Alternative Siting Analysis for the LMFBR Demonstration Plant," and Appendix E, "Additional Information Regarding Consideration of Alternate Sites for the LMFBR Demonstration Plant," an analysis of alternative sites outside the TVA service area and the concepts of underground siting and co-location with an LMFBR fuel reprocessing or fuel fabrication plant. The conclusion reached from this additional alternative siting analysis was again that the Clinch River site was the preferred site for the LMFBR Demonstration Plant.

In a letter dated November 30, 1981, NRC requested additional information to update the CRBRP Project alternative siting analysis presented in the Environmental Report. The

(3) See CRBRP Environmental Report Appendix E for a complete discussion of the standards governing consideration of alternative sites outside the TVA power service area presented in the NRC Commissioners Order.

Project's response to NRC's questions concerning the Environmental Report Section 9.2 analysis of alternative sites within the TVA power service area is provided in Environmental Report Appendix G. The NRC requested update of the supplemental alternative siting analysis presented in Environmental Report Appendixes D and E is provided herein. In parallel with the organization of Environmental Report Appendix D, a re-examination of alternative DOE sites for the LMFBR Demonstration Plant is provided in Section 2.1, and Section 2.2 contains a re-examination of TVA owned sites outside the TVA power service area. The concepts of underground siting and co-location with an LMFBR fuel reprocessing or fuel fabrication plant are reviewed in Section 2.3. Section 3.0 provides an update to the additional information concerning alternative DOE sites at Hanford, Savannah River, and Idaho contained in Environmental Report Appendix E.

The enclosed update is not intended to supplant or supercede either Environmental Report Appendix D or E since much of the information presented in these appendixes is still valid and is not repeated here. The enclosed update is intended only to reconfirm, revise, and/or supplement, as necessary, the previous Environmental Report analysis and must be used in conjunction with it.

2.0 CONSIDERATION OF ADDITIONAL ALTERNATIVE SITES AND CONCEPTS FOR THE LMFBR DEMONSTRATION PLANT

This section provides an update of the consideration of additional alternative sites and concepts presented in Appendix D of the CRBRP Environmental Report.

2.1 Consideration of DOE Land as Alternative Sites for the LMFBR Demonstration Plant

As requested by the NRC, the CRBRP Project has re-examined the analysis presented in Appendix D, Section 2.1, of the CRBRP Environmental Report, regarding the determination of whether or not there is a DOE site(s) outside the TVA system that would be a substantially better alternative site than the present Clinch River site for the LMFBR Demonstration Plant. Specifically, the previously considered sites at Hanford, Savannah River, and the Idaho National Engineering Laboratory (INEL) were reviewed to see if they are presently acceptable as candidate sites and if the information provided on these candidate sites in Appendix D is still adequate for comparison to the Clinch River site. The results of this review are provided below.

The Appendix D analysis of ERDA sites as potential alternative sites for the LMFBR Demonstration Plant began by screening, in a two-phase process, all U.S. Government real property in the custody of ERDA at the time. The screening process reduced the number of feasible sites for the LMFBR Demonstration Plant to three, Hanford, Savannah River, and INEL. The principle reasons for which the other sites were excluded included insufficient land area to meet minimum exclusion area distance, lack of available cooling water, interference with ERDA's Division of Military Application Weapons Program, high surrounding population density, and the undesireability of co-location with existing ERDA facilities. A review of the screening process and the bases for the elimination of all ERDA sites, except Hanford, Savannah River, and INEL, has found that the previous screening analysis is still valid. A similar screening process was also applied to additional properties presently owned by the U.S. Government and in the custody of DOE that were not considered in the previous analysis. The results found no DOE properties of sufficient size to warrant their consideration as potential alternative sites for the LMFBR Demonstration Plant.

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The reconnaissance level information provided in Appendix D for Hanford (Section 2.1.2.1), Savannah River (Section 2.1.2.2), and INEL (Section 2.1.2.3), has been reviewed in detail and, while most of this information is still correct, some information requires updating. To ensure NRC has the correct, updated information, the previously provided data on site access; nearby industrial, military, and transportation facilities; demography; meteorology (atmospheric dispersion); geology (foundation conditions); seismology; hydrology (cooling water availability, water quality, and flooding); bio-environment; socio-economics (labor availability); transmission lines; land and land use; scenic, archaeological and historic sites; and utility participation for each site is reviewed and, as necessary, corrected or supplemented in the following sections. Also, a revised comparison of the site characteristics at Clinch River, Hanford, Savannah River, and INEL is provided in Table 1.

The final conclusion reached based on the review of the updated information for Hanford, Savannah River, and INEL is that the previous findings reached in Appendix D remain valid, i.e.:

1. Atmospheric dispersion and site isolation factors (minimum exclusion boundary distance, surrounding population density) are somewhat more favorable at Hanford, Savannah River, or INEL than the Clinch River site. However, it must be emphasized that the Clinch River site is still a completely acceptable site for construction of a nuclear facility.(4)

2. A comparison of other siting parameters (see Table 1) would not lead one to select the Hanford, Savannah River, or INEL areas as preferable to the Clinch River site.

(4) The acceptability of the Clinch River site is fully demonstrated in the CRBRP PSAR and Environmental Report and is confirmed by the NRC staff in their CRBRP FES and Site Suitability Report.

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TABLE 1

COMPARISON OF SITE CHARACTERISTICS

	CLINCH RIVER	HANFORD	IDAHO	SAVANNAH RIVER
Site Size:				
Exclusion Boundary	2,200 feet	Potential for >2,200 feet	Potential for >2,200 feet	Potential for >2,200 feet
Population Center Distance	7.0 miles(Oak Ridge-27,552)	(Richland-33,582)[a]	~25 miles (Idaho Falls-38,696)	~25 miles (Augusta-47,532)
Cooling Water	Clinch River - Adequate	Columbia River - Adequate	Groundwater - Adequate	Savannah River - Adequate
Seismology - design basis SSE acceleration	0.25g	0.25g	0.50g to 0.20g[b]	0.20g
Atmospheric Dispersion	Short term (5% X/Q in sec/m^3) 0-2 hrs 1.1×10^{-3} at 670m(EB) 0-8 hrs 1.2×10^{-4} at 4023m (LPZ) 8-24 hrs 8.4×10^{-5} at LPZ 1-4 days 3.7×10^{-5} at LPZ 4-30 days 1.2×10^{-5} at LPZ Annual average 1.44×10^{-4} (highest offsite value)	[c]Short term (5% X/Q in sec/m^3) 0-2 hrs 3.0×10^{-4} 1927m(EB) 0-8 hrs 2.8×10^{-5} at 6440m (LPZ) 8-24 hrs 1.9×10^{-5} at LPZ 1-4 days 8.3×10^{-6} at LPZ 4-30 days 2.5×10^{-6} at LPZ Annual average 1.7×10^{-6} (highest offsite value)	[d]Short term X/Q in sec/m^3 At 670m 1.95×10^{-4} At 4023m 3.4×10^{-5}	[e]Short term (5% X/Q in sec/m^3) 0-2 hrs 2.8×10^{-4} at 1098m(EB) 0-8 hrs 1.0×10^{-4} at 3220m (LPZ) 8-24 hrs 2.1×10^{-5} at LPZ 1-4 days 8.7×10^{-6} at LPZ 4-30 days 2.5×10^{-6} at LPZ Annual average 2.7×10^{-6} (highest offsite value)
Labor availability	Adequate	Adequate	Potential construction labor shortage	Adequate

a. Richland borders the Hanford Reservation, for FFTF it is 6 miles, for WPPSS it is 8 miles
b. The determination of the seismicity and volcanic hazards at the INEL site by the NRC staff could be a major source of project delay.
c. SER for WPPSS 1 & 4
d. Calculated using stability class F and wind speed of 1.8 m/sec using onsite data (IDO-12048)
e. "SER for Alvin W. Vogtle Nuclear Plant"

TABLE 1 (cont'd)

	CLINCH RIVER	HANFORD	IDAHO	SAVANNAH RIVER
Population Density	Cumulative Population (1980) 0-1 mile 150 0-2 miles 740 0-3 miles 1460 0-4 miles 2420 0-5 miles 4440 0-10 miles 52,040 0-50 miles 830,840 (933,280 in 2030)	Cumulative Population (1980)[f] 0-10 miles 25,361 0-50 miles 263,746 (328,139 in 1990)	Cumulative Population (1980)[g] 0-10 miles ∿6 0-50 miles ∿140,550	Cumulative Population (1977)[h] 0-10 miles ∿3,000 0-50 miles ∿500,000
Site Access	Road, railroad, and barge	Road, railroad, and barge	Road and railroad only	Road, railroad, and barge
Transmission line construction required	∿3.2 miles of transmission line construction required	Only minor transmission line construction expected	Uncertain	Only minor transmission line construction required
Utility Participation	Yes	No	No	No

Comparison of Geology (foundation conditions); flooding potential; industrial, military, and transporation facilities near the site; land and land use; aquatic and terrestrial impacts; and scenic and historic sites are essentially the same for the 4 areas.

f. From Table 2
g. From Figure 2
h. SER for Alvin W. Vogtle

3. A cooperative arrangement between utilities and DOE for the design, construction, and operation of the LMFBR Demonstration Plant on a utility system is not likely in the localities of the Hanford, Savannah River, or INEL sites. This would preclude satisfaction of a primary LMFBR Demonstration Plant objective.(5)

With regards to the first two conclusions, a very similar comparison of the Hanford, INEL, and Oak Ridge National Laboratory (ORNL) sites as part of the Large Developmental Plant LMFBR Conceptual Design Study independently confirmed these conclusions.(6,7) More specifically, the Large Developmental Plant siting and environmental studies concluded that "no information was uncovered which would decidedly indicate that the Demonstration Plant (Large Developmental Plant) could not be located at any of the selected sites," that "acceptable sites for the Developmental Plant have been identified on each of the Hanford, Idaho, and Oak Ridge reservations," and that "the results of economic and other comparisons at these sites did not identify any factors significant enough to favor one site over the others."

On the basis of the foregoing, neither Hanford, Savannah River, nor INEL is environmentally superior or preferable to the Clinch River site. In addition, the Project previously provided (Environmental Report Appendix E) additional information showing that the Project's ability to meet LMFBR program and project information goals is strongly site dependent and that the Clinch River Site is the preferred alternative for the LMFBR Demonstration Plant. A re-examination of this information based upon current information is provided in Section 3.0 below. This analysis confirms that neither Hanford, Savannah River, nor INEL are substantially better alternatives for satisfying program and project objectives for this demonstration plant.

(5) See CRBRP Environmental Report Appendix E and Section 3.0 for additional information concerning LMFBR Program and LMFBR Demonstration Plant project objectives.

(6) LMFBR Developmental Plant Conceptual Design Study Final Report, Site Evaluation Report, CDS 400-9, March 1981, prepared by Burns and Roe, Inc.

(7) LMFBR Developmental Plant Conceptual Design Study Final Report, Preliminary Environmental Review Summary, CDS 400-10, January 15, 1981, prepared by Burns and Roe, Inc.

2.1.1 Hanford

The reconnaissance level information provided for the Hanford site in Section 2.1.2.1 of Appendix D to the CRBRP Environmental Report has been reviewed to assure that it is adequate for comparison to the Clinch River site. The results of this review are reported below and are based on telephone conversations with and information received from cognizant personnel at the Hanford site and the references listed in Section 2.1.1.15.

2.1.1.1 Site Access

No significant changes.

2.1.1.2 Nearby Industrial, Military, and Transportation Facilities

In addition to those onsite activities previously discussed in Appendix D, Puget Sound Power and Light Company is planning to build a two-unit commercial nuclear power station (Skagit/Hanford Nuclear Project) at a site approximately five miles west of the Washington Public Power Supply System Nuclear Unit 2.

2.1.1.3 Demography

In a recent report by Pacific Northwest Laboratory, the population distributions within a 50-mile radius of four locations on the Hanford site were calculated based on the U.S. Bureau of Census 1980 population counts for Washington and Oregon. Tables 2 and 3 show the population distribution within the 50-mile radius of FFTF for 1980 and the projected population distribution for 1990, respectively. Additional demographic data in the vicinity of the Hanford site with projections past 1990 are available in the Skagit/Hanford Nuclear Project Environmental Report.

As specifically requested by the NRC staff, 46° 26' Latitude, 119° 23' Longitude, are reasonable coordinates for NRC's use in computing population distributions and densities around a possible LMFBR Demonstration Plant site at Hanford.

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TABLE 2

DISTRIBUTION OF POPULATION IN 50-MILE RADIUS OF THE FFTF BY POPULATION GRID SECTOR FOR THE YEAR 1980

Compass Direction	Number of People 0-10 mi	10-20 mi	20-30 mi	30-40 mi	40-50 mi	Totals
NORTH	0	78	859	811	16,267	18,015
NNE	20	343	5,728	2,945	1,021	10,057
NE	114	377	760	1,033	217	2,501
ENE	211	1,041	2,644	492	451	4,839
EAST	229	600	183	169	183	1,364
ESE	229	442	544	292	1,060	2,567
SE	344	25,267	13,654	2,105	952	42,322
SSE	10,829	40,933	5,688	719	2,364	60,533
SOUTH	11,760	9,385	1,525	5,611	15,691	43,972
SSW	1,446	4,550	583	185	1,927	8,691
SW	179	1,538	5,234	535	239	7,725
WSW	0	1,206	7,748	14,956	481	24,391
WEST	0	190	3,339	6,089	17,171	26,789
WNW	0	0	932	1,221	3,176	5,329
NW	0	0	295	903	705	1,903
NNW	0	0	264	1,302	1,182	2,748
TOTALS	25,361	85,950	49,980	39,368	63,087	263,746

TABLE 3

DISTRIBUTION OF POPULATION WITHIN A 50-MILE RADIUS OF THE FFTF
BY POPULATION GRID SECTOR FOR THE YEAR 1990

Compass Direction	Number of People					
	0-10 mi	10-20 mi	20-30 mi	30-40 mi	40-50 mi	Totals
NORTH	0	107	1,057	968	19,099	21,231
NNE	27	467	7,121	3,517	1,205	12,337
NE	156	513	997	1,293	270	3,229
ENE	288	1,415	3,598	671	611	6,583
EAST	312	817	249	211	208	1,797
ESE	312	602	634	324	1,176	3,048
SE	452	34,069	17,622	2,394	1,252	55,789
SSE	13,881	52,612	7,360	867	2,821	77,541
SOUTH	15,073	12,032	1,955	6,678	18,712	54,450
SSW	1,854	5,832	745	229	2,249	10,909
SW	228	1,971	6,709	638	279	9,825
WSW	0	1,546	9,109	17,380	559	28,594
WEST	0	244	3,946	7,076	19,951	31,217
WNW	0	0	1,149	1,416	3,659	6,224
NW	0	0	346	1,045	750	2,141
NNW	0	0	310	1,528	1,386	3,224
TOTALS	32,583	112,227	62,907	46,235	74,187	328,139

2.1.1.4 Meteorology (Atmospheric Dispersion)

No significant changes.

2.1.1.5 Geology (Foundation Conditions)

No significant changes.

2.1.1.6 Seismology

No significant changes. It should be noted, however, that an investigation is currently in progress to evaluate recently obtained data related to reported faulting in the area which may impact (increase) the required design basis acceleration for the safe shutdown earthquake which is presently 0.25g.

2.1.1.7 Hydrology (Cooling Water Availability, Water Quality, and Flooding)

No significant changes.

2.1.1.8 Bio-Environment

Two federally listed, threatened or endangered animal species are known to occur within the Hanford Reservation, bald eagles and peregrine falcons. Bald eagles are winter residents, although sporatic nesting attempts have been made in the past. The only published records of peregine falcons in the Tri-cities area is of winter migrants. There are no other significant changes from the bio-environment description of the Hanford site in Appendix D, but additional information is available in the references listed in Section 2.1.1.15.

2.1.1.9 Socio-economics (Labor Availability)

The most up-to-date socio-economic information concerning the area surrounding Hanford is contained in the Environmental Report for the Skagit/Hanford Nuclear Project. A review of this study plus the recent planned termination of the Washington Public Power Supply System Nuclear Unit 4, indicates that an adequate labor supply would be available in the Richland-Kennewick-Pasco area with a minimum influx of new construction workers.

2.1.1.10 Transmission Lines

No significant changes.

2.1.1.11 Land and Land Use

No significant changes.

2.1.1.12 Scenic, Archaeological, and Historic Sites

The U.S. Department of the Interior (1979) lists 20 historic sites for the three counties (Benton, Grant, and Franklin) in which the Hanford site is located. Among these, the Ryegrass Archaeological District is listed as being in the "Hanford Works Reservation" (since 1978 designated as "Hanford Site") along the Columbia River. Other historic sites listed are: Paris Archeological Site, Hanford Island Archeological Site, Hanford North Archeological District, Locke Island Archeological District, Rattlesnake Springs Sites, Snively Canyon Archeological District, Wooded Island Archeological District, and Savage Island Archeological District. Concerning natural and scenic features, two sites have been proposed for designation as National Natural Landmarks, the Hanford Dunes and the Arid Lands Ecology Reserve. In addition, the Arid Lands Ecology Reserve along with the rest of the Hanford Site, exclusive of the operating areas (approximately 6%) was recently designated as a National Environmental Research Park (NERP). The Hanford Reach of the Columbia River, which includes the entire length of the river within the Hanford Reservation, is the last free-flowing section of the Columbia River and has been proposed as a potential wild, scenic, or recreational river under the Wild and Scenic Rivers Act.

Hanford, as a candidate site for the LMFBR Demonstration Plant, is not pre-empted by any of the above updated findings. Additional information concerning the above can be found in the references listed in Section 2.1.1.15.

2.1.1.13 Utility Participation

In a letter dated February 16, 1982 from the Public Power Council of Pacific Northwest consumer owned utilities, the previous determination that the Northwest utilities were not willing to take on the additional responsibilities of the LMFBR Demonstration Plant at the Hanford site is reconfirmed. A copy of this letter is attached as Exhibit I.

2.1.1.14 Other New Considerations

Two other items need to be noted to satisfactorily complete this update for the Hanford site. First, as a result of the May 18, 1980 and subsequent eruptions of Mount St. Helens an additional new design basis is necessary for Hanford relating to ash fall. Ash fall would affect mostly equipment qualification and HVAC system design. While this is an added design basis not applicable to the other sites, the significance in terms of added plant cost should be relatively minor.

The second item concerns the recent announcement by the Washington Public Power Supply System (Supply System) that it intends to terminate the construction on Nuclear Unit 4 (WNP-4) which is approximately 25% complete. While it may appear initially that some large cost savings or schedule reduction could occur should the LMFBR Demonstration Plant utilize the existing WNP-4 site, structures, and services, a more detailed examination quickly finds this would not be the case. There are significant size and generic design differences between the 1250 MWe WNP-4, which is a light water reactor, and the LMFBR Demonstration Plant. For instance, the WNP-4 containment building, internal structures and supports, and foundation would be totally unsuitable for use by the LMFBR Demonstration Plant. Also, co-location of the LMFBR Demonstration Plant in close proximity with the other two Supply System Units, WNP-1 and WNP-2, would create undue interference and problems for both the Supply System and the LMFBR Demonstration Plant project. In addition, any cost savings that might be realized would be negligible in comparison with the LMFBR program and project benefits that would be lost and increased costs from relocating the LMFBR Demonstration Plant to Hanford (see Section 3.0).

2.1.1.15 Additional Sources of Information

Sources which were utilized for the update of the Hanford site description include:

Skagit/Hanford Nuclear Project Preliminary Safety Analysis Report and Environmental Report, Docket Numbers 50-522 and 50-523

Population Estimates for the Areas Within a 50-Mile Radius of Four Reference Points on the Hanford Site (PNL-4010) D.J. Sommer, R.G. Rau, and D.C. Robinson, Pacific Northwest Laboratory, November 1981

LMFBR Developmental Plant Conceptual Design Study - Phase II, Preliminary Environmental Review, Volume II, Hanford Reservation, CDS 500-10, prepared by Burns and Roe, Inc.

LMFBR Developmental Plant Conceptual Design Study Final Report, Site Evaluation Report, CDS 400-9, March 1981, prepared by Burns and Roe, Inc.

Final Environmental Impact Statement, Supplement to ERDA-1538, December 1975, Waste Management Operations, Hanford Site, Double-Shell Tanks for Defense High-Level Radioactive Waste Storage, April 1980, DOE/EIS-0063

2.1.2 Savannah River

The reconnaissance level information provided in CRBRP Environmental Report Appendix D, Section 2.1.2.2, "Savannah River" has been reviewed to assure that it is adequate for comparison to the Clinch River site. The results of this review are reported below and are based on telephone conversations with and information received from cognizant personnel at the Savannah River Plant and the references listed in Section 2.1.2.14.

2.1.2.1 Site Access

No significant changes.

?.2 Nearby Industrial, Military, and Transportation Facilities

No significant changes.

2.1.2.3 Demography

The current work force at the Savannah River Plant has increased to 8300 (July 1980). This transient work force could grow substantially as a result of a decision to construct and operate a Defense Waste Processing Facility at the Savannah River site (expected peak construction work force of 5000). The Vogtle construction work force is another large source of daily transient population in the vicinity of the Savannah River site.

Although a revised distribution of population within 50 miles of the Savannah River Plant based on 1980 U. S. Census data was not readily available, Table 4 presents the 1980 census population data for counties and communities where 89% of the current Savannah River Plant work force resides (see Figure 1).

As specifically requested by the NRC staff, 33° 19' Latitude, 81° 32' Longitude, are reasonable coordinates for NRC's use in computing population distributions and densities around a possible LMFBR Demonstration Plant site at Savannah River.

2.1.2.4 Meteorology (Atmospheric Dispersion)

No significant changes.

2.1.2.5 Geology (Foundation Conditions)

No significant changes.

2.1.2.6 Seismology

No significant changes.

2.1.2.7 Hydrology (Cooling Water Availability, Water Quality, and Flooding)

No significant changes.

2.1.2.8 Bio-Environment

Four species listed as endangered or threatened by the U. S. Fish and Wildlife Service have been identified on the Savannah River site. They are the bald eagle, red-cockaded woodpecker, Kirtland's warbler, and American alligator. There are no other significant changes to the bio-environment description of the Savannah River site in Appendix D, but additional information is available in the references listed in Section 2.1.2.14.

TABLE 4

1980 POPULATIONS FOR SELECTED COUNTIES AND COMMUNITIES SURROUNDING THE SAVANNAH RIVER PLANT

Location	Population
South Carolina	
Aiken County	105,625
City of North Augusta	13,593
City of Aiken	14,978
Allendale County	10,700
Town of Allendale	4,400
Bamberg County	18,118
City of Bamberg	3,672
City of Denmark	4,434
Barnwell County	19,868
City of Barnwell	5,572
Georgia	
Columbia County	40,118
City of Grovetown	3,491
Richmond County	181,629
City of Augusta	47,532
TOTAL	376,058

Source: U.S. Bureau of Census, 1980 Census of Population and Housing, South Carolina, PHC80-V-42; Georgia, PHC80-V-12; March 1981.

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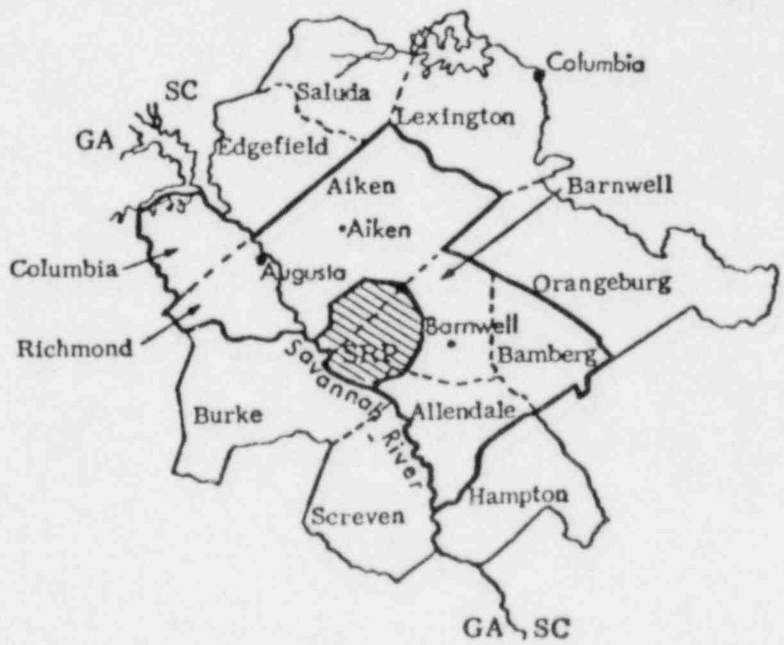


FIGURE 1

COUNTIES AND COMMUNITIES SURROUNDING THE SAVANNAH RIVER PLANT

2.1.2.9 Socio-economics (Labor Availability)

The most recent source of information concerning labor availability and socioeconomic conditions in the Savannah River site area is the Draft Environmental Impact Statement for the Defense Waste Processing Facility (DWPF). Based on this information, it appears that labor availability is sufficient, but any conclusion on socioeconomic impacts from construction and operation of the LMFBR Demonstration Plant would require additional analysis and would be dependent on the timing of labor requirements for the ongoing Vogtle Nuclear Plant construction, and potential construction of the DWPF.

2.1.2.10 Transmission Lines

The Savannah River Plant is currently connected by two 115 kV transmission lines to the utility system and the reservation is crossed by a 230 kV transmission line.

2.1.2.11 Land and Land Use

No significant changes.

2.1.2.12 Scenic, Archaeological, and Historic Sites

No significant changes.

2.1.2.13 Utility Participation

The previous determination that the Southeast utilities (Duke Power Company, Carolina Power and Light Company, Virginia Electric and Power Company, the Southern Company, and South Carolina Electric and Gas Company) could not constitute a utility owner-operator group for locating the LMFBR Demonstration Plant on any of their systems including the Savannah River site, has been reconfirmed in a January 26, 1982 letter from Mr. William S. Lee, President and Chief Operating Officer of Duke Power Company. (A copy of Mr. Lee's letter is attached as Exhibit II along with copies of his two previous letters of November 4 and December 1, 1976 which he references).

2.1.2.14 Additional Sources of Information

Sources which were utilized for the update of the Savannah River site description include:

Draft Environmental Impact Statement Defense Waste Processing Facility, Savannah River Plant, Aiken, South Carolina, September 1981, U. S. Department of Energy (DOE/EIS-0082D)

Environmental Information Document Defense Waste Processing Facility, July 1981, E.I. du Pont de Nemours & Co. (DPST-80-249)

2.1.3 Idaho National Engineering Laboratory

As has been done for the Hanford and Savannah River sites, the reconnaissance level information provided in CRBRP Environmental Report Appendix D, Section 2.1.2.3, "Idaho National Engineering Laboratory" has been reviewed to assure that it is adequate for comparison to the Clinch River site. The results of the review are given below and are based on telephone conversations with and information received from cognizant personnel at the INEL and the references listed in Section 2.1.3.14.

2.1.3.1 Site Access

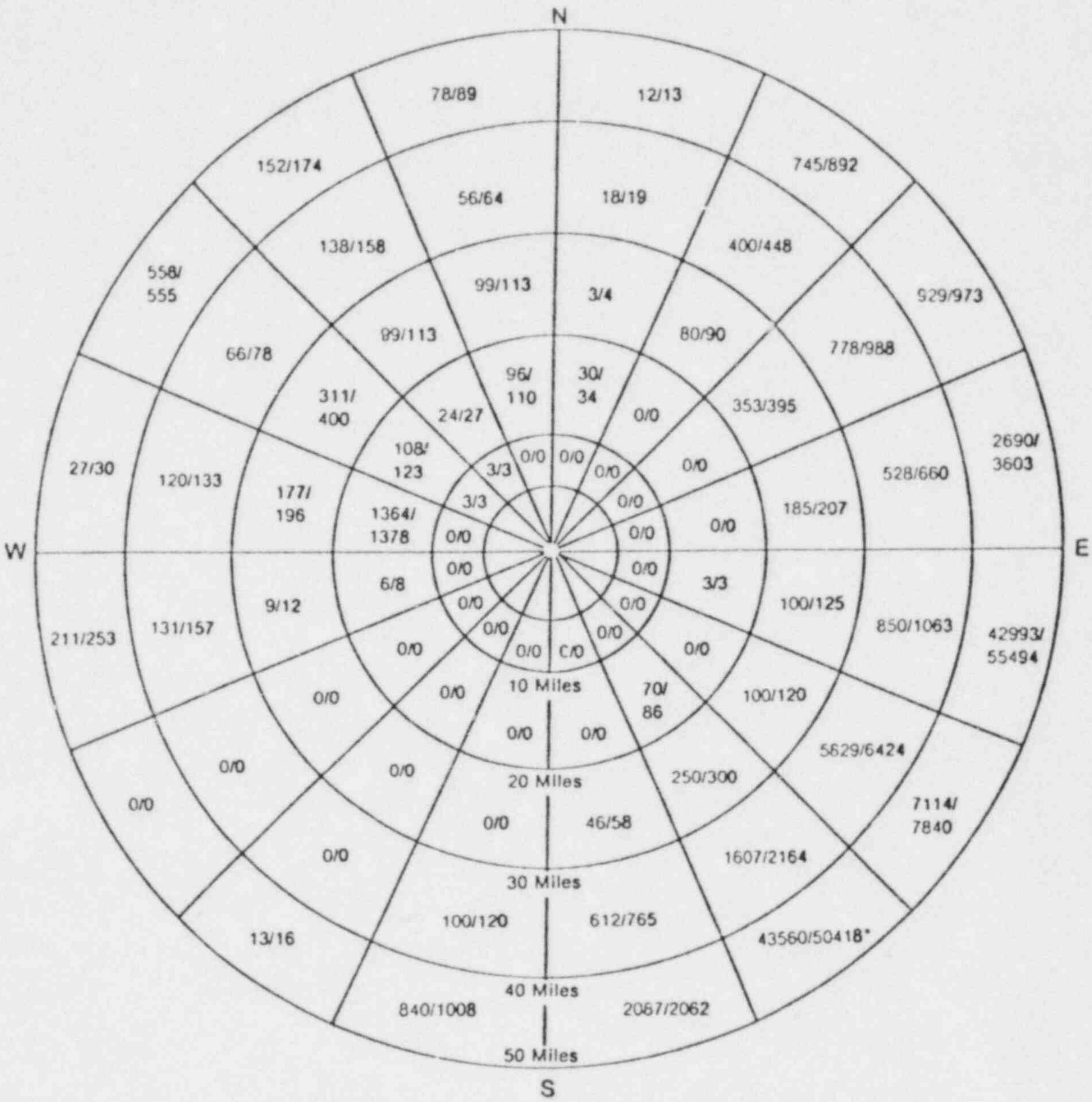
No significant changes.

2.1.3.2 Nearby Industrial, Military, and Transportation Facilities

No significant changes.

2.1.3.3 Demography

Figure 2 is provided to give the best available information regarding the distribution of population within a 50-mile radius of the INEL Central Facilities Area. Both the distribution based on the 1970 U. S. Census and an updated distribution based on preliminary 1980 U. S. Census data is shown. Figure 3 illustrates the area encompassed by the 50-mile radius circle surrounding the Central Facilities Area. The 1980 population



Population Data
1970 Census/1980 Preliminary Census

*Includes about 39000/45022 residents in Pocatello, which is slightly beyond the 50-mile radius

INEL-A-18 305

FIGURE 2

POPULATION DISTRIBUTION AROUND THE INEL, CENTERED AT THE CENTRAL FACILITIES AREA

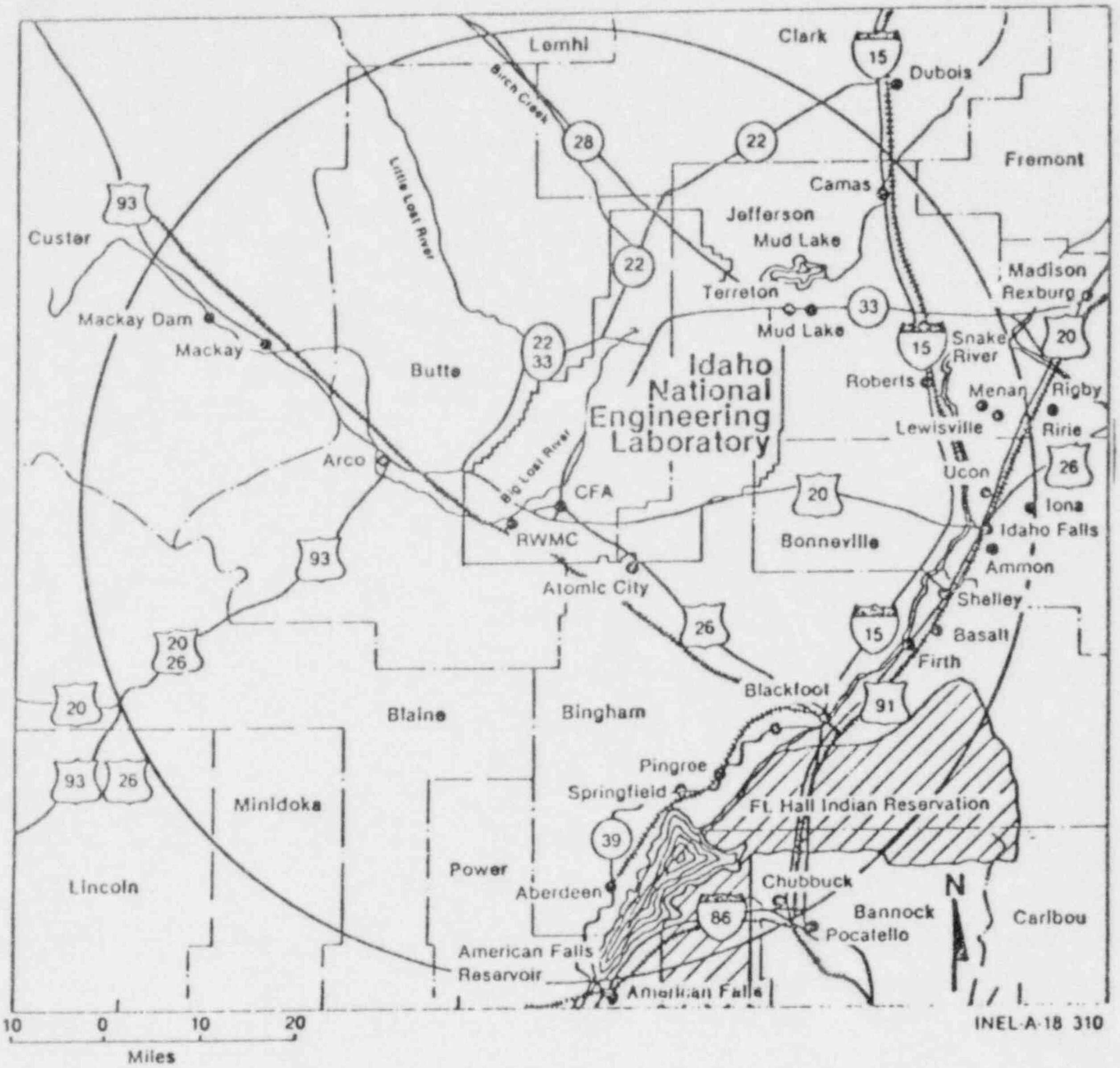


FIGURE 3

INEL VICINITY MAP CENTERED ON THE CENTRAL FACILITIES AREA (CFA) residing within 50 miles of the Central Facilities Area (including Pocatello, which is just outside the 50-mile radius circle) was 140,550. Tables 5 and 6 show the population of towns within the 50-mile radius having more than 300 inhabitants and the population by county for those people who reside within the 50-mile radius, respectively. (Because the population distributions in Figure 2 are estimated, total population values do not correspond exactly to those shown on Table 6.)

As specifically requested by the NRC staff, 43° 40' Latitude, 112° 30' Longitude, are reasonable coordinates for NRC's use in computing population distributions and densities around a possible LMFBR Demonstration Plant site at INEL.

2.1.3.4 Meteorology (Atmospheric Disperson)

No significant changes.

2.1.3.5 Geology (Foundation Conditions)

No significant changes.

2.1.3.6 Seismology

It was previously stated that INEL was reclassified from seismic Zone 2 of the Uniform Building Code to the higher risk Zone 3 in 1970. This seismic zone classification has, however, recently been reduced back to a seismic risk Zone 2. This reduction was based on the fact that the Eastern Snake River Plain geologic province is relatively aseismic although surrounded by seismicity and that the earthquakes of the neighboring tectonic provinces could not logically be expected to occur within the Eastern Snake River Plain where INEL is located.

Estimated maximum bedrock acceleration postulated by rupture along known faults at the INEL range from greater than 0.5 g on the western boundary to less than 0.2 g in the southeastern corner. It is expected that a site for the LMFBR Demonstration Plant could be found with a design basis safe shutdown earthquake of 0.25 g or less. It should be noted, however, that because there is no NRC licensed facility on or near INEL, a long project delay could occur while the NRC staff evaluates not only the seismicity of the

TABLE 5

POPULATIONS LIVING WITHIN 50 MILES OF THE CENTRAL FACILITIES AREA BY COUNTY

County[a]	Population 1970	Population 1980
Bannock[b]	42,183	49,672
Bingham	23,474	28,404
Blaine	360	432
Bonneville	40,959	50,380
Butte	2,966	3,352
Clark	62	65
Custer	602	668
Jefferson	5,973	7,287
Lemhi	22	25
Power	221	265
Total	116,822	140,550

Source: 1970 U.S. Census (Bureau of the Census 1973) and 1980 preliminary U.S. Census data (Bureau of the Census 1980).

a. Four other counties (Fremont, Lincoln, Madison, and Minidoka) intersect the 50-mile circle; however, no population centers lie within the circle.

b. Includes residents of the city of Pocatello, which is just outside the 50-mile radius.

TABLE 6

CITY POPULATIONS WITHIN 50 MILES OF THE CENTRAL FACILITIES AREA[a]

City	Population 1970	Population 1980
Aberdeen	1,542	1,436
Ammon	2,553	4,616
Arco	1,244	1,230
Basalt	349	410
Blackfoot	8,716	10,054
Chubbuck	2,927	6,880
Firth	362	450
Idaho Falls	35,776	38,696
Iona	890	1,070
Lewisville	468	498
Mackay	539	536
Menan	545	598
Pocatello[b]	38,826	45,022
Roberts	393	456
Shelley	2,674	3,260
Ucon	664	928

Sources: 1970 U.S. Census (Bureau of the Census 1973) and 1980 preliminary U.S. Census data (Bureau of the Census 1980).

a. Cities with more than 300 inhabitants.

b. Pocatello is just outside the 50-mile radius, but is included in the table.

INEL site, but also the history and the hazards that may be posed by the volcanic nature of the INEL site.

2.1.3.7 Hydrology (Cooling Water Availability, Water Quality, and Flooding)

No significant changes.

2.1.3.8 Bio-Environment

No significant changes.

2.1.3.9 Socio-economics (Labor Availability)

No significant changes.

2.1.3.10 Transmission Lines

No significant changes.

2.1.3.11 Land and Land Use

No significant changes.

2.1.3.12 Scenic, Archaeological, and Historic Sites

One historical site in addition to EBR-I has been identified on the INEL. The site has been fenced and the information required for potential registration as a national historic site has been sent to the State. This historic site, however, has no impact on the INEL as a site for the candidate LMFBR Demonstration Plant.

2.1.3.13 Utility Participation

(To be provided later.)

2.1.3.14 Additional Sources of Information

Sources which were used for the update of the INEL site description include:

LMFBR Developmental Plant Conceptual Design Study - Phase II, Preliminary Environmental Review, Volume I, Idaho National Engineering Laboratory, CDS 500-10, prepared by Burns and Roe, Inc.

LMFBR Developmental Plant Conceptual Design Study Final Report, Site Evaluation Report, CDS 400-9, March 1981, prepared by Burns and Roe, Inc.

2.2 Consideration of TVA-Owned Land Outside the TVA Power Service Area as Alternative Sites for the LMFBR Demonstration Plant

A review of the Environmental Report Appendix D Section 2.2 analysis was conducted. The review verified that the Page and Artemus sites located in Kentucky are still the only TVA-owned sites outside the TVA power service area, but that the sale of the Page site has been approved by the TVA Board of Directors. The review also verified that the general site characteristics, transmission hookup costs, and off-site power requirements information provided in Section 2.2 of Appendix D is still valid. Therefore, the basis for and the conclusion reached that no TVA land outside the TVA power service area is better, much less substantially better than the Clinch River site, remains unchanged.

2.3 Consideration of Co-Location with an LMFBR Fuel Reprocessing and an LMFBR Fuel Fabrication Plant and Underground Sites

Although not specifically requested by NRC to re-examine the concepts of underground siting and co-location of the LMFBR Demonstration Plant with various other fuel cycle facilities such as an LMFBR fuel fabrication plant and/or an LMFBR fuel reprocessing plant, a review has been made of the previous analysis of these alternatives in Environmental Report Appendix D Section 2.3. Based on this review, no findings or developments have arisen from studies of these concepts since the analysis was done to change the resulting conclusion that neither concept offers tangible improvement in safety, environmental acceptability, safeguards, or economics of the proposed CRBRP, and thus these alternatives do not warrant adoption for the LMFBR Demonstration Plant.

3.0 ADDITIONAL INFORMATION REGARDING CONSIDERATION OF ALTERNATE SITES FOR THE LMFBR DEMONSTRATION PLANT

This section is an update to CRBRP Environmental Report Appendix E which, in response to an NRC request, provided additional information concerning alternative sites at Hanford, Savannah River, and INEL, and to a more limited extent, potential sites within the TVA power service area. Appendix E also provided the CRBRP Project's overall assessment and balancing of factors that were regarded as significant in the comparison of alternative sites. The overall assessment in Appendix E was logically divided into four successive parts, each of which is reviewed here. The conclusion of this review and update is that the Clinch River site is the preferred site and that no other site represents a substantially better alternative for meeting pertinent LMFBR program and LMFBR Demonstration Plant project objectives.

The Standards Governing Consideration of Alternative Sites

Part A of Appendix E to the Environmental Report contains an important discussion of the standards that the NRC Commissioners recognized as controlling the review and evaluation of alternative sites for the CRBRP project. No change is required to this discussion of the four basic principles embodied in the Commission's Order that are of fundamental importance to the alternative site analysis (see Environmental Report Appendix E, pages E-4 to E-6). Indeed, the discussion is buttressed by the legislative history of the Project from its inception to the present, and in particular, by the Omnibus Budget Reconciliation Act of 1981. (See Applicants' Memorandum in Support of Request to Conduct Site Preparation Activity ("Applicants' Memorandum"), November 30, 1981 (Docket No. 50-537), at pages 14-25; Appendix A).

Program and Project Objective

The basic LMFBR program and LMFBR Demonstration Plant project objectives updated in the LMFBR Program Environmental Impact Statement (EIS) Supplement (DOE/EIS-0085-D) remain essentially the same as discussed in Appendix E. The current plan, however, now identifies only two major developmental plant projects, CRBRP and the Large Developmental Plant, and the revised timing objective for the LMFBR Demonstration Plant (CRBRP) is that it should be completed as expeditiously as possible.[8] The critical objective of demonstration of the technical performance, reliability, maintainability, safety, environmental acceptability, and economic feasibility, with extensive utility involvement in a utility environment remains unchanged. The essence of the findings in Appendix E Part B therefore remains the same. These findings were that the evaluation of alternative sites in terms of the objectives defined in the DOE LMFBR Environmental Impact Statement must focus upon whether the alternatives are likely to be available as substantially better means for meeting the fundamental objectives of (1) timing (as expeditiously as possible) and (2) demonstration with utility participation in a utility environment.

The Clinch River Site is the Preferred Alternative for Meeting Program and Project Objectives

The CRBRP Project has reviewed the evaluation in Part C of Environmental Report Appendix E that previously showed the likelihood of the Clinch River site meeting the timing and utility participation objectives and that neither Hanford, Savannah River, nor INEL are acceptable alternatives for meeting these objectives. The latest CRBRP Project schedule of key milestones is given in Table 7. It is clear from this schedule that the timing for construction and operation of CRBRP support the revised program objective of completion of the LMFBR Demonstration Plant as expeditiously as possible. On the other hand a decision now to locate the LMFBR Demonstration Plant at either Hanford, Savannah River, or INEL would cause a bare minimum delay of 33 months and a more probable delay of 43 months or more starting from the time a decision was made to change sites. These delay times are the same as those in Appendix E since no changes have occurred that would affect the basis for their calculation (see CRBRP Environmental Report Appendix E, pages E-11 to E-19). Based on this it is clear that considering the probable impact upon project arrangements and authorizations, and even the optimistic estimates of time determined in the Appendix E evaluation to reach today's stage of the CRBRP licensing process for either Hanford, Savannah River, or INEL, none of these alternative sites is a satisfactory means for meeting the present LMFBR program timing objective.

(8) LMFBR Program Environmental Impact Statement Supplement, DOE/EIS-0085-D, p. 51-52. See also Applicants' Memorandum at pages 14-25; Appendix A.

TABLE 7
CRBRP KEY MILESTONES

NRC Grant an LWA under 10 CFR 50.10(e)(3)(i)-(ii)	April, 1983
Start Nuclear Island Mat	June, 1984
NRC grant of CP	June, 1984
Submit FSAR to NRC	August, 1986
Start Na System Testing	March, 1989
NRC grant of OL	July, 1989
Start Fuel Loading	September, 1989
Initial Criticality	February, 1990

Similarly the extent to which Clinch River, and the alternative sites at Hanford, Savannah River, and INEL will be available for meeting the project objectives of extensive utility participation and demonstate in a utility environment examined in Appendix E remains unchanged (see CRBRP Environmental Report Appendix E, pages E-20 to E-25 and Sections 2.1.1.13, 2.1.2.13, and 2.1.3.13 above). Therefore, it is again concluded that since the Clinch River site fully satisfies the objective of utility participation and demonstration in a utility environment, and neither Hanford, Savannah River, nor INEL is likely to be available for meeting these objectives, Clinch River is clearly the preferred alternative site for the LMFBR Demonstration Plant.

Hanford, Savannah River, and INEL Do Not Offer Significant Advantages in Comparison to Clinch River

The last part of the discussion in Appendix E of the Environmental Report, hypothesized for the purposes of the analysis that Hanford, Savannah River, or INEL were likely to be available as means for satisfying LMFBR program and project objectives, and showed that even then a closer examination of the significant differences between Clinch River and these sites disclosed that on balance of all relevant considerations, these sites were not substantially better alternatives than the Clinch River site. The differences between the Clinch River site and the three alternative sites which the previous review found to exist were (1) cost, (2) benefits, (3) effectiveness of the demonstration, and (4) risks.

1. Costs

The comparative cost analysis presented in Appendix E of locating the LMFBR Demonstration Plant at Clinch River versus Hanford, Savannah River, or INEL has been updated for the reference 43-month delay case and the results are presented in Table 8. As can be seen the costs have all

TABLE 8

ESTIMATED IMPACT OF
RELOCATING CLINCH RIVER BREEDER REACTOR PLANT
TO ALERNATE SITE

Item	Incremental Cost $ (Million) Hanford	Idaho	Savannah River
Escalation	601	601	601
Staff and Support Stretch Out	164	164	164
Equipment Procurement	6	13	10
Relocate Project Office	7	6	5
Additional Travel	3	3	1
Difference in Prevailing Labor Rates	429	376	51
Site Studies - Other than Geological	1	1	1
Site Studies - Geological	7	7	7
Site Work Package	3	3	3
Seismic	11	162	11
Foundation Materials and Walls	2	3	2
Site Adaptation Redesign	10	88	10
Excavation	(15)	0	(6)
Water Supply Line	1	1	0
Environmental Report Rework	1	1	1
Preliminary Safety Analysis Report Rework	1	1	1
Reduced Revenue from Sale of Power	356	214	(27)
TOTAL COST IMPACT - ADD	1588	1644	835

increased as would be expected. Thus, there remains a dramatic increased cost that would result from relocating the LMFBR Demonstration Plant from the Clinch River site.(9)

2. Benefits to the LMFBR Program

As indicated previously, the recent LMFBR Program EIS Supplement reconfirmed the basic objectives and direction of the LMFBR Program and called for completing of the CRBRP as expeditiously as possible. This reconfirmation was concluded after performing a new analysis of optional programs, structures, and timing.(10) Thus siting the LMFBR Demonstration Plant at Hanford, Savannah River, or INEL would result in substantially diminished benefits for the LMFBR Program for the reasons discussed in Appendix E and in the LMFBR Program EIS Supplement.

3. Effectiveness of Demonstration in a Utility Environment

The same arguments raised in Appendix E remain valid today concerning use of atypically remote sites, as opposed to the more typical Clinch River site, and exposure to additional costs and delays if some future and presently unknown circumstance persuaded a utility (utilities) at Hanford, Savannah River, or INEL to even partially assume some operating responsibility. Thus the effectiveness of demonstration of the LMFBR technology in a utility environment is better at the Clinch River site than at Hanford, Savannah River, or INEL.

(9) The Applicants have provided additional estimates of delay costs for the project in the November 30, 1981 Site Preparation Activities Report, the January 18, 1982 Applicant's Answer to Questions Set Forth in Attachment A to the Commission's December 24, 1981 Order (Question/Answer 9(a), (Costs)), and the January 28, 1982 Applicant's Response to NRDC and Tennessee Attorney General Comments. These analyses considered only delay of construction at the Clinch River site but generally support the expected dramatic increase in cost that would result from relocating the LMFBR Demonstration Plant from the Clinch River site.

(10) LMFBR Program Environmental Impact Statement Supplement, DOE/EIS-0085-D, Section IV.

4. Risk

In Appendix E an evaluation of the relative potential consequences associated with postulated severe accidents was made to determine whether a significant reduction in consequences would result at any of the alternative sites as compared to Clinch River. The basic results, which remain valid, showed that the consequences, and hence the risks, associated with all design basis accidents at CRBRP are less than those associated with natural background radiation. Although the analysis also showed that the more favorable atmospheric dispersion characteristics and population distribution at Hanford, Savannah River, or INEL further reduced these consequences by approximately a factor of 50, the predominance of natural background radiation indicates that an insignificant reduction in real environmental impact would result for any of the three sites as compared to Clinch River. For additional information on this analysis and a discussion on how the requirements and design features of CRBRP will ensure that risks associated with accidents beyond the design basis are sufficiently low, and are comparable to LWRs, see Appendix E, pages E-33 to E-40.

Therefore, the Project, after careful consideration of the cost, benefits, effectiveness, and risks associated with the alternative sites, believe that the reduced environmental impacts of accidents for the alternative sites are still substantially outweighed by the lesser costs, greater benefits, and enhanced effectiveness of the demonstration in a utility environment for the Clinch River site. A summary of the key reconfirmed finding is illustrated on Table 9. Thus, it is concluded that Clinch River is the preferred site and certainly neither Hanford, Savannah River, nor INEL represent substantially better alternatives for satisfying LMFBR program information goals.

TABLE 9

SUMMARY OF ALTERNATIVE SITE COMPARISONS

	Clinch River	Hanford	Idaho	Savannah River
Support Completion as Expeditiously as Possible	Yes	No	No	No
Demonstration in Utility Environment?				
a. Licensing	Representative of typical utility site	(These sites are atypically remote and may not establish clearly the licensability in a typical utility environment)		
b. Utility Participation	TVA operator maximum utility participation	(Utility participation unknowable but unlikely)		
Congressional Authorization	Exists	(Requires transitional legislation and Project arrangement approval)		
Cost	Reference	$1588M	$1644M	$835M
Schedule	Reference	(43 months delay from the decision to relocate)		
Program Benefit	Reference	(LMFBR Program benefits greatly diminished or lost)		
Environmental Impacts of Accidents	Below Natural Background	(No significant improvement)		

4.0 SUMMARY AND CONCLUSIONS

The results of this review and update of the Environmental Report supplemental alternative siting analyses contained in Appendixes D and E have shown that the previous conclusions reached have remained unchanged. In summary these conclusions are:

1. The two TVA owned sites located outside the TVA power service area, one of which is in the process of being sold, are clearly not substantially better than the Clinch River site.

2. Neither the concepts of underground siting nor co-location with an LMFBR fuel reprocessing or fuel fabrication plant offers tangible improvement in the safety, environmental acceptability, safeguards, or economics of the LMFBR Demonstration Plant.

3. That among all U. S. Government real property presently in the custody of DOE, the Hanford, Savannah River, and Idaho National Engineering Laboratory (INEL) sites are acceptable candidate sites for the LMFBR Demonstration Plant but that none of the three is a satisfactory alternative for meeting the pertinent LMFBR program and project objectives of timing and utility participation. Furthermore, even if it were hypothesized for the purposes of analysis that the Hanford, Savannah River, and INEL sites were satisfactory alternatives for meeting these objectives, it is clear that they do not represent substantially better alternatives for meeting the pertinent LMFBR program and project objectives. In fact, upon consideration and balancing of the relative costs, benefits, effectiveness, and risks associated with Hanford, Savannah River, INEL and Clinch River, it is clear that Clinch River remains as the preferred plant location.

EXHIBIT I

public power council
500 W. Eighth Street · Suite 110
Vancouver, WA 98660
(206) 694-8593
(503) 241-3163

February 16, 1982

Mr. William Rolf
Project Management Corporation
Clinch River Breeder Reactor Project
P.O. Box U
Oak Ridge, Tennessee 37830

RE: Use of Hanford, Washington Site for LMPBR Demonstration Plant

Dear Mr. Rolf:

This letter will confirm that Pacific Northwest consumer owned utilities are not prepared to assume the project manager or owner role for a LMFBR demonstration plant at Hanford. Today, therefore, the Public Power Council Executive Committee agreed that the Clinch River site is the most appropriate location.

Very truly yours,

Robert M. Greening, Jr.

Robert M. Greening, Jr.
Manager

RMG:esn

EXHIBIT II

DUKE POWER COMPANY
P. O. BOX 33189
CHARLOTTE, N. C. 28242

CARL HORN, JR.
CHAIRMAN OF THE BOARD &
CHIEF EXECUTIVE OFFICER
(704) 373-4984

WILLIAM S. LEE
PRESIDENT &
CHIEF OPERATING OFFICER
(704) 373-4283

January 26, 1982

Mr William F Rolf
General Manager
Project Management Corp
P O Box O
Oak Ridge, Tennessee 37830

Dear Bill:

As expressed in my letters of November 4 and December 1, 1976, I do not feel that the Savanah River Reservation is currently a viable site for the breeder demonstration plant.

Sincerely,

WSLee

W S Lee

WSL/s

cc Mr Lawrence J Kripps
Energy, Inc

AMENDMENT XV
JULY 1982

DUKE POWER COMPANY

POWER BUILDING, BOX 2178, CHARLOTTE, N. C. 28242

WILLIAM S. LEE
EXECUTIVE VICE PRESIDENT

(704) 373-4083

November 4, 1976

Mr Peter Van Nort
General Manager
Project Management Corporation
P O Box U
Oak Ridge, Tennessee 37830

Dear Peter:

As plans for the breeder demonstration project were being formulated in 1971 and 1972, B B Parker served on the AEC's Senior Utility Steering Committee and I served on their Senior Utility Technical Advisory Panel. On several occasions during this period, we at Duke considered the possibility of a site for the breeder demonstration plant on the Savannah River Reservation now under ERDA's management. This Reservation is in South Carolina and contiguous to the territory of South Carolina Electric and Gas but not far from Duke Power's system with its heavy transmission grid interconnecting with a number of southeast utilities.

Because of Duke's extensive nuclear experience at that time and our proximity to that site, it was our feeling that for that site to be eligible, Duke would have to be in a position to participate in operating the plant and to provide substantial technical input for the project to be successful. At that time, our engineering, construction and operating personnel were busily engaged in trying to complete and bring in service the three Oconee units, we had begun building the two McGuire units and had committed the two Catawba units, all of which were being designed and built by Duke personnel. Under these circumstances, we were not in a position to undertake a leadership role that we felt would have been necessary for the Savannah River site to be a viable option.

At the joint meeting of the Steering Committee and the Advisory Panel on May 26, 1971, I advised the group that Duke's other commitments in the nuclear field were so demanding of our talents and energies that the Savannah River site should not be a candidate for the first demonstration plant. Bill Parker had checked by telephone with the top officers of our neighboring utilities who concurred in this conclusion. He reported at the same joint meeting on May 26 that the five principal companies in this part of the southeast could not constitute a utility-owner-operator group for locating the demonstration plant on any of the five systems. Attached is a copy of his letter of June 1, 1971, to the presidents of our four neighboring utility systems confirming his telephone survey with them and his report at the May 26 joint meeting.

At that time, the other companies were also involved in new nuclear commitments, and it was apparent to us that we could not jeopardize our own nuclear undertakings by also providing the leadership that we felt would have been necessary to make the Savannah River site a viable option to demonstrate a breeder operating as a part of a utility system.

Yours very truly,

Bill

W S Lee

WSL/s

atta

cc w/atta: Mr Ruble Thomas, Southern Services
Mr B B Parker
Mr George Edgar, Attorney, Washington, D C

DUKE POWER COMPANY
POWER BUILDING
422 SOUTH CHURCH STREET, CHARLOTTE, N. C. 28201

B. B. PARKER
EXECUTIVE VICE PRESIDENT
& GENERAL MANAGER

June 1, 1971

P. O. BOX 2178

Mr. Shearon Harris, President
Carolina Power & Light Company
P. O. Box 1551
Raleigh, North Carolina 27602

Mr. T. Justin Moore, Jr., President
Virginia Electric and Power Company
P. O. Box 1194
Richmond, Virginia 23209

Mr. Alvin W. Vogtle, Jr., President
The Southern Company
3390 Peachtree Road, N. E.
Atlanta, Georgia 30326

Mr. A. M. Williams, Jr., President
South Carolina Electric & Gas Company
P. O. Box 764
Columbia, South Carolina 29202

Gentlemen:

As you are aware, I have been appointed to a Senior Utility Steering Committee of the AEC and Bill Lee has been appointed to a Senior Utility Technical Advisory Panel to advise and assist the AEC in developing an acceptable Fast Breeder Program.

The first meeting of these groups was scheduled on April 28 with the AEC, but neither Bill nor I could attend. I learned through Don Crawford on Friday, May 21, that it was my responsibility to determine the interest of the Southeast Utilities in the possibility of locating the Fast Breeder Plant in the Southeast and particularly to look at the possibility of one being located on the Savannah River site.

We, at Duke Power, decided that we do not have the manpower to join with other Southeast Utilities in providing the manpower, talent and expertise to join with other utilities as the owner-operators of a Fast Breeder Plant. We made a quick telephone survey and received essentially the same response from each of your companies.

Mr. Shearon Harris, President
Mr. T. Justin Moore, Jr., President
Mr. Alvin W. Vogtle, Jr., President
Mr. A. M. Williams, Jr., President

I would like to report to you that in a joint meeting of these two panels in Washington with the AEC on May 26, I informed the group that insofar as our five companies are concerned, we could not, at this time, constitute a utility-owner operator group for locating this fast breeder plant on any of our systems. I would like to point out, however, that this matter is still open for further consideration if any of you so desire.

Sincerely,

Bill

bp/ck

copy: Mr. J. A. Jones
Mr. E. B. Crutchfield
Mr. V. C. Summer
Mr. W. S. Lee

DUKE POWER COMPANY

POWER BUILDING, BOX 2178, CHARLOTTE, N. C. 28242

WILLIAM S. LEE
EXECUTIVE VICE PRESIDENT

(704) 373-4183

December 1, 1976

Mr Peter Van Nort
General Manager
Project Management Corporation
P O Box U
Oak Ridge, Tennessee 37830

Dear Peter:

My letter of November 4 outlined the factors in our 1971 and 1972 determination that the Savannah River Reservation was not, in our opinion, a viable site for the breeder demonstration plant. The reasons as stated in my letter apply equally today, and we therefore do not feel that that site is a viable alternative to the Clinch River site.

Sincerely yours,

Bill

W S Lee

WSL/s

APPENDIX G

UPDATE TO THE CRBRP ALTERNATIVE SITING ANALYSIS WITHIN THE TVA POWER SERVICE AREA

UPDATE TO THE CRBRP ALTERNATIVE SITING ANALYSIS WITHIN THE TVA POWER SERVICE AREA

1.0 BACKGROUND AND INTRODUCTION

The alternative siting analysis for the CRBRP is presented in Section 9.2 of the CRBRP Environmental Report. The choice of the TVA power service area as the region of interest for this analysis was inherent in the selection by AEC of the TVA/Commonwealth Edison proposal for a cooperative AEC/utility arrangement to design, construct, and operate the nation's first large-scale demonstration LMFBR.[1] The alternative siting analysis in Environmental Report Section 9.2 was conducted in accordance with 10 CFR Part 51 and Regulatory Guide 4.2. The conclusion reached in Environmental Report Section 9.2, after careful consideration of both hook-on arrangements at existing TVA plants and an entirely new plant at undeveloped candidate sites, was that an all new plant located at the Clinch River site was the preferred choice for the LMFBR Demonstration Plant. In response to admittance by the NRC Commissioners of an NRDC contention concerning the CRBRP Project's alternative siting analysis and a subsequent NRC request for additional information, the Project provided in Environmental Report Appendixes D and E an analysis of alternative sites outside the TVA power service area and the concepts of underground siting and co-location with an LMFBR fuel reprocessing or fuel fabrication plant. The conclusion reached from this supplemental alternative siting analysis was again that the Clinch River site was the preferred site for the LMFBR Demonstration Plant.

Based on the Project's alternative siting analyses and their own independent analyses, the NRC staff in the Final Environmental

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[1] See CRBRP Environmental Report Section 9.2 and Appendix D, Section 1.0 for additional information concerning the history and selection of an AEC/utility arrangement for the design, construction, and operation of the LMFBR Demonstration Plant.

Statement for CRBRP, dated February 1977, concluded "....that the applicant's preferred proposal, utilizing the Clinch River site, is reasonable and that no substantially better alternative is available." The choice of the Clinch River site for the LMFBR Demonstration Plant has also been confirmed by DOE's LMFBR Program Supplemental Environmental Impact Statement.[2] In addition, it is important to point out that the Clinch River site environmental and safety analyses, completed subsequent to the Project's selection of the Clinch River site, have demonstrated that the Clinch River site is an acceptable site for construction of the CRBRP.[3]

Following the restart of NRC's CRBRP licensing review in the fall of 1981, NRC requested additional information to update the Project's alternative siting analyses presented in the Environmental Report. The requested update to Environmental Report Appendixes D and E, consisting of a reexamination of the previous analysis of alternative DOE sites, TVA owned sites outside the TVA power service area, and the concepts of underground siting and co-location with an LMFBR fuel reprocessing or fuel fabrication plant, is contained in Environmental Report Appendix F. This appendix provides the additional NRC requested information to update the Environmental Report alternative siting analysis presented in Environmental Report Section 9.2 and Appendix A considering the TVA power service area as the region of interest.

NRC's request for additional information specifically requested that the previous assessment in Environmental Report Section 9.2 be

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[2] See the LMFBR Program Supplemental Environmental Impact Statement, DOE/EIS-0085-D, Appendix G.

[3] See the CRBRP Environmental Report and Preliminary Safety Analysis Report (PSAR) and NRC's Final Environmental Statement (February 1977) and Site Suitability Report (March 4, 1977) for CRBRP

reviewed in the context of NRC's Proposed Rule on Alternative Sites (45 FR 24168-24178, April 9, 1980). To best accommodate this request, this update has been organized along the lines of the alternative site review process described in the Proposed Rule. Thus, Section 2.0 discusses the acceptability of the TVA power service area as the region of interest, Section 3.0 confirms that the Project has selected for consideration a slate of candidate sites that provides reasonable representation of the diversity of land and water resources within the region of interest and includes sites that are among the best that could reasonably be found, and Section 4.0 reexamines the comparison of the Clinch River site with alternative sites considering both environmental and project economic, technology, and institutional factors. The conclusion, in light of the Proposed Rule and current information, that the Clinch River site is the preferred site for the LMFBR Demonstration Plant is summarized in Section 5.0.

2.0 REGION OF INTEREST

The preamble to NRC's Proposed Rule on Alternative Sites states that the region of interest should be determined on the basis of environmental diversity such that "a substantial range of environmental alternatives from which to choose in making the final siting decision" is provided. "For the purpose of determining the region of interest, environmental diversity," according to the Proposed Rule, "refers to the types of water bodies available within the region (upper and lower reaches of large rivers, small rivers, lakes, bays, and oceans) and the associated physiographic units."

The region of interest for the LMFBR Demonstration Plant siting assessment presented in CRBRP Environmental Report Section 9.2 was considered to be the TVA power service area. As can be seen in Figure 1, the region of interest includes several rivers ranging in size from small, e.g., the Duck and Elk, up to rather large rivers, e.g., the Tennessee, Mississippi, and Ohio. Additionally, the water bodies vary from free flowing to impounded lakes, and for many rivers include an area from their headwaters to their mouths. Physiographic units associated with these rivers include coastal plains, interior low plateaus, the Appalachian Plateau, valley and ridge, and Blue Ridge. Based upon these features, the area TVA serves well qualifies it as an acceptable region of interest.

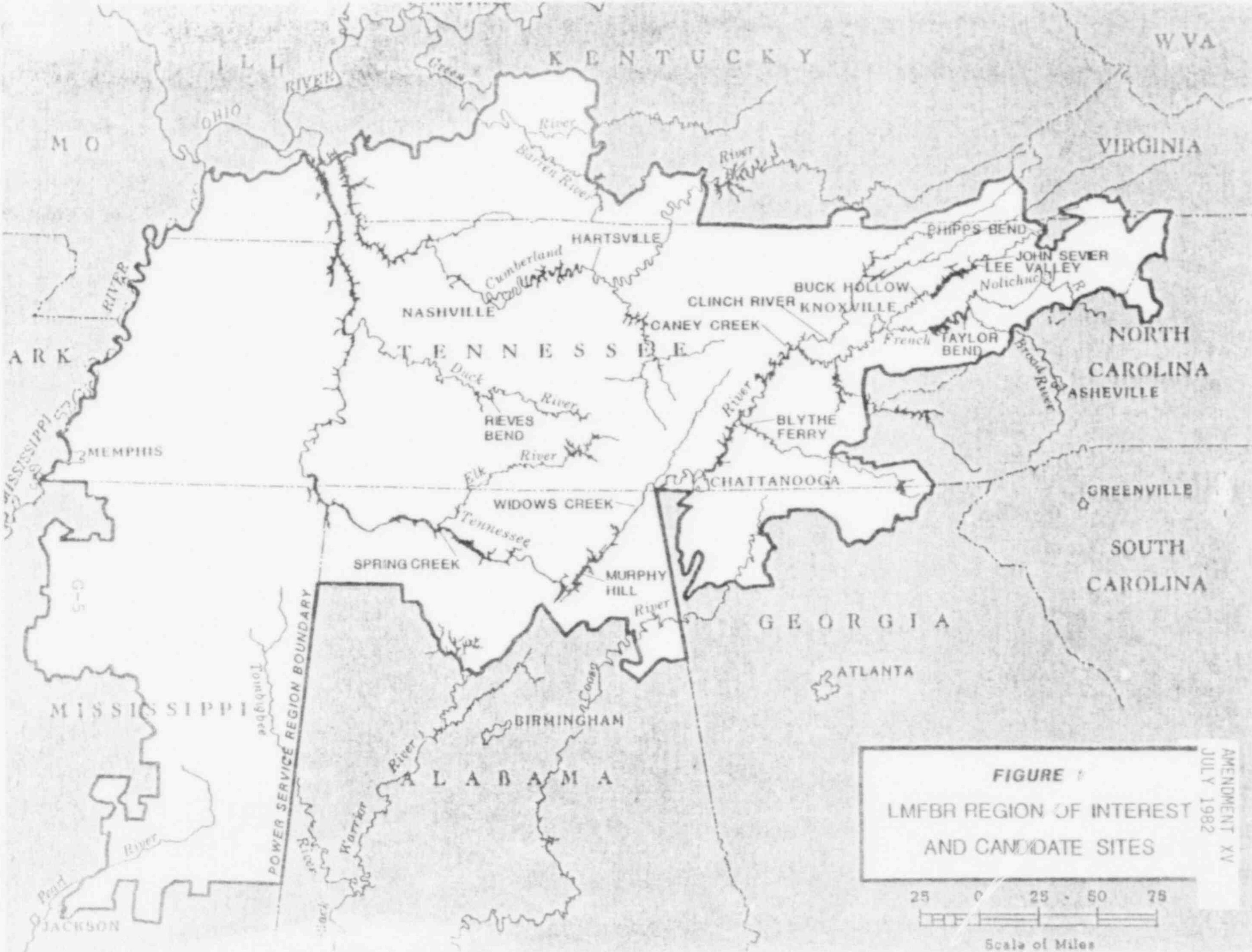

FIGURE 1

LMFBR REGION OF INTEREST AND CANDIDATE SITES

AMENDMENT XV
JULY 1982

3.0 SELECTION OF CANDIDATE SITES

In terms of the NRC Proposed Rule On Alternative Sites, the original siting assessment in CRBRP Environmental Report Section 9.2 undertook a product-oriented approach which focused upon the individual qualities of each proposed site. Under this product-oriented approach the Proposed Rule requires (a) that candidate sites be selected "from the region of interest to provide reasonable representation of the diversity of land and water resources within the region of interest," and (b) that each site meet specific threshold criteria. A review of the selection of candidate sites in the original assessment versus the new requirements of the Proposed Rule is provided in this section along with a discussion of other potential siting options suggested in NRC's request for additional information dated November 30, 1981.

Within the region of interest, (i.e., the TVA power service area) the original siting assessment considered all TVA steam plants for a possible hook-on arrangement which were expected to be operational on a time schedule consistent with the planned operation of the LMFBR Demonstration Plant (see Environmental Report Table 9.2-1) and 109 "new" sites for an entirely new plant. These hook-on and new sites were on or near certain rivers in the Tennessee and Cumberland River basins.[4] These rivers are identified in Table 1 and are classified in terms of environmental diversity. As this table shows, these rivers and their associated physiographic units, and therefore, sites along them, are consistent with the concept of environmental diversity as discussed in the Proposed Rule.

The slate of 13 candidate sites identified in Environmental Report Section 9.2 and Appendix A was derived from the above set of hook-on

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[4] Although the Thomas H. Allen Steam Plant and the Shawnee Steam Plant are located on the Mississippi and Ohio Rivers, respectively, these plants along with the Johnsonville Steam Plant were dismissed as hook-on candidates, because of the seismic design uncertainty in the western end of the TVA system at the time of the original siting assessment (see Environmental Report Section 9.2.2, page 9.2-4). Therefore, these two rivers are omitted from this discussion.

TABLE I

CLASSIFICATION OF RIVERS WHERE SITES WERE CONSIDERED FOR THE LMFBR DEMONSTRATION IN TERMS OF ENVIRONMENTAL DIVERSITY

River	River Type	Associated Physiographic Units
Tennessee	Large, impounded	Originates in valley and ridge and flows through Cumberland Plateau and interior low plateau to coastal plain
Duck	Small, impounded	Interior low plateau
Sequatchie	Small, headwater	Appalachian Plateau
Clinch	Medium to small, impounded, headwaters	Valley and ridge
Emory	Small, impounded, headwaters	Valley and ridge
Little Tennessee	Small, impounded, headwaters	Originates in Blue Ridge and flows to valley and ridge
Tellico	Small, headwater	Originates in Blue Ridge and flows to valley and ridge
Holston	Medium to small, impounded, headwaters	Valley and ridge
French Broad	Medium, impounded, headwaters	Originates in Blue Ridge and flows to valley and ridge
Nolichucky	Small, impounded, headwaters	Originates in Blue Ridge and flows to valley and ridge
Cumberland River Basin		
Cumberland	Large to medium, impounded	Originates in interior low plateau and flows to coastal plain
Red	Small, headwater	Interior low plateau
Caney Fork	Small, impounded, headwater	Interior low plateau

and new sites on the basis of engineering and environmental assessments. As can be seen from Figure 1 and Table 2, the 13 candidate sites adequately reflect the environmental diversity in the region of interest (i.e., the TVA power service area).

The second requirement of candidate sites stated in the Proposed Rule is that each candidate site should meet the threshold criteria stated in Section VI.2.b. When reviewed in terms of information present at the time of the original assessment, all of the 13 candidate sites meet the threshold criteria with the exception of the Rieves Bend site which would not have met criteria one, four, and eight concerning consumptive water use, discharge of effluents and additional environmental concerns significantly impacting project costs and/or permit ability, respectively (see Environmental Report Appendix A Sections 11.3.2.3 and 11.3.2.4, pages A-173 and -174). However, the Rieves Bend site could have been excluded as a candidate site without diminishing in any way the representative environmental diversity exemplified by the remaining 12 candidate sites.

The slate of candidate sites[5] was also reviewed in terms of the threshold criteria after having considered appropriate current information. Current information did not adversely affect any site's ability to meet the threshold criteria. It should be noted, however, that the following information concerning the sites was not available at the time of the earlier assessment.

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[5] The John Sevier and Widows Creek sites were not included as candidate sites in this updated assessment since the Project is no longer considering a hook-on arrangement at these sites (see Question/Response 320.1R provided in Amendment XV to the Environmental Report).

TABLE 2

CANDIDATE SITES

Site	River	River Type	Physiographic Character
Spring Creek	Tennessee	Large, impounded	Interior low plateau
Blythe Ferry	Tennessee	Large, impounded	Valley and ridge
Caney Creek	Tennessee	Large, impounded	Valley and ridge
Clinch River	Clinch	Small, riverine, impounded	Valley and ridge
Taylor Bend	French Broad	Small, impounded, headwater	Valley and ridge
Buck Hollow	Holston	Medium, headwater	Valley and ridge
Phipps Bend	Holston	Medium, headwater	Valley and ridge
Lee Valley	Holston	Medium, headwater	Valley and ridge
Murphy Hill	Tennessee	Large, impounded	Appalachian Plateau
Johntown (Hartsville)	Cumberland	Medium, riverine, impounded	Interior low plateau
Rieves Bend	Duck	Small, potentially impounded	Interior low plateau
John Sevier	Holston	Medium, impounded, headwater	Valley and ridge
Widows Creek	Tennessee	Large, impounded	Appalachian Plateau

1. The probable maximum flood elevation has been redefined for several of the sites, but the associated design changes and additional costs that would result would be within five percent of overall project cost as discussed in threshold criterion number eight.

2. A coal gasification plant is under construction on the Murphy Hill site.

3. Light water nuclear plants are under construction at the Hartsville (Johntown) and Phipps Bend sites.

The conclusion, based on this review of the candidate sites presented in Environmental Report Section 9.2 and Appendix A is that the original siting assessment meets the Proposed Rule Section VI.2 requirements for selection of candidate sites, i.e., that a sufficient number of candidate sites that meet the threshold criteria were identified to reasonably represent the environmental diversity of the TVA power service area.

In addition to the request to review the previous site selection process in light of the Proposed Rule's requirements and currently available information, NRC also asked several specific questions requesting (1) the rationale and supporting information for exclusion of potential candidate sites along the Mississippi, the Ohio (at or in the vicinity of the Shawnee Steam Plant), the Tombigbee, the Black Warrior, the Coosa, the Green, the Barren, and the Pearl Rivers; (2) reconsideration of the possible use of planned or existing power plant sites, including Phipps Bend, Hartsville, Yellow Creek, Watts Bar, Browns Ferry, Sequoyah, and Bellefonte; (3) whether an all new LMFBR Demonstration Plant could be built at the hook-on sites previously compared to the proposed Clinch River site; and (4) whether another suitable candidate site exists on the Clinch River including the possibility of locating an all new LMFBR Demonstration Plant at the Bull Run or Kingston Steam Plant sites.

In response to the first question, the Mississippi River and the Ohio River near the Shawnee Steam Plant were excluded because of the seismic design uncertainty due to their proximity to the New Madrid seismic zone. The Green, Pearl, Barren, Coosa, Tombigbee, and Black Warrior Rivers were excluded because only their headwaters are located in the region of interest and these headwater areas did not appear to exhibit adequate cooling water capabilities, i.e., siting opportunities. Additionally, since other small rivers with similar physiographic characteristics were considered, there is fully adequate environmental diversity despite the absence of these rivers.

Questions 2, 3, and 4 all suggest the co-location of the LMFBR Demonstration Plant with planned or existing TVA power plants. The Project has not considered the viability from an engineering standpoint of siting an all new plant at an existing or planned TVA power plant site since the Project has identified a sufficient number of new (i.e., undeveloped) candidate sites that meet all the selection requirements of the Proposed Rule. Therefore, there is no need for consideration of co-location alternatives.

The fourth NRC question above asks if another suitable candidate site exists on the Clinch River. While we recognize that the Proposed Rule suggests that one of the alternative sites have the same water source as the proposed site, TVA's siting studies have not identified any other potential site on the Clinch River suitable for location of a nuclear power plant.[6]

In summary then, the Project, in response to NRC's request for additional information (Question 750.2R), has identified, based on a review of the original siting assessment presented in Environmental Report Section 9.2 and Appendix A, ten candidate sites that provide reasonable representation of the diversity of land and water resources within the region of interest, each of which meets the eight threshold criteria of Section VI.2.b of the Proposed Rule. These ten candidate sites are Spring Creek, Blythe Ferry, Caney Creek, Clinch River, Taylor Bend, Buck Hollow, Phipps Bend, Lee Valley, Murphy Hill, and Hartsville (Johntown). To this list the Project, for purposes of the environmental evaluation, in Section 4.0, has added Yellow Creek. Yellow Creek is a representative site of the western area of the TVA power service area where at the time of the original LMFBR Demonstration Plant siting assessment, nuclear power facilities had been restricted due to unresolved questions about regional seismic activities and uncertainties in licensing a nuclear power plant there. However, in June 1972 TVA submitted to the AEC for

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[6] TVA has conducted siting studies to identify sites in the northeastern portion of the TVA system encompassing the Clinch River system. During the course of these studies, 34 potential sites were identified and examined of which 13 were located on the Clinch River or Norris Reservoir. Six of these sites were specifically included in the 109 new sites that were reviewed for the LMFBR Demonstration Plant siting assessment. Upon further examination, it was determined that none of the sites in the Clinch River system except the proposed Clinch River site met the engineering requirements of a large power plant. Among the reasons for elimination were poor foundation conditions, water supply, flooding potential, and environmental factors, such as proximity to wildlife and recreational areas (see TVA's "Site Evaluation Report, Nuclear Units X21-22, X24-25," dated February 1975).

its review a report, "Relationships of Earthquakes and Geology in West Tennessee and Adjacent Areas,"[7] and in November 1973 TVA received a favorable letter from the ACRS on the findings presented in this report. As a result, TVA believed it could gain NRC's approval for a site in TVA's western area upstream of Tennessee River mile (TRM) 170. This has been confirmed by the NRC's granting a construction permit for the Yellow Creek Nuclear Plant.

Note: Although the Project chose in Section 4.0 to compare all eleven candidate sites (i.e., the proposed Clinch River site and the ten alternative candidate sites), a smaller number of candidate sites could have been chosen which still fully represent the environmental diversity of the region of interest (i.e., the TVA power service area). The Hartsville, Murphy Hill, Phipps Bend, and Yellow Creek sites, about which more information is available than any of the other alternative candidate sites, would form such an acceptable set of candidate sites. This is true because, these four sites meet the eight threshold criteria of the Proposed Rule and are representative of the environmental diversity of the TVA power service area since: the Hartsville site represents a medium impounded river in the interior low plateau; the Murphy Hill site represents a large river in the Applachian plateau; the Phipps Bend site represents the headwaters of a medium river in the valley and ridge; and Yellow Creek represents a large river in the coastal plain.

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[7] Relationships of Earthquakes and Geology in West Tennessee and Adjacent Areas, Dr. Richard G. Stearns and Dr. Charles W. Wilson, Jr., Department of Geology, Vanderbilt University, U.S. TVA, June 1972.

4.0 COMPARISON OF THE CLINCH RIVER SITE WITH ALTERNATIVE SITES

The Proposed Rule For Alternative Sites states:

> The NRC will determine obvious superiority among the candidate sites by a sequential two-part analytical test. The first part gives primary consideration to hydrology, water quality, aquatic biological resources, terrestrial resources, water and land use, socioeconomics, and population to determine whether any alternative sites are environmentally preferred to the proposed site. The second part overlays consideration of project economics, technology, and institutional factors to determine whether, if such an environmentally preferred site exists, such a site is, in fact, an obviously superior site.

In accordance with the first part of the Proposed Rule's sequential two-part analytical test, Section 4.1 compares the eleven candidate sites identified in Section 3.0 (i.e., the proposed Clinch River site and the ten alternative candidate sites) considering environmental factors. Even though Section 4.1 finds that none of the ten alternative candidate sites is environmentally preferable to the Clinch River site, Section 4.2 discusses and demonstrates that even had an environmentally preferred site been identified, the second part of the Proposed Rule's two-part test for obvious superiority would show that consideration of project economics and institutional factors (i.e., the LMFBR program timing objective) would lead to a finding that no alternative site is an obviously superior site to the preferred Clinch River site.

4.1 Environmental Preferability Test

The original siting analysis presented in Environmental Report Section 9.2 and Appendix A compared each of the original 13 candidate sites (See Table 2) in terms of not only environmental factors but also with regard to economic and engineering characteristics (i.e., access facilities, transmission facilities, geology (foundation conditions), seismology, hydrology (flooding), and meteorology). The Project has reexamined the Environmental Report Section 9.2 and Appendix A siting analysis and concluded that the addition of current information for the most part indicates that the data used in the original assessment remain applicable today except for the changes previously noted in Section 3.0. Thus, the addition of applicable current information would not change the previous conclusion that the Clinch River site is the preferred site for the LMFBR Demonstration Plant.

In addition to the above reexamination of the previous siting assessment, the Project has conducted a separate analysis comparing only the environmental siting characteristics of the eleven candidate sites that were identified in Section 3.0. These eleven sites are the proposed Clinch River site and the ten alternative candidate sites of Spring Creek, Blythe Ferry, Caney Creek, Taylor Bend, Buck Hollow, Phipps Bend, Lee Valley, Murphy Hill, Hartsville, and Yellow Creek. This new analysis was done in accordance with the first part of the Proposed Rule's sequential two-part analytical test giving primary consideration to hydrology, water quality, aquatic biological resources, terrestrial resources, water and land use, socioeconomics. and population to determine if any of the ten alternative candidate sites are environmentally preferred to the proposed Clinch River site. Attachment I discusses and summarizes the results of this environmental comparison. The conclusion of the Attachment I assessment substantiates all of the previous siting analyses by finding that none of the ten alternative candidate sites examined are judged to be environmentally preferred to the Clinch River site.

During the NRC staff's review of the Clinch River site following the renewal of CRBRP licensing in the fall of 1981 a number of new issues have been raised by the staff that could impact the above findings. These issues are separately addressed in the following subsections. These issues concern (1) the U.S. Fish and Wildlife notification to NRC that 11 species of endangered freshwater mussels may be present in the vicinity of the Clinch River site (see NRC Question 290.11R) and (2) the possible impact on striped bass (*Morone saxatilis*) by CRBRP thermal discharges during a postulated period of extended no Clinch River flow at the CRBRP site during the hot summer and fall months.

4.1.1 Endangered Freshwater Mussels

In its November 30, 1981, request to the Project for additional information for environmental review of the CRBRP application, NRC asked for all available information concerning the possible presence of 11 species of endangered freshwater mussels in the vicinity of the Clinch River site (Question 290.11R). The response to this question is provided in Amendment XV to the Environmental Report. The response concluded that due to the limited amount of suitable substrate and the failure of several surveys to encounter significant mussel populations, the potential for the occurrence of endangered mussels in the vicinity of the Clinch River site is remote. The Project has, however, committed to conducting a survey of freshwater mussels in the vicinity of the Clinch River site in order to determine whether a significant population of endangered freshwater mussels is located in the Clinch River near the CRBRP site. A description of the proposed survey is enclosed as Attachment II. The survey will be performed when water clarity and flow conditions are optimal which means, based on historical conditions, the survey should be performed sometime in June 1982. A full report covering the survey and its evaluation will be prepared and provided to NRC.

Therefore, based on the information provided by the Project in the response to NRC Question 290.11R, there is no reason to believe that a significant population of any of the suggested 11 species of endangered freshwater mussels is present in the vicinity of the Clinch River site. Thus, the concern regarding the presence of endangered freshwater mussels should not be a factor in determining whether an alternative site is environmentally preferable to the Clinch River site.

4.1.2 Clinch River No-Flow Conditions

The Environmental Report in Section 2.5.1.3 discusses that historical low flows at the Clinch River site have resulted from regulated rather than from natural flows because the Tennessee River and Clinch River are "controlled" rivers. The two longest periods of no flow, 29 consecutive days in February and March 1966 and 11 consecutive days in April and May 1967, resulted from special reservoir operations conducted to aid in controlling the growth of Eurasian water milfoil in the Melton Hill Reservoir. As stated in the Environmental Report, such extended periods of zero flow from Melton Hill Dam are not anticipated in the future and should the need arise for any regulation at Melton Hill Dam which would result in long periods of zero release, the operations would be coordinated to meet flow requirements at the CRBRP site.

Recognizing the potential no flow characteristics of the Clinch River at the CRBRP site, the Project performed thermal-hydraulic modeling studies of the CRBRP discharge in order to assess the environmental impact of the CRBRP thermal discharges. The physical thermal-hydraulic and mathematical modeling investigations were performed by the University of Iowa, Institute of Hydraulic Research (Iowa Institute). A complete description of these studies and the results are presented in Appendixes A and B to Section 10.3 of the Environmental Report. A total of six cases were modeled: typical winter case, typical summer case, hypothetical winter extreme case, hypothetical summer extreme case, extended no flow winter case, and extended no flow summer case. Based on the results of the Iowa Institute work, the Environmental Report in Sections 5.1.2 and 5.1.3 discusses and concludes, respectively, that the CRBRP discharge will comply with the Draft NPDES permit thermal requirements and that aquatic life in the Clinch River will not be seriously impacted by the thermal effluent from the CRBRP. The latter conclusion was reached after individually looking at the various types of aquatic life including fish, benthos, periphyton, and planktonic species (i.e., phytoplankton, zooplankton, fish eggs, and larvae).

In the Final Environmental Statement for the CRBRP (February 1977), the NRC staff reviewed the Project's physical thermal-hydraulic and mathematical modeling and also presented the results of their own independent analysis of the thermal plume using a three dimensional model. The final conclusion reached concerning the thermal plume effects on the river biota was "In summary, the staff judges the impacts from the thermal discharges upon the aquatic biota to be insignificant."

Recently, as part of its continuing CRBRP review, the staff has indicated a concern for the possible impact CRBRP operation (i.e., thermal discharges) may have on striped bass (Morone saxatilis). The specific concern is whether any adverse impact could occur due to CRBRP operation in the hot summer and fall months when the adult striped bass are known to seek the cool thermal refuge of the Clinch River.[8,9] The following information is presented in response to this concern.

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[8] Letter, C. Coutant to M. Masnik, dated December 16, 1981.
[9] Cheek, T. E. 1982. Distribution and habitat selection of adult striped bass, Morone saxatilis (Walbaum), in Watts Bar Reservoir, Tennessee. Thesis, Tennessee Technological University.

As discussed above, the Environmental Report has analyzed the environmental impact of CRBRP thermal discharges for typical, hypothetical extreme, and extended no flow summer and winter cases that include conditions "more severe than those that would be anticipated during the lifetime of the facility." Since there is no need for a cool-water refuge during winter, only the summer cases will be reexamined here.

Maximum temperature rises at the river surface and bottom for the typical summer and hypothetical extreme summer cases are shown in Environment Report Table 5.1-2 and Figures 5.1-2 and 5.1-4. As can be seen, the maximum plant-induced temperature differential would be confined to a very small area.

During extended periods of no river flow at the site, thermal plume development is initiated. With cessation of flow past the plant, the plume begins to spread out across the river surface from the zone of near-field mixing. As this spreading proceeds, the amount of ambient water available for entrainment in the discharge jet diminishes and near-field dilution is reduced. Initially, plume temperature rises; however, as the surface area encompassed by the plume increases, heat loss to the atmosphere becomes an important transport mechanism. Eventually, with the plume extending across the full width of the channel for approximately two miles up- and downstream, a point is reached at which the surface area occupied is sufficiently large that the rate of heat loss through surface cooling is equal to the rate of heat addition at the discharge. A steady-state condition is thus attained and no further increases in either temperature or spatial extent are realized. As the plume occupies the surface layer of roughly one-third of pool depth, ambient water is present beneath it throughout its length. In the summer no-flow case, steady-state conditions are achieved in approximately 10 days. Maximum plume temperature rise in the transitional zone is 1.3°F. The plant-induced temperature rise decreases to 1°F after 3/4 mile in either direction and is further reduced to 0.5°F at upstream and downstream distances of 2 miles as shown in Environment Report Figure 5.1-6.

Under the very unlikely summertime worst case conditions extreme ambient temperatures (74°F or more) in the upper one-third of the river water column would be increased less than 1.3°F near the discharge and from 0.5 to 1.0°F within two miles of the discharge. The lower two-thirds of the water column would be unaffected. Thus, under worst case conditions, four miles of surface water will be heated 0.5 to 1.3°F above ambient. This compares with approximately 19 river miles between Melton Hill Dam and the confluence of the Clinch and Emory Rivers just upstream of the Kingston Steam Plant. Although striped bass may avoid the slightly warmer surface waters in the vicinity of the discharge, there is no basis for suggesting that the cool-water refuge will be significantly limited. Maximum surface temperature in the plume near the discharge under worst case hypothetical conditions would be less than 80°F; this is several degrees below the estimated lethal temperature for striped bass.[10,11,12,13]

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[10] Weddle, H. R., C. C. Coutant, and J. L. Wilson. 1980. Summer habitat selection of striped bass, Morone saxatilis in Cherokee Reservoir, Tennessee, 1977. Oak Ridge National Environmental Sciences Division Publication No. 1360. Oak Ridge, Tennessee 37830.

[11] Axon, J. R., 1979. An evaluation of striped bass introductions in Harrington Lake. Fisheries Bulletin of the Kentucky Department of Fish and Wildlife Resources, Bulletin No. 63.

[12] Schaich, B. A., and C. C. Coutant, 1980. A biotelemetry study of spring and summer habitat selection of striped bass in Cherokee Reservoir, Tennessee, 1973. Environmental Sciences Division Publication No. 1441. Oak Ridge, Tennessee 37830.

[13] Brungs, W. A., and B. R. Jones, 1977. Temperature criteria for freshwater fish: Protocol and procedures EPA-600/3-77-051. 130 p.

Since the warmer water will not penetrate the lower two-thirds of the water column, thermal blockage would not prevent striped bass from utilizing the five miles of river between the CRBRP site and Melton Hill Dam. Striped bass migrate past the Kingston Steam Plant which discharges up to 61 m^3/s of heated water into the Clinch River at CRM 3.0. Summer temperatures in the Clinch River near the Kingston Plant reached 82.8°F at the surface and 79.8°F at the bottom during a 1979 TVA study.[14] The fact that striped bass pass through this stretch of river, which is warmer than hypothetical worst case conditions at the CRBRP site, supports the conclusion that the CRBRP discharge will not prevent them from utilizing the five-mile stretch of river below Melton Hill Dam.

In summary, for the typical or hypothetical extreme summer cases, the thermal plume is so small that adverse effects on striped bass would not be expected. Under extended no flow conditions, the avoidance of surface waters in the immediate area of the discharge would not result in any significant adverse impacts.

In addition, TVA currently has studies underway at its Biothermal Research Station located at the Browns Ferry Nuclear Plant to determine lethal temperatures for adult and juvenile striped bass under controlled field conditions in the experimental outdoor channels at this facility. The preliminary results of this study are expected to be available in late 1982, and will provide

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[14] Craven, T. M., D. L. Dycus, and D. A. Tomljanovich. 1982. Responses of selected aquatic biota in Watts Bar Reservoir to thermal discharges from Kingston Steam-Electric Plant - 1978 and 1979. Draft report. Office of Natural Resources, Tennessee Valley Authority.

baseline information on the temperature tolerance of striped bass which would be applicable to the CRBRP site as well as other power plant sites. It is expected that the conclusion of this work will substantiate the above determination of no significant impact to the striped bass from operation of CRBRP.

However, additional more definitive assessments of the thermal discharges are also being pursued by the Project which include: (1) a statistical analysis of streamflow during the critical months of July through September; (2) a reevaluation of the thermal plume dispersion incorporating consideration of the discharge into a stratified water body; and (3) a review of alternative diffuser designs and two-dimensional modeling of the far field. This third step would be pursued only after consultation with TVA biologists if the results of the first two analyses indicate there is no suitable zone of passage for striped bass.

It is the Project's opinion that the results of the reevaluation of the hydrodynamics (including alternative diffuser designs, if necessary) and an updated biological assessment, including the results from the biothermal research project study on striped bass, will show there is no substantive concern with respect to the impact of CRBRP operation on the striped bass fishery in Watts Bar Reservoir. Under this condition, there would be no need for streamflows from Melton Hill Dam to be altered to assure protection of the striped bass.

In the unlikely event that all of the above efforts fail to show that CRBRP thermal discharge will have no significant impact on the striped bass thermal refuge, appropriate restrictions upon thermal discharge from the CRBRP during periods when the river water temperature is high and zero flow conditions exist will be imposed.

Based on the above, sufficient assurance is provided that there will be no significant impact on striped bass due to CRBRP thermal discharges. Therefore, the NRC concern with possible no flow conditions at the CRBRP site should not be a factor in determining whether another alternative site is environmentally preferable to the Clinch River site.

4.2 Project Economics, Technology, and Institutional Factors

Section 4.1 addressed the first part of the Proposed Rule's two-part analytical test requiring comparison of the proposed site with alternative sites and concluded that none of the ten alternative candidate sites is environmentally preferable to the Clinch River site. Notwithstanding the Section 4.1 findings, this section addresses the second part of the two-part analytical test that examines project economics, technology, and institutional factors. The important project economic, technology, and institutional factors affected by the selection of the site for the LMFBR Demonstration Plant are schedule impacts, project cost, and utility participation, all of which are discussed in the following subsections.

4.2.1 Schedule Impacts

In the LMFBR Program Supplemental Environmental Impact Statement (DOE/EIS-0085-D) the timing objective for the LMFBR Demonstration Plant (CRBRP) is that it should be completed as expeditiously as possible. While this objective can be met at the Clinch River site, a decision to relocate the LMFBR Demonstration Plant at another site within the TVA power service area would have the same schedule impact discussed in Environmental Report Appendix E for relocation to either Hanford, Savannah River, or INEL, i.e., a bare minimum delay of 33 months or a more probable delay of 43 months or more starting from the time a decision was made to change sites. There are two basic sources of this delay:

1. The impact upon existing Project arrangements and authorizing legislation,[15] and

2. The impact upon schedules for the preparation of design and licensing information and issuance by NRC of an environmental statement and a site suitability report to reach today's stage of the CRBRP licensing process.

A detailed discussion of the basis for the 33 and 43 month delay estimates is provided in Appendix E of the Environmental Report (pages E-13 to E-19). The only difference to the Appendix E discussion for relocation to a site outside the TVA system to relocation to a site inside the TVA system is that for the limited purpose of this analysis the assumption is made that TVA would still be willing to operate the plant as part of its system, buy the electric power generated by the plant, and possibly purchase the plant at the conclusion of the demonstration period, and that the CRBRP Project Office would not be relocated.

On the basis of a delay of this magnitude, it is clear that relocation of the LMFBR Demonstration Plant to any alternative site within the TVA power service area would prevent accomplishing the LMFBR program timing objective (i.e., constructing and operating an LMFBR Demonstration Plant as expeditiously as possible).

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[15] It should be noted that relocating the LMFBR Demonstration Plant within the TVA power service area would have the same impact on project arrangements and authorization as relocating the LMFBR Demonstration Plant to the Hanford, Savannah River, or INEL sites because both the Project arrangements and authorization specifically contemplate location of the project at the Clinch River site.

4.2.2 Project Cost

The Project has prepared a comparative cost analysis to identify the cost differences between location of the LMFBR Demonstration Plant at the Clinch River site versus another alternative site within the TVA power service area. Because none of the identified candidate sites within the TVA power service area was found to be environmentally preferable to the Clinch River site (see Section 4.1) there was no basis for considering any specific site in this cost analysis. Instead, where the individual cost factors considered could potentially be site specific, a range of values was used so that the total cost difference calculated would encompass any possible TVA alternative site.

For this analysis October 1, 1982, was taken as time zero for computing the delay in the Project schedule due to relocation. This is based on the assumption that the NRC determination and the Project decision process would require until October 1, 1982, before the Project would accept the Clinch River site as not licensable. The result of the Project's cost analysis using the reference delay case of 43 months is presented in Table 3. Table 3 contains extensive footnotes that indicate the bases the Project used in calculating each line item of cost. As indicated in footnotes 3, 10, and 12, minimal cost impact has been included for redesign, component or structural modifications, or reprocurement costs. The risk of increased costs in addition to those included in Table 3 resulting from relocating the plant to an alternative site is believed, however, to be high, especially considering the fact that as of May 1982 the CRBRP design was over 85% completed and $622.2 million worth of plant equipment had been ordered with $278.3 million of this equipment already delivered.

TABLE 3

COST IMPACT OF RELOCATING CRBRP

TO AN ALTERNATIVE TVA SITE - REFERENCE 43 MONTH DELAY CASE

	Item	Incremental Cost $ (Million)
1.	Escalation	601
2.	Staff and Support Stretch Out	164
3.	Equipment Procurement	7-36
4.	Relocate Project Office	0
5.	Additional Travel	1
6.	Difference in Prevailing Labor Rates	0-137
7.	Site Studies - Other than Geological	1
8.	Site Studies - Geological	7
9.	Site Work Package	3
10.	Seismic	11-162
11.	Foundation Materials and Walls	2
12.	Site Adaptation Redesign	10-86
13.	Excavation	0-6
14.	ER Rework	1
15.	PSAR Rework	1
16.	Reduced Revenue from Sale of Power	0
	TOTAL COST IMPACT - ADD	809-1210

Notes for respective line items in Table 3

1. Escalation

The $601M escalation cost was calculated using an 8% escalation rate based on the following:

-Base case total plant cost	$3.2B
-Cost through October 1, 1982	$1.3B
-Cost to go as of October 1, 1982	$1.9B

2. Staff and Support Stretch Out

The cost of staff and support stretch out is summarized as follows:

-Project Office	$ 25M
-Reactor Manufacture	$111M
-Architect Engineer	$ 19M
-Construction	$ 9M
	$164M

3. Equipment Procurement

Includes costs for continued storage, crating and reloading, and transportation of already delivered components, and differences in transportation costs for all components not yet delivered. No costs are included for any equipment components that may have to be repurchased or modified because of changes in engineering specifications due to the change in site.

4. Relocate Project Office

It is assumed that the existing CRBRP PO would be maintained in Oak Ridge for all alternative TVA sites.

Notes for Table 3 (Cont'd)

5. Additional Travel

Based on a minimum estimate of changes in commuting costs compared to actual expenditures at Oak Ridge.

6. Difference in Prevailing Labor Rates

At any alternative TVA site, except those in northeastern Tennessee, the increase in local labor costs compared to the base case at the Clinch River site range from $56-137 million. The basis for this estimate started with the scope of work and total manhours required to construct CRBRP. Using the work scope, an average wage was calculated by weighting each craft's local labor rate by its percentage of the work for different locations in the TVA power service area. Comparisons were then made against an Oak Ridge average and the increase calculated according to the man hours required to construct the CRBRP.

7. Site Studies - Other than Geological

Based on actual expenditures for specific tasks that have already been performed. Dollars shown are only for tasks where work is not transferable to an alternative site.

8. Site Studies - Geological

See note for Item 7.

Notes for Table 3 (Cont'd)

9. Site Work Package

See note for item 7.

At any alternative site even if the SSE and OBE were the same as at the Clinch River site, differences in the seismic response spectra would require the reanalysis of structures and components. Because much of the cost of the original analysis was for component modeling which does not need to be redone, 10% of the total actual expenditures made between 1974 and July 1, 1981, was estimated as the minimum cost for required seismic reanalysis. It should be noted that since seismic design parameters are site-specific, a new seismic model would have to be developed for each site. Because the resulting site-specific seismic response spectra could be more severe than the CRBRP design basis for some components, these components could have to be redesigned or, if the component has already been ordered or delivered, it may require modification, or may have to be scrapped and repurchased. None of these potential redesign, component modification, or reprocurement costs have been included in the $11M estimate.

11. Foundation Materials and Walls

As with item 10, all alternative sites would require reanalysis of the foundation materials and walls. The $2M estimate is a minimum estimate considering only the expected reanalysis costs.

Notes for Table 3 (Cont'd)

12. Site Adaptation Redesign

At any alternative site, plant buildings and site development, roads, railroads, utility systems, sewer and drainage systems, etc., would need redesign. This additional cost was assumed to be 25% of all structural design-related work and 25% of all site design-related work based on actual expenditures between 1974 and July 1, 1981. As was noted in item 10, the site specific seismic model or other site specific geologic factors could require redesign of the plant foundations and walls. None of these costs have been included in the $10M.

13. Excavation

The Clinch River site rock depth equals 50 feet whereas at certain of the TVA alternative sites examined the estimated rock depth was as shallow as 30 feet. Using a cost of $15/cubic yard and the additional amount to be excavated (400,000 c.y.), the maximum additional excavation cost is $6M.

14. Environmental Report Rework

Minimum estimate based on the amount of material to be modified, updated, or verified.

15. Preliminary Safety Analysis Report Rework

See note for item 14.

Notes for Table 3 (Cont'd)

16. Reduced Revenue from Sale of Power

It is assumed that the revenue from the sale of power during the demonstration period would remain unchanged.

This substantially higher risk of design changes should the CRBRP be relocated would require a higher contingency in the total Project cost estimate. Therefore, the actual incremental cost increase for an alternative TVA site could be several hundreds of millions of dollars more than the $809-1210 million shown in Table 3.

In summary, taking the current Project cost of $3.2 billion as a base, the cost of the same project at an alternative site within the TVA power service area would be higher than at the Clinch River site by a minimum of $809-1210 million for the reference 43 month delay case. Even this minimum cost assessment vividly illustrates the dramatic increase in project cost for an alternative site compared to the Clinch River site.

4.2.3. Utility Participation

As mentioned in Section 4.2.1 above, if the LMFBR Demonstration Plant were to be built somewhere on the TVA power system other than at the Clinch River site, the assumption has been made for the limited purposes of this analysis that a site would be available and that TVA would agree to continue in the same role it now has at the Clinch River site. Thus, the LMFBR program objective of utility participation would be satisfied for any selected site within the TVA power service area.

4.3 Conclusion

The Project has carefully reexamined and reanalyzed the comparison of the proposed Clinch River site with the ten alternative candidate sites identified in Section 3.0 in accordance with the Proposed Rule's sequential two-part test. Of the ten alternative candidate sites, nine were previously candidate sites in the siting assessment presented in Environmental Report Section 9.2 and Appendix A with the tenth site, Yellow Creek, being added to represent sites in TVA's western area (see Section 3.0). The conclusion reached in Section 4.1 concerning the required comparison of these sites with primary consideration given to environmental factors was that none of the ten alternative candidate sites are environmentally preferable to the Clinch River site. While this finding from part one of the Proposed Rule's two-part test would not require any additional determination on project economic, technology, and institutional factors (i.e., part two of the Proposed Rule's two-part test), the Project nevertheless presented in Section 4.2 a discussion of Project schedule and cost impacts that are site dependent. In Section 4.2 it was shown that a substantial increase in Project cost (a minimum of $809 - 1210 million) and a reference schedule delay of 43 months that would prevent satisfaction of the LMFBR program timing objective of constructing and operating an LMFBR Demonstration Plant as expeditiously as possible would result from relocating the CRBRP. These findings, independent of the conclusion in Section 4.1 on environmental preferability, lead to a determination that no obviously superior site exists. Thus, the Project has demonstrated in accordance with the requirements of the Proposed Rule that the Clinch River site is the preferred site for the LMFBR Demonstration Plant and that no obviously superior site exists.

5.0 SUMMARY AND CONCLUSIONS

At the request of the NRC, the Project has provided this update to the original CRBRP siting assessment provided in CRBRP Environmental Report Section 9.2 and Appendix A. This update, using appropriate current information, has shown that in accordance with the NRC Proposed Rule on Alternative Sites, (1) the TVA power service area is an appropriate "region of interest" (Section 2.0), (2) previously considered alternative sites constitute a sufficient number of candidate sites which meet the threshold criteria and reasonably represent the environmental diversity in the TVA power service area (Section 3.0), and (3) none of the ten alternative candidate sites identified in Section 3.0 are environmentally preferable to the Clinch River site (Section 4.1). Furthermore, the discussions in Section 4.2 show that there would be substantially increased project costs at another TVA site and that the LMFBR program timing objective could not be met at any alternative TVA site. When these Project economic and institutional factors are added to the findings concerning environmental preferability, it is clear that no obviously superior site exists in the TVA power service area for locating the LMFBR Demonstration Plant. Therefore, the Project concludes that the proposed Clinch River site remains the preferred site for the LMFBR Demonstration Plant.

Attachment I

Comparison of the Environmental Considerations at
Eleven Candidate Sites For The LMFBR
Demonstration Plant

Comparison of the Environmental Considerations at Eleven Candidate Sites for the LMFBR Demonstration Plant

I. INTRODUCTION

This analysis was conducted in accordance with the first part of the Proposed Rule's[1] sequential two-part analytical test on alternative sites. The first part gives primary consideration to hydrology, water quality, aquatic biological resources, terrestrial resources, water and land use, socioeconomics and population (including meteorological conditions) to determine if any of the ten alternative candidate sites are environmentally preferable to the proposed Clinch River site. The sites considered are the proposed Clinch River site and the ten alternative candidate sites of Spring Creek, Blythe Ferry, Caney Creek, Taylor Bend, Buck Hollow, Lee Valley, Phipps Bend, Yellow Creek, Hartsville, and Murphy Hill. These sites provide a reasonable representation of the diversity of land and water resources within the TVA power service area. The location of these sites is shown in figure I-1. In addition, a description of each of the alternative candidate sites, with the exception of Yellow Creek, can be found in Appendix A of the Clinch River Breeder Reactor Plant (CRBRP) Environmental Report (ER).

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1. NRC's Proposed Rule on Alternative Sites (45 FR 24168-24178, April 9, 1980)

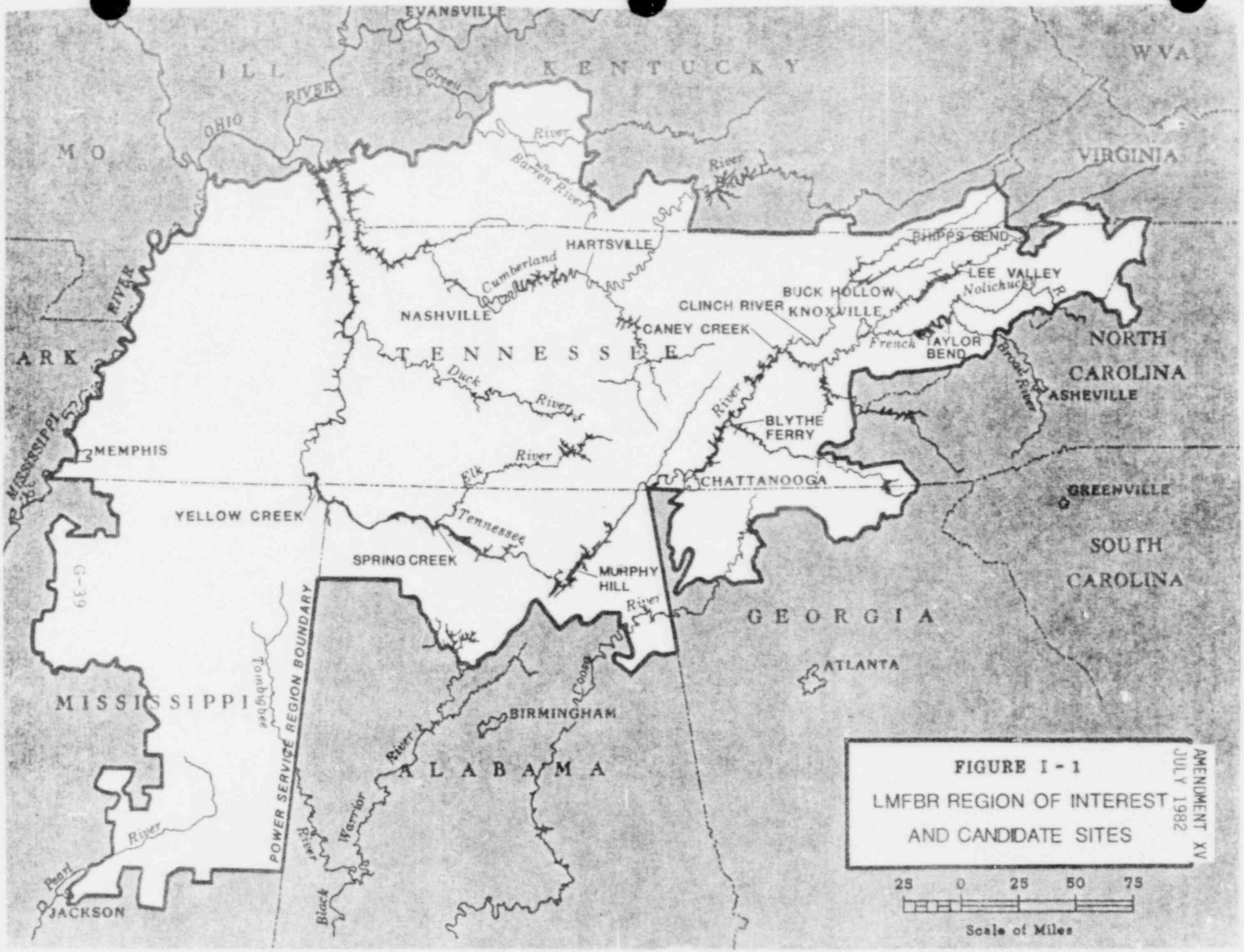

FIGURE I - 1

LMFBR REGION OF INTEREST AND CANDIDATE SITES

It should be recognized that since some of the sites have been subject to different amounts of study, some variation exists in the level and type of information available for each of the alternative sites. As a result, more discrete environmental impacts may have been discovered at those sites for which there has been a greater amount of detailed study than for those sites for which there has been less detailed study. Thus, the fact that the discussion of the Clinch River site mentions a matter not covered in the discussion of, for example, Caney Creek, may not necessarily mean that the Clinch River characterization is unique only to that site since further study at Caney Creek may indicate the same or similar consideration.

Nor does the absence of discussion with respect to a specific site necessarily mean that a consideration was not addressed during the assessment, but rather it may be that the consideration was determined to be of little significance or did not represent a substantial difference between the alternative candidate site and the Clinch River site. A summary of important site characteristics entitled "Table I-1, Summary of Environmental Considerations - LMFBR Candidate Sites" can be found at the end of this report.

A. HYDROLOGY

The major hydrologic considerations which were evaluated for the sites discussed below included ground water, water availability, water quality, thermal hydrodynamics, and flooding potential.

1. Clinch River

In the past, two extended periods of zero flow at Melton Hill Dam were imposed for the purpose of controlling the growth of Eurasian water milfoil. These extended periods resulted from special operations of the dam and are not anticipated in the future.

2. Spring Creek

Spring Creek is located on Wheeler Reservoir which is characterized by elevated thermal conditions and a sensitive trophic status. Spring Creek's downstream location from TVA's Browns Ferry Nuclear Plant would require that special consideration be given to the thermal effects of any discharge. The Spring Creek site is underlain by very soluble carbonate rock which would make it difficult to predict ground water movement.

3. Blythe Ferry

The Blythe Ferry site is underlain by highly soluble carbonate rock thus making ground water movement difficult to predict. A large portion of the site is also below the probable maximum flood elevation.

4. Caney Creek

The Caney Creek site is underlain by highly soluble carbonate rock thus making ground water movement very difficult to predict.

5. Taylor Bend

Taylor Bend is located on Douglas Reservoir which is characterized by strong thermal stratification, dissolved oxygen (DO) depletion in the hypolimnion, and annual fluctuation of the reservoir (62 feet) reducing the stream flow to the original French Broad River channel during periods of reservoir drawdown.

6. Buck Hollow

The Holston River at the Buck Hollow site is characterized by stressed water quality and biological conditions. Additionally, a major portion of the site is below the probable maximum flood elevation.

During periods of strong thermal stratification in Cherokee Reservoir located approximately 13 miles upstream of the site, the water in the Holston River at Buck Hollow is low in DO resulting in a very limited and stressed biological community at Buck Hollow. Since the reach of the Holston River at Buck Hollow is not impounded, frequent and sometimes prolonged dewatering of the river channel occurs.

7. Lee Valley

The Lee Valley site is located on the headwaters of tne Cherokee Reservoir which are characterized by historically porr water quality, strong thermal stratification and hypolimnatic DO depletion. Annual fluctuations in Cherokee pool elevation are about 52 feet. Additionally, special consideration needs to be given to the thermal effects of any discharge due to the proximity of the site to TVA's John Sevier Steam Plant.

8. Phipps Bend

A large portion of the Phipps Bend site is below the probable maximum flood elevation. The site is located on the Holston River which is characterized by historically poor water quality and stressed biological communities.

9. Yellow Creek

The Yellow Creek site is characterized by a limited interchange of water through the site embayment.

10. Hartsville

There are no significant hydrologic considerations at the Hartsville site.

11. Murphy Hill

A large portion of the Murphy Hill site is below the probable maximum flood elevation.

CONCLUSION

Each of the above candidate sites could be considered as acceptable sites for an LMFBR from a hydrologic standpoint. However, the Clinch River site possesses certain hydrologic advantages over the Yellow Creek, Murphy Hill, Phipps Bend, Spring Creek, Blythe Ferry, Taylor Bend, Buck Hollow, Lee Valley, and Caney Creek sites. The Clinch River site is substantially equal to the Hartsville site.

B. METEOROLOGY

Although not specifically required in NRC's Proposed Rule on Alternative Sites, a discussion of meteorological conditions has been included. Site comparison criteria for meteorological considerations relate primarily to atmospheric diffusion conditions, including opportunity for dilution before released effluents would be expected to reach communities within 10 miles of the site, local stagnation potential, and the relative difficulty in determining and describing transport and diffusion patterns of effluents and the confidence levels in transport and diffusion estimates.

1. Clinch River

The predominant wind direction for this site is from the southwest at both the 75- and 200-feet levels. Winds from the northwest and east also dominate the patterns. Irregular terrain conditions generate uncertainty about transport and diffusion patterns. Periods of poor atmospheric dispersion conditions do occur. The cumulative population for cities and towns with a population (1980 census) of greater than 5,000 in a 50-mile radius around the site is the same as for Caney Creek, somewhat higher than for the Yellow Creek and Phipps Bend sites, and lower than the other alternative sites. The population distribution is well below NRC staff criteria that would require consideration of alternative sites with lower population. Uncertainties with regard to transport and diffusion patterns reduce the confidence in effluent plume predictions (real-time and future), especially for transport, for the Clinch River site during stable and/or light wind conditions.

2. Spring Creek

Spring Creek is characterized by less population within 10 miles of the site than Clinch River. The open terrain at Spring Creek results in less potential for stagnation conditions and less uncertainty about transport and diffusion patterns.

3. Blythe Ferry

Blythe Ferry has less population than the Clinch River site in the surrounding 10-mile area and more predictable transport and diffusion patterns. Blythe Ferry is located in the lower portion of the Great Valley and not far from Cumberland Plateau's stagnation enhancing effect during generalized stagnation conditions. The terrain at Blythe Ferry has a more regular pattern than that in the vicinity of the Clinch River site. The transport and diffusion patterns are believed to be more straightforward than at the Clinch River site, especially for stable atmospheric conditions. With somewhat less complicated terrain patterns, there would likely be fewer local "pockets" of higher concentrations of effluents. Overall, the difference in stagnation potential is not considered to be substantial.

There would be considerable difficulty with effluent transport toward the Cumberland Plateau. Although additional uncertainty about transport and diffusion estimates exists for the Clinch River site, the overall difference is not believed to be significant.

4. Caney Creek

There are no appreciable air quality or meteorological differences between the Caney Creek site and the Clinch River site.

5. Taylor Bend

The only population center within 10 miles of Taylor Bend (Newport) is located about 5 miles to the southeast. Generally favorable dilution conditions are expected during transport of effluents toward that city. Taylor Bend is located in close proximity to the north edge of the Great Smoky Mountains on the upper part of a large, irregularly shaped reservoir. In this part of the Great Valley the topography is not regularly aligned in an upvalley-downvalley manner. Collection and analysis of meteorological data to characterize diffusion and transport conditions might require one or more secondary measurement locations. The relative difficulty would be about the same as for the Clinch River site. Because of the reservoir and somewhat more open terrain (except for the mountains to the south), local stagnation potential is considered to be lower than for the Clinch River site. Investigating the transport and diffusion patterns for effluents from the proposed plant might be as difficult for Taylor Bend as for the Clinch River site. However, it is believed that, once conditions were reasonably determined, estimates related to transport and diffusion patterns could be made with more confidence than for the Clinch River site.

6. Buck Hollow

Buck Hollow has less population within 10 miles than the Clinch River site. Except for the low-level irregularity of hills and the pronounced meander of the Holston River, the terrain near the site is not as complicated as the Clinch River site. Larger scale ridges in the general area around the site are aligned in a upvalley-downvalley orientation. Thus, diffusion and transport patterns are believed to be rather straightforward and easy to determine. The task of describing diffusion patterns should be less difficult than for the Clinch River site and could be made with more confidence.

7. Lee Valley

The Lee Valley site is about 10 miles from both Rogersville and Morristown, to the northeast and to the southwest, respectively. The arrangement of substantial ridges in the area is such that dilution of effluents transported in these general directions would likely be equivalent to the Clinch River site area. However, the population within 10 miles is less for Lee Valley than for the Clinch River site. While the terrain in the Lee Valley site area is in some ways less complex than in the Clinch River site area, the difficulty of evaluating transport and diffusion patterns would not be substantially less. With the confinement and channeling influences of the local ridge and valley topography within this part of the Great Valley, the stagnation potential is similar to that for the Clinch River site. The particular ridge and valley pattern near Lee Valley is believed to be a major factor that would affect confidence levels in transport and diffusion estimates to an extent similar to that for the Clinch River site.

8. Phipps Bend

Phipps Bend has less population within 10 miles than Clinch River. Though the transport and diffusion patterns of effluents for the Phipps Bend site area may be slightly less difficult to determine than for the Clinch River site due to the river cuts through the local ridges, a substantial difference does not appear to exist. At Phipps Bend, the Holston River valley is aligned with the pronounced valley-ridge terrain. The relatively narrow secondary topographic variations within the valley markedly influence the low-level airflow under stable conditions. The overall potential for stagnation is believed to be substantially higher for the Phipps Bend site than the Clinch River site. The narrowness of the valley, the steepness of the adjacent ridges (especially on the southeast side), and the prevalence of very light winds indicate a higher potential for local stagnation. In general, slightly more confidence would be expected in estimates of diffusion and transport of effluents from the Phipps Bend site. However, the difference is not considered to be significant.

9. Yellow Creek

Yellow Creek has less population within 10 miles than the Clinch River site. The terrain is more open at the Yellow Creek site than at the Clinch River site resulting in less uncertainty about transport and diffusion patterns for Yellow Creek.

Generalized stagnation conditions are substantially less frequent at the Yellow Creek site. However, under stable conditions, the potential for "pockets" of higher concentrations of effluents is considered to be comparable to that in the vicinity of the Clinch River site. Since the localized stagnation potential is considered more significant than the generalized atmospheric stagnation potential, the relative differences between the Yellow Creek and Clinch River sites are not believed to be appreciable.

10. Hartsville

Hartsville has less population within 10 miles than does Clinch River.

The diffusion and transport patterns are considered to be less complicated and uncertain in the vicinity of the Hartsville site since the site area is more open and is less subject to generalized stagnation conditions.

11. Murphy Hill

Murphy Hill has lower population within 10 miles than does Clinch River. Although Murphy Hill is in a pronounced valley-ridge area, the Tennessee River valley in the vicinity of the site is aligned with the ridge orientation. Though the transport and diffusion patterns are believed to be more straightforward than those at the Clinch River site, especially for stable conditions, no substantial difference exists between the sites. Generalized and local stagnation potentials would be roughly equivalent, though at Murphy Hill it would be somewhat more a consequence of topographical channeling and confinement. The expected diffusion patterns for Murphy Hill should be somewhat easier to describe than those for the Clinch River site. However, the difference is not considered to be substantial.

Expected differences in confidence levels for diffusion and transport estimates slightly favor the Murphy Hill site due to greater topographic regularity.

CONCLUSION

Each of the above candidate sites could be considered as an acceptable site for a LMFBR from the standpoint of meteorological concerns.

From the standpoint of dilution before released effluents would be expected to reach communities within 10 miles, all of the sites with the exception of Caney Creek, where no appreciable difference was noted, possess certain advantages over the Clinch River site.

Regarding the difficulty of determining the transport and diffusion patterns of effluents, all of the sites with the exception of Phipps Bend, Caney Creek, Taylor Bend, and Lee Valley, where no appreciable difference was noted, possess certain advantages over the Clinch River site.

With respect to local stagnation potential, the Hartsville, Spring Creek, and Taylor Bend sites possess certain advantages over the Clinch River site; no appreciable difference was noted with respect to Murphy Hill, Yellow Creek, Blythe Ferry, Caney Creek, Buck Hollow, and Lee Valley; and Clinch River possesses certain advantages over the Phipps Bend site.

Regarding the difficulty of describing expected diffusion patterns, all of the sites with the exception of Murphy Hill, Phipps Bend, Caney Creek, and Lee Valley, where no appreciable difference was identified, possess certain advantages over the Clinch River site.

With respect to safety factors (confidence levels) in transport and diffusion estimates during radiological emergency planning support, all of the sites with the exception of Murphy Hill, Phipps Bend, Blythe Ferry, Caney Creek, and Lee Valley, where no appreciable differences were identified, possess certain advantages over the Clinch River site.

Thus, from the standpoint of overall site meteorological conditions, the Hartsville, Yellow Creek, Spring Creek, Taylor Bend, Blythe Ferry, Murphy Hill, and Buck Hollow sites possess certain advantages over the Clinch River site. No appreciable differences have been identified for the Phipps Bend, Caney Creek, and Lee Valley sites.

C. AQUATIC BIOLOGICAL RESOURCES

1. Clinch River

No species, designated as rare or endangered by any governmental agency, were collected or observed in the baseline ecological survey performed from March 1974 through January 1975. During ecological surveys conducted in May 1982, a single specimen of a listed endangered mussel was discovered upstream from the Clinch River site. A subsequent freshwater mussel survey failed to discover any further specimens near the site.

A waterfowl refuge is located 8 miles southwest of the site along the Tennessee River. No significant impact to the aquatic ecosystem will result from plant and transmission line construction.

2. Spring Creek

A wetland habitat and migrant-wintering waterfowl habitat exist on Spring Creek embayment. Toxolasma lividus lividus, a mussel species listed as endangered in Alabama, is present in the vicinity of the site.

Spring Creek is characterized by a biologically productive embayment and adjacent reservoir shoreline, and the sensitive trophic status and elevated thermal condition of Wheeler Reservoir. Spring Creek's downstream location from TVA's

Browns Ferry Nuclear Plant would require that special consideration be given to the thermal effects of any additional discharge.

3. Blythe Ferry

Much of the Blythe Ferry site would classify as wetland habitat which supports many species of wetland wildlife including ospreys and eagles. A portion of the site is located within the Hiwassee Wildlife Refuge and is managed by the Tennessee Wildlife Resources Agency for Canada geese and migrant-wintering waterfowl.

The Blythe Ferry site is also characterized by areas of biologically productive overbank surrounding the site.

One aquatic species Federally listed as endangered, *Percina tansi*, snail darter, is potentially present in these overbank areas.

4. Caney Creek

Caney Creek is characterized by a biologically productive embayment. Wintering bald eagle habitat and natural osprey nests are located within approximately 4 miles of Caney Creek embayment. The site area includes wood duck and goose habitat.

5. Taylor Bend

The Taylor Bend site is characterized by a migrant-wintering habitat that includes the support of wintering bald eagles and ospreys. Taylor Bend is a site for the osprey hacking project and an integral part of the Tennessee Osprey Restoration Project. The site is also a waterfowl concentration area.

6. Buck Hollow

The Holston River at the Buck Hollow site is characterized by stressed water quality and biological conditions. Since the reach of the Holston River at Buck Hollow is not impounded, frequent and sometimes prolonged dewatering of the river channel occurs.

A wood duck nesting and brood habitat is present in the vicinity of the site. A number of migrant ospreys have been reported on this section of the Holston River. The site vicinity provides float hunting for many species of waterfowl. The Buck Hollow section of the Holston River is also a feeding area for the German Creek black crown night heron colony.

7. Lee Valley

The Lee Valley site is located on the headwaters of the Cherokee Reservoir which are characterized by complex thermal hydrodynamic conditions resulting in the existence of high biological productivity.

8. Phipps Bend

The Holston River in the vicinity of the Phipps Bend site is small and has historically been identified as having limited aquatic productivity with the exception of the occurrence of large beds of aquatic macrophytes throughout the reach of the Holston River near the site.

9. Yellow Creek

The Yellow Creek site is characterized by an aquatic nursery area in the embayment, limited water interchange in the upstream portion of the embayment near the site, and a diverse population of waterfowl.

10. Hartsville

A small mussel bed containing a mussel species Federally listed as endangered and a wetland habitat are adjacent to the Hartsville site.

11. Murphy Hill

A biologically productive overbank area is immediately downstream from the Murphy Hill site. Additionally, the site contains waterfowl and wetland wildlife habitat.

CONCLUSION

Each of the above candidate sites could be considered as acceptable sites for an LMFBR from the standpoint of aquatic resources. However, the Clinch River site possesses certain aquatic resource advantages over the Spring Creek, Blythe Ferry, Buck Hollow, Hartsville, Lee Valley, Phipps Bend, and Murphy Hill sites. The Clinch River site is substantially equal to the Caney Creek, Taylor Bend, and Yellow Creek sites.

D. TERRESTRIAL RESOURCES

1. Clinch River

The site contains forest types which reflect previous land uses and present forest management practices. Plant species are largely those expected for land undergoing secondary succession. Rare plant species include *Panax quinquefolium,* ginseng; *Cimicifuga rubifolia,* black snakeroot; and *Saxifraga careyana,* Carey's saxifrage.

Three endangered mammalian species are potentially present: *Myotis sodalis,* Indiana Bat; *Myotis grisescens,* Gray Bat; and *Lutra canadensis,* River Otter. Two Federally listed endangered birds have been observed on the site: *Haliaeetus leucocephalus leucocephalus*, Southern Bald Eagle and *Pandion haliaetus*, American Osprey. Other bird species observed on the site that are listed as threatened by the State of Tennessee are *Accipiter striatus,* Sharp-Shinned Hawk; *Accipiter cooperii,* Cooper's Hawk; and *Circus cyaneus,* Marsh Hawk.

2. Spring Creek

The Spring Creek site is characterized by open agricultural lands and scattered pine forest.

3. Blythe Ferry

Upland wildlife habitat on the site is fair. Threatened or endangered species potentially present at the site include *Myotis grisescens*, Gray Bat, Federally listed as endangered, and *Gyrinophilus palleaucus*, Tennessee cave salamander, State-listed as threatened.

4. Caney Creek

The Caney Creek site is characterized by a fair to poor habitat for small game and nongame wildlife.

5. Taylor Bend

The Taylor Bend site is characterized by populations of large game wildlife species, particularly deer, with limited habitat for small game.

6. Buck Hollow

Two Federally endangered species (*Myotis grisescens*, Gray Bat; and *Myotis sodalis*, Indiana Bat) are potentially present at the Buck Hollow site.

7. Lee Valley

The Lee Valley site is characterized by fair habitat for open land wildlife including a deer population.

8. Phipps Bend

The Phipps Bend site contains one plant species proposed for Federal listing: Cimicifuga rubifolia, black snakeroot; and one State-listed species: Ammodramus savanarrum, Grasshopper Sparrow.

9. Yellow Creek

The Yellow Creek site is characterized by a large diverse population of wildlife. Three reptiles, one avian, and two mammalian species listed as "rare" in Mississippi, are present in the vicinity of the site.

10. Hartsville

The Hartsville site is characterized by a fair habitat for small game and nongame wildlife. The site contains two State-listed threatened species: Thryumanes bewickii, Bewick's wren, and Ammodramus savanarrum, Grasshopper Sparrow.

11. Murphy Hill

The Murphy Hill site supports a variety of biological resources and is surrounded by waterfowl and wetlands habitat. Small game habitats and white-tailed deer are present. Two Federally endangered mammals are present in the vicinity of the site.

CONCLUSION

Each of the above candidate sites could be considered as acceptable sites for an LMFBR from the standpoint of terrestrial resources. However, the Clinch River site possesses certain terrestrial resource advantages over the Spring Creek, Blythe Ferry, Taylor Bend, Buck Hollow, Murphy Hill, and Yellow Creek sites. The Clinch River site is substantially equal to the Caney Creek, Phipps Bend, Lee Valley, and Hartsville sites.

E. LAND USE

1. Clinch River

The Clinch River site has long been considered a potential industrial location and is bordered by a partially developed industrial park. Use of the Clinch River site would be compatible with existing and future land uses in the surrounding area.

A 100-unit campsite is on the Caney Creek embayment about one mile SE of the site boundary and a 30-unit camping and day use area is located about three miles SE of the site.

Four sites within 10 miles of the CRBRP site and proposed transmission lines are listed on the National Register of Historic Places, the Harriman City Hall, the former County Court House at Kingston, Southwest Point on the Tennessee River SW of Kingston, and the X-10 Graphite Reactor at Oak Ridge National Laboratories. The Tennessee Historical Commission has recently determined that on the basis of architectural, archaeological, and historic studies conducted at the Clinch River site, construction of an LMFBR would not affect any properties included in or eligible for inclusion in the National Register of Historic Places.

2. Spring Creek

The Spring Creek site is characterized by various agricultural uses and forested lands. Residential development is taking place further up the Spring Creek embayment. Extensive development has been restricted by a low bridge crossing the embayment within the proposed site boundaries which severely limits access to the main reservoir. Public access sites maintained by the Alabama Conservation Department are located at the mouth of Spring Creek (mile 283L) and Goldfield Branch (mile 285L). National Register sites occur in the area; however, the site has not been surveyed and the status of archaeological resources is unknown. Use of the site for the LMFBR would be compatible with existing and future land uses.

3. Blythe Ferry

A shoreline residential development is present nearby the Blythe Ferry site. The Blythe Ferry, a private ferry service located at the site, provides passage across the river between Cleveland and Dayton, Tennessee. Use of the site for an LMFBR presents certain land use conflicts and would require, for instance, the closing of the ferry service.

TVA public use areas are located at Armstrong Bend (mile 505L) and Grasshopper Creek (mile 495L). Since the area has not been surveyed for cultural resources, the status of these resources is unknown. However, no properties listed in the National Register exist on the site. Portions of the site lie within the Hiwassee Wildlife Refuge.

4. Caney Creek

Woodland and various agricultural uses are the predominant land uses on and around the site. Some scattered residential development is located near the boundary of the proposed exclusion area. Recreation features in the vicinity of the site include Roane County Park on Caney Creek embayment (mile 262R) and three State maintained public access sites within five miles of the site. The status of archaeological resources is unknown. No National Register properties exist on the site.

5. Taylor Bend

Work began in 1973 on a second home resort area located within the proposed site area boundary. The long range plans for the resort call for a golf course, pool, and 2,000 homes. After a troubled beginning which included a change of ownership, only 200 lots have been developed and the golf course and 75 homes constructed. Use of the site for the LMFBR would require the purchase of this development.

Other recreation facilities within 10 miles of the site include a private campground and boat dock at mile 54.4-55L. Three archaeological sites have been identified in the vicinity, but no National Register of Historic Places eligibility determination has been conducted.

6. Buck Hollow

Land use in the vicinity of the site is a mixture of wooded land and various agricultural uses. Future use of the site would likely be pasture land. Recreation features include a proposed TVA stream access site, Indian Cave, and a commercial recreation area one mile from the site at mile 40R. Cultural resources on the site are unknown since there has been no onsite archaeological survey conducted. Use of the site for the LMFBR would not result in a significant land use conflict.

7. Lee Valley

Most of the land on and in the vicinity of the site is forested or in various agricultural uses. However, a Boy Scouts of America camp encircles the nearby Dry Branch embayment; and a portion of the camp may be within the site boundaries.

The status of cultural resources is unknown since a survey has not been conducted.

8. Phipps Bend, Yellow Creek, Hartsville, and Murphy Hill

Three of the eleven alternative sites--Phipps Bend, Yellow Creek, and Hartsville--have, until the recent deferrals, been sites of active nuclear plant construction. A fourth site, Murphy Hill, has been selected as a suitable site for a coal gasification project and site preparation activities are currently underway. The closest development to the Murphy Hill site is a residential area across the reservoir from the site. Use of any of these sites for the LMFBR project would be compatible with the existing surrounding land use. Land use in the vicinity of these sites is unlikely to change to any degree in the near future to alter this assessment.

The Phipps Bend site contains known archaeological resources, but none are presently listed on the National Register. There would be no preemption or likely adverse impacts to areas listed or potentially eligible for listing on the National Register of Historic Places.

An archaeological district is associated with the Yellow Creek site area.

The town of Dixon Springs and the Dixona historic district are located nearby Hartsville. Several small commercial recreation facilities are also located in the general site vicinity of Hartsville.

CONCLUSION

Each of the above candidate sites could be considered as acceptable sites for an LMFBR from the standpoint of land use. However, the Clinch River site possesses certain land use advantages over the Taylor Bend, Blythe Ferry, and Lee Valley sites. The Clinch River site is considered substantially equal to each of the other seven alternative candidate sites.

F. SOCIOECONOMICS

Construction employment in support of the LMFBR project is expected to peak at about 5,400. The socioeconomic effects depend primarily on the fraction of the work force which inmigrates and the ability of nearby communities to accommodate the inmigrants.

1. Clinch River

Proximity to Knoxville's large labor market would result in a relatively low projected inmigration rate (25 percent or less). The Knoxville metropolitan area can accommodate this size of influx with no significant impact. No highway segments would have traffic levels exceeding their capacities.

2. Blythe Ferry

The Blythe Ferry site is located in proximity to Chattanooga's labor market, thus socioeconomic impacts would likely be similar in magnitude to those of the Clinch River site. The inmigration which would occur would locate largely in Cleveland and the Chattanooga area. These cities (populations of 26,000 and 170,000 respectively) could accommodate the influx with no significant impact.

Transportation impacts due to commuting should be relatively small with the exception of the last highway link from Route 58 to the site.

3. Caney Creek

The Caney Creek site is located in close proximity to the Clinch River site, thus the magnitude of the socioeconomic impacts would be expected to be essentially the same. However, the distribution of those impacts would be considerably different. Since the site is closer to the Rockwood, Kingston, and Harriman areas, most of the inmigrants would be expected to locate in the vicinity of these three communities rather than Knoxville and some significant impacts may occur.

Access is available to the site from three road segments which would tend to reduce the impacts of commuting traffic. However, there would still be a large increase in traffic in the vicinity of the site. The degree of impact has not been determined.

4. Taylor Bend

The magnitude of the socioeconomic impacts would likely be about the same at the Taylor Bend site as at the Clinch River site. However, since most inmigrants would locate in and around Morristown and Newport some minor impacts may occur.

5. Buck Hollow

The Buck Hollow site has about the same relationship to the Knoxville labor market as the Clinch River site. Therefore, the magnitude of the socioeconomic impacts would likely be about the same. Most of the inmigrants would locate in east and northeast Knox County, the Jefferson City area and west Jefferson County. The magnitude of the projected inmigrants to an urbanized area of this size would not be expected to result in significant adverse impacts.

Transportation impacts would likely be small except for Route 92 connecting Jefferson City and Rutledge. The degree of impact has not been determined.

6. Lee Valley

The magnitude of the impacts would likely be the same at the Lee Valley site as at the Clinch River site. However, since most of the inmigrants would locate in and around Morristown, some significant impacts may occur.

Commuting traffic could result in impacts at certain points (e.g., downtown Morristown) and on certain highway segments (e.g., county road connecting 11E with the site). The degree of these traffic impacts has not beeen determined.

7. Yellow Creek, Hartsville, and Phipps Bend

The magnitude of the socioeconomic impacts would likely be larger at these sites than at the Clinch River site, and some significant impacts may occur.

Transportation impacts vary widely among these sites. No significant impacts are likely at Phipps Bend. At Yellow Creek and Hartsville minor to moderate impacts would be expected.

8. Murphy Hill and Spring Creek

The magnitude of the socioeconomic impacts would likely be larger on these sites than those projected for the Clinch River site. Given the capabilities of communities in the surrounding areas, some significant impacts may occur.

Transportation impacts constitute the most significant difference between these two sites. At Murphy Hill, significant transportation impacts would be expected. Also, the State was considering a $19 million road improvement program in the area due to existing traffic problems. No traffic impacts due to commuting would be expected at Spring Creek, but it appears that a county road and bridge would have to be closed.

CONCLUSION

Each of the above candidate sites could be considered as acceptable sites for an LMFBR from the standpoint of socioeconomics. However, the Clinch River site is either substantially equal to or possesses certain socioeconomic advantages over the ten alternative candidate sites.

G. POPULATION

10 CFR, Part 100 specifies that "sites having a cumulative population density projected at the time of initial operation of a nuclear power station which exceeds 500 persons per square mile averaged over any radial distance out to 30 miles, or the projected population density over the lifetime of the facility exceeds 1,000 persons per square mile averaged over any radial distance out to 30 miles, special attention should be given to the consideration of alternative sites with lower population densities."

Based on current information, though the Clinch River site is the most urbanized of all 11 sites, it still conforms with appropriate NRC population density criteria. It is therefore concluded that all of the alternative sites are in conformance with applicable regulations. Basic site population characteristics have been identified and are included in table I-1.

II. OVERALL SITE ENVIRONMENTAL PREFERABILITY

As shown in table I-1, each alternative site has its own unique set of site-specific considerations which project relative advantages and disadvantages to locating an LMFBR at any particular site. From the standpoint of the environmental parameters discussed above with the exception of meteorology, the Clinch River site is advantageous or substantially equal to each of the alternative sites evaluated. The fact that some alternative sites possess a meteorological advantage over the Clinch River site does not outweigh, however, other environmental parameters that demonstrate Clinch River's equivalence to or advantage over the alternative sites.

Thus, based on an overall comparison of environmental characteristics and the relative advantages and disadvantages of each site, it is concluded that none of the 10 alternatives is environmentally preferable to the Clinch River site for location of the LMFBR.

TABLE I-1

SUMMARY OF ENVIRONMENTAL CONSIDERATIONS - LMFBR CANDIDATE SITES

	METEOROLOGY	1980 POPULATION - NEAREST TOWN (within 50 miles) OF 5,000+	25,000+	100,000+
1. Clinch River	Poor atmospheric dispersion conditions. Topographic channeling and confinement could result in recirculation.	Oak Ridge, TN 9 mi., NE pop. 27,662	Oak Ridge, TN 9 mi., NE pop. 27,662	Knoxville, TN 22 mi., ENE pop. 183,139
2. Spring Creek	Fair atmospheric dispersion. Light to moderate wind speeds. Little potential for low-level atmospheric recirculation.	Athens, AL 18 mi., ENE pop. 14,558	Decatur, AL 19 mi., ESE pop. 42,002	Huntsville, AL 38 mi., E pop. 142,513
3. Blythe Ferry	Poor atmospheric dispersion conditions. Potential for confinement which could result in low-level atmospheric recirculaton.	Soddy Daisy, TN 15 mi., SW pop. 8,388	Cleveland, TN 18 mi., SSE pop. 26,415	Chattanooga, TN 29 mi., SSW pop. 169,565
4. Caney Creek	Poor atmospheric dispersion conditions. Topographic channeling and confinement could result in low-level atmospheric recirculation.	Rockwood, TN 5 mi., S pop. 5,767	Oak Ridge, TN 25 mi., NE pop. 27,662	Knoxville, TN 39 mi., ENE pop. 183,139
5. Taylor Bend	Poor atmospheric dispersion conditions. Topographic channeling and confinement could result in low-level atmospheric circulation.	Newport, TN 6 mi., SE pop. 7,580	Knoxville, TN 37 mi., W pop. 183,139	Knoxville, TN 37 mi., W pop. 183,139
6. Buck Hollow	Poor atmospheric dispersion conditions. Topographic channeling and confinement could result in low-level atmospheric recirculation.	Jefferson City, TN 6 mi., E pop. 5,612	Knoxville, TN 22 mi., SW pop. 183,139	Knoxville, TN 22 mi., SW pop. 183,139
7. Lee Valley	Poor atmospheric dispersion conditions. Topographic channeling and confinement could result in low-level atmospheric recirculation.	Morristown, TN 11 mi., SW pop. 19,683	Kingsport, TN 38 mi., ENE pop. 32,017	Knoxville, TN 49 mi., SW pop. 183,139
8. Phipps Bend	Poor atmospheric dispersion conditions. Topographic channeling and confinement could result in low-level atmospheric recirculation.	Kingsport, TN 15 mi., ENE pop. 32,027	Kingsport, TN 15 mi., ENE pop. 32,027	Greater than 50 mi.
9. Yellow Creek	Fair atmospheric dispersion conditions. There is little potential for low-level atmospheric recirculation.	Savannah, TN 9 mi., N pop. 6,992	Florence, AL 35 mi., ESE 37,029	Greater than 50 mi.
10. Hartsville	Fair atmospheric dispersion conditions. There is little potential for low-level atmospheric recirculation.	Lebanon, TN 15 mi., SW pop. 11,892	Hends'ville, TN 30 mi., W pop. 26,561	Nashville, TN 43 mi., WSW pop. 455,651
11. Murphy Hill	Poor atmospheric dispersion conditions. Topographic channeling and confinement could result in low-level atmospheric recirculation.	Guntersville, AL 12 mi., SW pop. 7,041	Huntsville, AL 30 mi., NW pop. 142,513	Huntsville, AL 30 mi., NW pop. 142,513

TABLE I-1 (CONT.)

	HYDROLOGY	WATER QUALITY
1. Clinch River	None identified.	None identified.
2. Spring Creek	Karst terrain makes prediction of ground water movement difficult.	Water temperature in site vicinity approaches or exceeds 86 F criteria during July-September.
3. Blythe Ferry	Karst terrain makes prediction of ground water movement difficult. Large portion of site is below PMF.	None identified.
4. Caney Creek	Karst topography makes prediction of ground water movement difficult.	None identified.
5. Taylor Bend	Douglas Reservoir strongly stratified during summer with DO depletion in hypolimnion. Annual reservoir fluctuation of about 62'.	None identified.
6. Buck Hollow	Extended periods of low or no streamflow resulting from peaking operation upstream at Cherokee Dam. Large portion of site is below PMF.	Low dissolved oxygen concentrations occur in vicinity of site.
7. Lee Valley	Strong thermal stratification with DO depletion in the hypolimnion. Annual reservoir fluctuation of about 52'.	Historic poor water quality although improvements are occurring.
8. Phipps Bend	Potential for macrophitic intake clogging. Large part of site is below PMF.	Historic poor water quality although improvements are occurring.
9. Yellow Creek	Limited interchange of water in the embayment.	Limited interchange of water in the embayment.
10. Hartsville	None identified.	None identified.
11. Murphy Hill	Large portion of the site is below the PMF.	None identified.

TABLE I-1 (CONT.)

	AQUATIC RESOURCES	TERRESTRIAL RESOURCES
1. Clinch River	Single specimen of endangered mussel species identified upstream. Additional studies failed to discover any other specimen.	Three mammals listed as endangered occur in the vicinity of the site; Gray Bat, Indiana Bat, and Eastern cougar. Two plant species promoted for federal listing as threatened: Cimicifuga rubifolia, black snakeroot, and Saxifraga careyana, Carey's saxifrage occur on the site.
2. Spring Creek	Presence of endangered mussel species in the vicinity of the site. Spring Creek embayment is a high biologically productive area. Waterfowl and wetland habitat.	None identified.
3. Blythe Ferry	Spawning and nursery area in overbank. Wetland wildlife habitat. Potential presence of three endangered species. Portion located within State wildlife refuge.	One federally listed endangered species, Myotis grisescens, Gray Bat; one State listed threatened species, Gyrinophilus palleucus, Tennessee cave salamander.
4. Caney Creek	No significant waterfowl habitat. No endangered species. Biologically productive Caney Creek embayment.	None identified.
5. Taylor Bend	Waterfowl and migrant-wintering habitat. No endangered species. Site is part of State Osprey Restoration project.	Population of large game wildlife.
6. Buck Hollow	Limited biological communities in site vicinity. Waterfowl and shorebird habitat. Potential presence of two endangered species.	Potential presence of two federally listed endangered species.
7. Lee Valley	High biological productivity in the epilimnion. No endangered species or important waterfowl or wetland habitat.	Deer habitat.
8. Phipps Bend	Wood duck habitat. Wetland onsite that supports a variety of waterfowl and wetland bird life. Intake entrainment of aquatic organisms.	Whitetailed deer are present on the site. One plant proposed for federally listing: Cimicifuga rubifolia, black snakeroot; and one State-listed threatened species: Ammodramus savanarrum, Grasshopper Sparrow.
9. Yellow Creek	Aquatic nursery area in Yellow Creek embayment. Wintering waterfowl habitat near State Line Island on main reservoir. Shoreline bird use habitat at head of Yellow Creek embayment. Wintering habitat for bald eagle on main reservoir.	No federally listed endangered or threatened species present onsite. Three reptile, one avian, and two mammalian species listed as "rare" in Mississippi occur in the vicinity of the site.
10. Hartsville	Small mussel bed containing a listed endangered mussel species adjacent to the site. Wetlands border the site along Dixon Creek and Old Hickory Reservoir. Wetland habitat on Dixon Island adjacent to site. Wood duck nesting and breeding habitat on Dixon Creek.	Two State-listed threatened species: Thryumanes bewickii, Bewick's Wren, and Ammodramus savanarrum, Grasshopper Sparrow.
11. Murphy Hill	Shallow, productive overbank adjacent to and downstream from the site. Wetlands surround the site along Guntersville Reservoir. Wintering waterfowl habitat. Wintering habitat for bald eagles. Wood duck breeding and nesting habitat.	Whitetailed deer present onsite. No threatened or endangered species onsite. Two federally endangered mammals, the Gray Bat and Indiana Bat, occur within 7 miles of the site.

TABLE I-1 (CONT.)

AMENDMENT XV
JULY 1982

	WATER AND LAND USE	SOCIOECONOMICS
1. Clinch River	Compatible with projected industrial use of the site area. Several recreational facilities occur within 10 miles of the site including Melton Hill Dam reservation and Atomic Speedway.	None identified.
2. Spring Creek	Compatible with projected forest and agricultural use of the site area. Two recreational public access areas in vicinity. No national register historical sites. Archaeological resources unknown.	Potential for some significant impacts.
3. Blythe Ferry	Potential for significant impact to nearby residential development. Two recreational public access sites in vicinity. No national register historic sites. Archaeological resources unknown.	None identified.
4. Caney Creek	Compatible with projected site area land use. County park and three access areas in vicinity. No national register historic sites. Archaeological resources unknown.	Potential for some significant impacts.
5. Taylor Bend	Resort development within site area. Use of site would result in relocation of existing resort development. Private campground and boat dock in vicinity. No national register historic sites. Three archaeological sites (eligibility undetermined).	Potential for minor impacts.
6. Buck Hollow	Compatible with projected forest and agricultural use of the site area. Commercial recreation area and proposed stream access point in vicinity. Cultural resources unknown.	None identified.
7. Lee Valley	Potentially significant impact to Boy Scout camp located in Dry Branch embayment. Two commercial recreation areas in vicinity. Cultural resources unknown.	Potential for some significant impacts.
8. Phipps Bend	Current use as an energy facility site. Compatible with site area development.	Potential for some significant impacts.
9. Yellow Creek	Current use as an energy facility site. Compatible with site area development.	Potential for some significant impacts.
10. Hartsville	Current use as an energy facility site. Compatible with site area development. Commercial boat docks and private country club approximately 3 miles from site. Dixon Springs and Dixons historic district are located nearby. Numerous areas of prehistoric habitation. One potentially significant archaeological site.	Potential for some significant impacts.
11. Murphy Hill	Current use as an energy facility site. Minimal impact to residential development. Major State park on Guntersville Lake nearby; two local parks; one wildlife management area; and lake and home development community. One historically significant structure, Walker Jordan cabin. One archaeological site.	Potential for some significant impacts.

Attachment II

PROPOSED SURVEY OF FRESHWATER MUSSELS IN THE VICINITY OF THE CRBRP SITE

PROPOSED SURVEY OF FRESHWATER MUSSELS IN THE VICINITY OF THE CRBRP SITE

I. General Survey Phase

At stations located every 0.2 mile between Clinch River Mile (CRM) 14.0 and CRM 18.0, scuba divers will search for mussels along ropes laid across the full width of the river. At each station, data collected will include the number of each mussel species found in each 20-foot interval, observations on substrate composition, and a depth profile.

II. Mussel Habitat Assessment Phase

If more than five mussel species are found in a 40-foot survey segment (two adjacent 20-foot intervals) or if one or more specimens of an endangered species is found in a 20-foot survey interval, the following, more intensive technique will be initiated. This detailed search phase is expected to be initiated rather rarely in the CRBRP reach of the Clinch River and, if more than four such investigations are warranted, the initiating criteria will be evaluated in light of the data being acquired.

Scuba divers will conduct a 15-minute search for mussels parallel to river flow starting 0.1 mile downstream from the general survey interval that initiated this assessment. If five or more mussel species are found during this dive, a second 15-minute dive will be made within the same substrate habitat type at the site. If the second dive yields one or more additional species, a third and, if similarly indicated, a fourth dive will be made in the suitable habitat at the site. The minimum search effort for this intensive phase at one site would be one 15-minute dive. The maximum effort for one site which could be indicated would be four 15-minute dives.

Data from each dive will be maintained separately and will include the location of the dive, the number of each mussel species found, comments on substrate conditions, and depth profile.

Field notes, narrative, and tabular summaries of all data will be supplied to the assessment staff for review and tabulation. A full report covering the survey and its evaluation will be prepared and provided to the CRBRP staff for possible transmittal to the Nuclear Regulatory Commission and other appropriate regulatory agencies.

AMENDMENT XV REVISIONS RESULTING FROM

ADDITIONAL OR UPDATED INFORMATION AND MINOR CORRECTIONS

3.4, 5.4	UPDATE COOLING TOWER RESIDUAL CHLORINE CONCENTRATION LIMITS
3.6	UPDATES PLANT EFFLUENT WATER CONCENTRATIONS
3.9	CORRECTS DESCRIPTION OF TRANSMISSION LINE
4.1	PROVIDES DESCRIPTION OF SOIL EROSION AND SEDIMENT CONTROL MEASURES AND RUNOFF TREATMENT POND FEATURES
5.2	PROVIDES CORRECTION TO RADIOLOGICAL IMPACTS FROM ROUTINE PLANT OPERATION
5.6	UPDATES AESTHETICS CONSIDERATION OF PLANT FACILITIES
6.1	DELETES PARAGRAPH INADVERTENTLY RETAINED FROM PREVIOUS AMENDMENT
10.3	CORRECTS PREVIOUS EROSION TABLE LISTING
APPENDIX F	PROVIDES UPDATED ALTERNATIVE SITING ANALYSIS OF DOE SITES
APPENDIX G	PROVIDES UPDATED ALTERNATIVE SITING ANALYSES OF TVA SITES

NRC QUESTION/RESPONSES - INCORPORATES PREVIOUSLY RESPONDED TO QUESTIONS INTO THE ENVIRONMENTAL REPORT

QUESTION 230.1R

The geology and seismology literature search needs to be updated. The latest reference in the bibliography is 1974. Considerable research in geology and seismology has been done since that time (i.e., Appalachian COCORP Plan; recent studies of the Giles County Earthquake by Bollinger presented at the Earthquakes and Earthquake Engineering meeting in September, 1981 in Knoxville, Tennessee; TVA Appalachian Study; Studies related to the Charleston, S.C. 1886 earthquake; site investigations at TVA and other nuclear projects in the region; studies of other recent and historic Appalachian earthquakes; etc.)

Summary of Response:

The geologic and seismological literature search has been updated to include the years 1974-1981. The various categories into which the recent literature has been presented are identified. A discussion of the findings of the literature search is presented.

Major findings in the geologic literature since 1974 are generally related to interpretation of the origin and structure of the southern Appalachians. Much of this is based on seismic reflection profiles from COCORP and the USGS. These findings have no negative impact on the Site.

Mapping of alluvial terraces along the Little Tennessee River by Delcourt and his correlation of the terraces with terraces at the Watts Bar Nuclear Plant site may provide an additional line of evidence for dating faults and other geologic structures in the Valley and Ridge. However, because other lines of evidence indicate that no faulting has taken place in the Site area since late Paleozoic time, it is not considered necessary to pursue the terrace study further.

In reviewing the available geologic literature, no studies were found which were interpreted to invalidate safety related conclusions made in Section 2.5 of the PSAR.

The most significant seismological related finding since 1974 has been the Giles County earthquake study by Professor G. A. Bollinger which tentatively identified a northeast striking basement fault with ascribed maximum magnitude of Ms 7.0. Using the procedure outlined in the report to estimate the design intensities at distances away from Giles County, the CRBRP site intensity is estimated to be MM VI. Since CRBRP is designed to MM VIII, the current design is more conservative than that arrived at by using Bollinger's Report. Independent studies by TVA reached similar conclusions for the Watts Bar plant located in the same tectonic province. There is no evidence that other similar structures exist within the Southern Appalachian geologic province.

No other new knowledge exists which would imply the inadequacy of the site design maximum intensity (MMVIII).

RESPONSE

The geological and seismological literature search has been updated to include the years 1974-1981. The geologic literature search was designed to include references to recent work performed in the general site area pertaining to possible recent faulting, location of faults not previously recognized in the area, new interpretations of age of thrust faulting, and physical properties of the Paleozoic rock units.

The seismologic literature search was designed to include references to recent work related to understanding the causes and distribution of earthquakes in the eastern United States, recent results of seismic monitoring in specific areas, and recent work defining the tectonic setting of the eastern United States.

The literature search consisted of six data bases (National Technical Information Service, Georef, Geoarchive, Dissertation Abstracts, Government Printing Office, and Engineering Index), a review of reference lists from available recent site-related publications, and a telephone survey of geoscientists familiar with recent work performed in the area. The search generated approximately 300 references, of which fewer than 200 appear to be directly applicable to the geologic or seismologic conditions in the area.

The geologic publications generally fall into three categories: 1) the statigraphy of the Paleozoic rock units; 2) analyses of geophysical data, especially the COCORP seismic data; and 3) developments in the interpretation of the origin of the Southern Appalachians, including origins of and mechanisms for thrust faulting in the Valley and Ridge province. The seismologic literature falls generally into five categories: 1) intraplate tectonics; 2) Cretaceous and Cenozoic faulting; 3) Southern Appalachian tectonics; 4) research conducted in specific areas of the eastern United States; and 5) speculations concerning the causes of eastern United States seismicity.

Geological Literature Review

In reviewing the available geologic literature, no studies were found which were interpreted to invalidate safety related conclusions made in Section 2.5 of the PSAR.

Stratigraphy

Recent studies have served to further characterize the nature and distribution of the Paleozoic rocks in the Valley and Ridge province of Tennessee (27, 33, 34, 40, 41). Additionally, detailed geologic studies within portions of the Valley and Ridge have dealt with the petroleum potential resulting from the geologic structure of the province (13, 15, 28).

Significant recent studies concerning the effects of Quaternary glaciation in the southern Appalachians have been performed (7,8,16,31). In particular, Delcourt's (7,8) study of the terrace deposits along the Little Tennessee River Valley details the fluvial-depositional processes occurring in the Quaternary. This work serves as a framework for interpretation of the recent geologic history in the Tennessee River drainage basin of the Valley and Ridge. Nine sets of terraces above the current floodplain were identified by Delcourt. Delcourt's study may provide an additional means of age-dating geologic events in the Valley and Ridge province. The position taken in the CRBRP PSAR and the consensus of geologic opinion is that the most recent movement along faults in the Valley and Ridge occurred during the late Paleozoic. It is therefore not considered necessary to conduct a terrace study at the CRBRP site.

Analyses of Geophysical Data

Recent analyses of geophysical data including seismic reflection profiles, gravity and aeromagnetic surveys, and remote sensing imagery, have aided in the interpretation of crustal structures in the southern Appalachians. These analyses are an integral part of studies concerning the development of the southern Appalachians.

Seismic reflection profiles, from both the COCORP (1,4,5,6,-29,38,39) and the U.S. Geological Survey (15), provide the most detailed interpretation of the structure of the southern Appalachians. Cook et at. (4) interpret the COCORP profiles, which extend from Madisonville, Tennessee to the Modoc fault near the Coastal Plain overlap in Georgia, to show a continuation of Valley and Ridge sedimentary strata beneath an allochthonous crystalline thrust sheet. The sedimentary strata are suggested to extend at least as far east as the Elberton granite in the Piedmont of northeastern Georgia, and probably to the eastern end of the profile. Harris et al. (15) using U.S. Geological Survey reflection profiles in northern Tennessee and North Carolina, give a similar interpretation. Harris and Bayer (14) extend the master decollement underlying the southern Appalachians to the edge of the present continental shelf and suggest that the entire Appalachian orogen, from Canada to the southern United States, may be detached above a master decollement.

In a 1964 report, Watkins (37) used aeromagnetic and gravity data from Tennessee and Kentucky to suggest a contact between a tectonically active Appalachian crustal block and a stable cratonic block along the western margin of the Valley and Ridge province. In more recent work, Hatcher and Zietz (21,22) used regional aeromagnetic and gravity data to define areas underlain by granitic or mafic crust and areas of varying sediment thickness below the crystalline thrust sheet, and to outline sutures in the Blue Ridge and Piedmont. They also suggest that the master decollement is rooted near the Kings Mountain Belt and that the Charlotte Belt/Carolina slate belt is autochthonous and separated from the allochthonous Inner Piedmont by one of the suture zones.

Remote sensing has been applied to interpretations of structure in the southern Appalachians by Johnston et at. (25). The imagery proved useful in the recognition and mapping of regional structure, jointing patterns, drainage patterns, fault and fracture traces, and rock types. Seay and Hopkins (36) interpreted gravity and aeromagnetic data, remote sensing imagery and seismicity to define tectonic structures in the southern Appalachians.

Development of the Southern Appalachians

Recent studies concerning the development of the southern Appalachians can be divided into two general categories: models developed to explain the tectonic evolution of the region, and research concerning the mechanisms, geometry, and timing of thrust faulting within the southern Appalachians.

Tectonic models have been developed which apply the existing geologic and geophysical data base of the southern Appalachians to the plate tectonics theory (3,10,17,18,19). These models serve as a basis for understanding the timing and mechanics of the formation of the southern Appalachian orogen, including the Valley and Ridge province.

Thrust faulting in the Valley and Ridge is generally accepted to result from "thin skin" tectonics which involves only the upper crust. The actual mechanisms are a subject of debate in the recent geologic literature. Some researchers believe the movement of thrust faults was initiated by gravity sliding along a master decollement formed by the uplift of the Blue Ridge province to the southeast (9,11,26). Other researchers (2,12,17,18,20) either argue against the gravity-slide model, or in favor of a model that explains the initiation of thrusting along a master decollement by major compressive forces caused by a late Paleozoic collision between the African and North American plates. Chapple (2) developed a model based on existing geologic information as well as assumptions concerning the geometry and mechanical properties of the Appalachian geosyncline. He concluded that compressive forces are required to initiate large-scale thrusting such as that found in the Valley and Ridge.

The age of thrusting is a subject of limited debate. Most researchers (17,18,20,32) believe that the most recent movement along the thrust faults occurred during the Permian (late Paleozoic Alleghenian Orogeny). One recent study (24) argues that there was movement as late as the Cretaceous. Schafer (35) cites evidence from offsets in drill holes to document movement along existing thrust faults in the past 15 years within the Valley and Ridge of Tennessee. Odom and Hatcher (30) and Hatcher and Webb (23) interpret this movement to be the result of significant overburden removal in the vicinity of the drill holes (large-scale road excavations), and not related to reactivation of the Alleghenian thrust faults. Odom and Hatcher (30) state that these faults "....have almost no possibility of reactivation by their original driving mechanisms."

Seismological Literature Review

Based on the literature reviewed to date, it is concluded that the specific design assumptions related to the derivation of the Site seismicity for the CRBRP plant will not be impacted. A brief summary with bibliography is included below.

Intraplate Tectonism

Recent studies concerning the occurrence of earthquakes in the eastern United States suggest that seismicity is the result of reactivation of pre-existing zones of weakness by the present stress field. A thorough discussion of this subject is given in (1). The orientation and origin of the modern stress field in the central and eastern United States is discussed in (1) and (2).

Faulting

Recent work has been published pertaining to Cretaceous and Cenozoic faulting along the eastern United States continental margin [3,4,5,6,7,8]. It has been proposed that northeast trending reverse faults of Cretaceous and Cenozoic age are responsible for seismicity along the eastern seaboard [9,10,11].

Southern Appalachian Tectonic Structure

Recent geologic and geophysical evidence is interpreted to indicate that much of the crystalline Southern Appalachians consist of allochthonous slabs thrust from the southeast along a decollement separating the crystalline rocks from essentially flat-lying sedimentary strata [12,13].

The Bouguer gravity field of the region has been studied by several investigators. Decomposition of the gravity field by wavelength filtering reveals a gradient extending from Maine to Alabama. It has been proposed(14) that seismicity in the crystalline Appalachians is concentrated along this gradient and notably along its transverse offsets.

Regional magnetic and gravity data were correlated with seismicity, satellite photo-imagery and related geologic data (15). Results suggest that the Precambrian crust underlying the folded Southern Appalachians has a complex structural pattern which can be divided into a series of distinct tectonic subdivisions.

Specific Areas of the Eastern United States
Charleston, South Carolina:

During the past decade, much research has been directed toward identification of the structure that generated in the 1886 Charleston earthquake. In 1977, the U.S. Geological Survey published Professional Paper 1028, a collection of papers which summarizes preliminary findings (17,18,19,21,22). It is understood that studies are presently on going by USGS related to Charleston area seismicity.

Focal depths for recent seismicity in the Charleston area suggest that the 1886 shock occurred in the upper crust(16). Drilling in the Summerville area has shown that the Coastal Plain sediments are underlain by a basalt layer of Jurassic age(17), which overlies red-bed deposits of earlier Mesozoic age. Further evidence of the graben-like deeper structure of the area comes from seismic refraction[18,19], magnetic[20], and gravity data[21]. Seismic reflection profiles show a reverse fault in the Summerville area (Cooke fault) with possible northeast strike, which moved during Cenozoic time[5]. As yet, the relationship of this fault to seismicity is unclear[16]. Fault plane solutions for the Charleston seismicity show northwest-striking or sub-horizontal nodal planes[22,16].

Recently, it has been proposed that movement along the Appalachian decollement inferred from COCORP reflection data[12,13] may be the cause of the 1886 Charleston event[23]. However, whether or not the decollement extends under the Charleston area is as yet controversial[16].

In their update on information concerning the Charleston area requested for the St. Lucie SER[24], the U.S.G.S. summarizes the current understanding of the area as follows:

"The problem regarding identification of specific tectonic structures capable of generating large earthquakes in the east is far from resolution. Local structures near Charleston are imcompletely known at present and the larger structural element, the decollement, is as yet hypothetical. However, the concentration of seismicity in the Charleston earthquake epicenter both before and after the August 31, 1886, event and the lack of post Miocene faulting in the Coastal Plain or any evidence for localizing large earthquakes indicate that the likelihood of a Charleston-sized event in other parts of the Coastal Plain and Piedmont is very low. Consequently, earthquakes similar to the 1886 event should be considered as having the potential to occur in the vicinity of Charleston and seismic engineering parameters should be determined on that basis."

Giles County, Virginia

Important new information about seismicity in the Giles County, Virginia, area has recently been obtained from monitoring by a dense seismograph network[25,26,27]. The seismic monitoring has revealed that focal depths in the Giles County area range from 5 km to almost 25 km. Furthermore, the epicenters in the area reveal a northeast lineation in the seismicity pattern. Focal depths indicate that activity is below the Paleozoic section, within the Precambrian basement rocks and middle crust. The strike of the epicenter trend of N37°E departs from the general trend of the Paleozoic Valley and Ridge axes in the area. This suggests that the seismicity is caused by a fault zone associated with an earlier trend.

Recently, an estimate has been made of the maximum possible earthquake for the Giles County area by Prof. G. A. Bollinger [28]. This represents the most significant finding since 1974 related to regional seismology. From the range of possible fault plane areas, values ranging from Ms 6.0 to Ms 7.0 were determined. In addition, hypothetical isoseismal maps representing the intensity effects of the maximum earthquake were prepared[28].

Attenuation from the Giles County area to the CRBRP site of the maximum hypothetical size earthquake would result in an event less than the design Intensity VIII and, consequently, will not impact the site seismicity.

TVA addressed this question in a recent response to NRC on evaluating the impact of the Bollinger hypothesis on the seismic design of the Watts Bar plant located in the same tectonic province and similar conclusions were reached (Ref. 31).

Speculations Concerning the Cause of Eastern United States Seismicity

The causes of eastern United States earthquakes are not yet understood. It has been noted that intraplate seismicity shows an association with igneous intrusive rocks(1), and hypotheses concerning the role of intrusive bodies in concentrating stress have been proposed(29,30). It has been argued that both seismicity and igneous intrusives are fundamentally related to rift zones, areas of pre-existing crustal weakness which may be reactivated by the modern stress field(1,16).

Two recently proposed hypotheses attempt to explain the origin of seismicity in the Piedmont and Coastal Plain provinces of the eastern United States. Under one hypothesis(23), the 1886 Charleston event is attributed to gravitational backslip along the Southern Appalachian decollement. Another hypothesis (9, 10, 11) proposes that seismicity along the Atlantic Coast is related to reactivated reverse movement on scattered northeast trending faults formed during Mesozoic rifting. However, these hypotheses are not viable in the folded Southern Appalachian area. Recent data from Giles County, Virginia, suggest that a reactivated, northeast trending, high angle, dip slip fault formed in early Paleozoic time may be responsible for the seismicity in that area (25).

GEOLOGY REFERENCES

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Question 230.2R (NRC letter dated 10/26/81, response dated 12/22/81)

Based on the site investigation data presented in the PSAR, the upper siltstone horizon of Unit A, within which the structure foundations are to be placed, is relatively devoid of solution features below foundation grade. However, it is not obvious that the underlying limestone unit of the Chickamauga Group, Unit A and the much deeper Knox group do not contain significant cavities. Determine the maximum size cavity, based on regional studies of karst features in these rock units, that could exist beneath the plant without being detected by the investigations performed. Evaluate the capability of the foundation rock unit (Unit A, upper siltstone) to bridge such cavities.

Summary of Response

1) The potential for cavities and other karst features within the Unit A Limestone of the Chickamauga Group below the proposed base excavation level for the Nuclear Island is considered minimal. It is believed that existing boring data, results of the test grouting program, and the planned bedrock verification program as addressed in the PSAR will be sufficient to confirm the homogeneity of the Unit A Limestone. This verification program is scheduled to commence shortly and results will be provided upon completion.

2) Research studies on the regional geology have shown that weathering in the Knox has been encountered to depths up to 200 feet. Geotechnical investigations at the site have indicated a depth of weathering in the Knox not exceeding 100 feet. Consequently, with a minimum depth of cover above the Knox of 450 feet, subsidence problems will not occur beneath the CRBRP site.

Response

EVALUATION OF THE POTENTIAL CAVITIES IN THE KNOX FORMATION

The size, shape, frequency, and extent at depth of karstic cavities depend upon 1) the extent of the weathering zone, 2) the presence or absence of impervious strata, and 3) local geologic structures (faults). In general, solution cavities, both ancient and recent, may be open, or completely filled with clastic material, or may be water-filled conduits. Ancient, or paleokarst cavities, are typically filled with recemented material and are as competent as the host rock around them.

Weathering within the Oak Ridge reservation is usually limited to the upper 100 feet of the surface. The weathering of rock is most severe in the local limestone and dolomite units, leaving karstic terrain with clay and chert residuum for soil. Below the weathering zone, the rock is generally jointed, but sound, with joint strength increasing and open joint frequency decreasing with depth.

The development of karst features at the surface and at depth in the rocks of the Knox Group is well documented. Sinkholes and cavities are very frequent and have created many problems in the foundation of structures throughout the entire region. The Knox Group has been described as a massive dolomite with a paleokarst upper unit. This upper unit reflects an ancient karstic erosional surface which was subsequently beveled and covered by the Chickamauga Group. According to local experts and available references, this paleokarst unit is now a very competent rock. The ancient solution cavities, joints and caves, were filled with residuum and recemented to the point that it is now difficult to detect the paleokarst unit from the overlying and underlying carbonate units. These paleokarst features are well documented in the zinc district of northeastern Tennessee where they are always filled and cemented and do not represent a hazard.

The only areas of karst with active solutioning exist within zones of active weathering, at or close to the contact between the Knox and the Chickamauga groups, and at depths ranging from 0 to 200 feet. The size of the cavities varies from enlarged joints to several tens, and occasionally hundreds of feet in span. Geotechnical investigation at the site indicated a maximum depth of weathering not exceeding 100 feet.

To summarize our own experience and available data the following can be concluded: 1) Frequent and large open cavities (up to several hundred feet) occur within the Knox Group. These solution features are exclusively developed at shallow depth (no deeper than 200 feet) and in relation to the zone of weathering. 2) Many cavities appear to be located at or close to the unconformity existing between the Knox and Chickamauga Groups. When this unconformity is at depth beneath the zone of weathering the karst features are ancient and filled, and the filling material is recemented.

In conclusion, it would appear that subsidence is not a problem below the CRBRP site and in view of the shallow depth of weathering, it would not be necessary to conduct hypothetical analytical studies to determine the maximum size cavity related to depth and strength properties of overlying strata.

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Project Management Corporation, 1975. Clinch River Breeder Reactor Plant, Environmental Report, Section 2.4.

QUESTION 230.3R (NRC letter dated 10/26/81, response dated 12/22/81)

Furnish a map and summary discussion of the relationship beneath the Pleistocene/Pliocene high terrace deposits and geologic structures at the site, particularly the shear zone encountered in core borings.

RESPONSE

In response to this question we are providing Figure 2.5-5 from the PSAR which is the site geologic map.

Although terrace deposit studies have been used as a tool to locate and date faulting and other geologic structures, they were not used for this purpose during the CRBRP licensing investigation. The age of geologic structures at and near the site (Copper Creek, White Oak Mountain, and other faults as well as the shear zone within the Chickamauga Group) were determined by other lines of evidence. At the time of the original PSAR development in 1973 and 1974, no other such terrace study had been carried out in eastern Tennessee within the Valley and Ridge geologic province. Since that time, one such study had been identified. This study was performed by P. A. Delcourt of the University of Tennessee (Knoxville) along the Little Tennessee River from Chilhowee Dam to the Tellico Dam (approximately 10 miles southeast of the CRBRP site). Delcourt* has mapped nine different terrace deposits along the river and has radiocarbon age dates on the three youngest terraces.

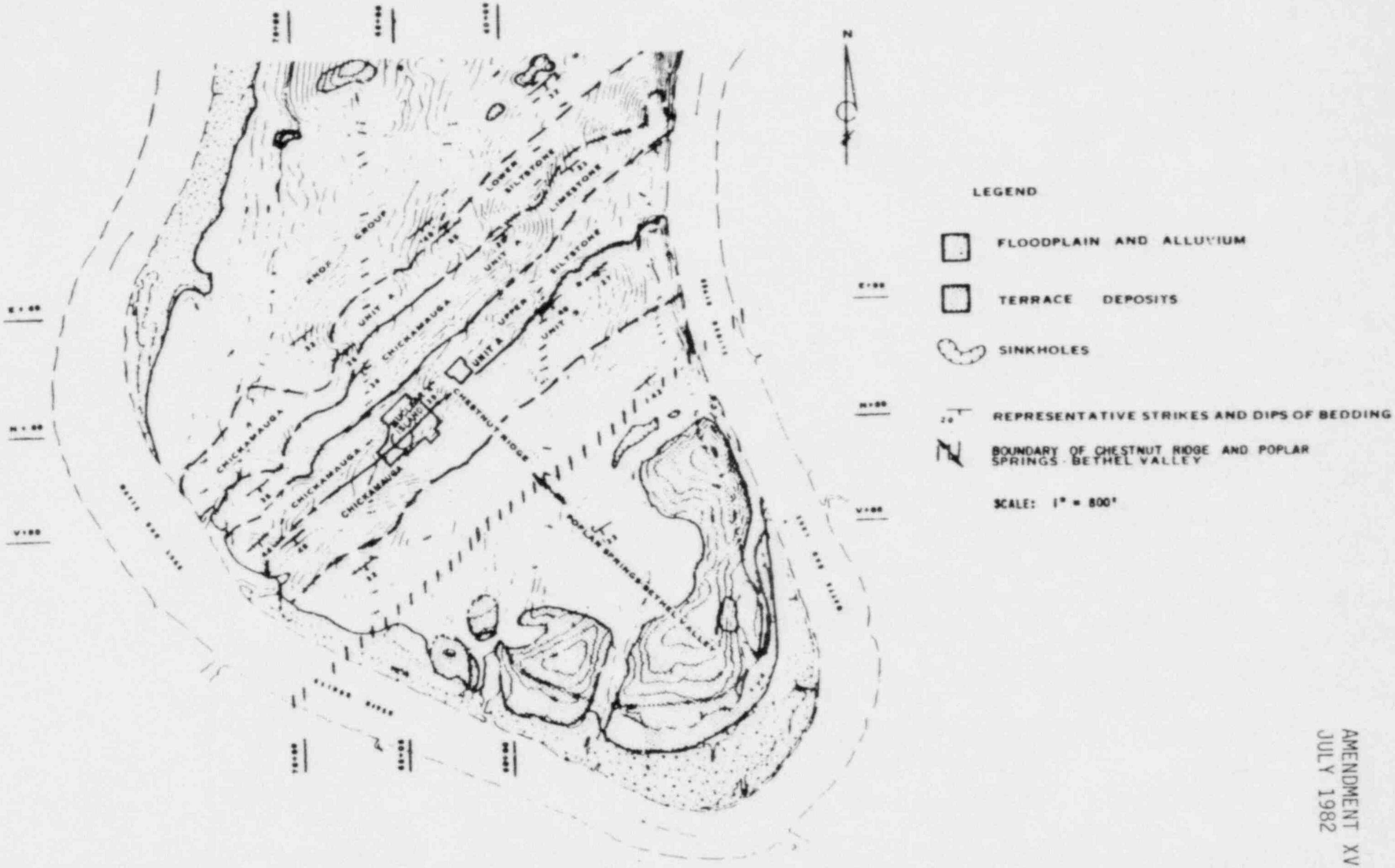
*Delcourt, P. A., 1981, Personal Communication to Law Engineering Testing Company.

The distribution and state of presentation of the terrace deposits along the Clinch River is not documented in the geologic literature; therefore, no assessment can be made concerning their relationship to the terrace deposits mapped by Delcourt along the Little Tennessee River or directly to the structures identified at the site. However, during the geologic mapping at the site, the general distribution of terrace material was plotted (PSAR Figure 2.5-5). Terrace deposits form a veneer over portions of the site. This material is high-level alluvium deposited by the Clinch River when stream levels were much higher than at the present. Such deposits are generally regarded as Pleistocene to Pliocene in age. The terrace deposits consist mainly of orange and red silty clay with thin layers of rounded quartz, chert, and quartzite gravel. A limited number of borings have penetrated the terrace deposits extending to depths ranging from 8 to 19.5 feet below the ground surface.

For a study to be conducted on the terrace deposits, it would first be necessary to establish whether sufficient material exists in the near vicinity of the CRBRP site to permit developing a correlation with geologic structures at the site including the shear zone encountered in the Chickamauga Group. Detailed surface mapping and surveying in conjunction with subsurface mapping (trenching with a backhoe) would be required. Correlation of individual terraces would have to be done by age dating (radiocarbon or palynology), comparison of lithologic composition of the terraces, or possibly by heavy mineral analyses of terrace material. Plotting the distribution of the terraces on longitudinal profiles would allow for detection of offsets in the terraces on the regional scale, while smaller scale offsets would have to be recognized in the field, generally from the trench study.

It is considered that a program of work of the nature described above is not warranted for the CRBRP site because, as outlined in the PSAR, other lines of evidence were sufficient to conclude that all structural elements including the shear zone are ancient and are not considered capable.

Q230.3R-4



AMENDMENT XV
JULY 1982

Figure 2.5-5 Site Geologic and Physiographic Map

QUESTION 230.4R

What is the current status of the radioactive waste injection well on the Oak Ridge Reservation approximately 4 miles east of the site?

RESPONSE

The injection well at the experimental shale fracturing facility has been retired from service. It was used for the injection of approximately 2 million gallons of waste grout over a 16 year period. The maximum determined extent of the grout sheets from these injections was approximately 700 ft* from the well.

A new injection well has been installed about 800 ft. south of the experimental facility. This well will be used for future injections of waste grout, starting in June, 1982.

The characteristics of both wells are given in the Environmental Impact Statement for the New Hydrofracture Facility - ERDA 1553.

*Management of Intermediate Level Radioactive Waste, ORNL
ERDA 1553, Sept. 1977

QUESTION 230.5R

The geology section for the Clinch River site in the Alternate Site write-up should be updated. It is written as if only four core borings have been drilled there and the geologic conditions are unknown. This can be done by referring to Chapter 2.4.

RESPONSE

An extensive geological survey was conducted following the selection of the Clinch River site for the demonstration plant. The results of the survey were documented in Section 2.4 of the ER and were updated by Amendment IX.

Section 9.2.5.3.4, "Geology" of the Alternative Energy Sources and Sites Section has been updated by referring to Section 2.4.

QUESTION 240.1R

Information Requirements Relating to Executive Order 11988 on Floodplain Management.

(Definition of 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.)

1. Provide descriptions of the floodplains of all water bodies, including intermittent water courses; within or adjacent to the site. On suitable scale map provide delineations of those areas that will be flooded during the one-percent chance flood in the absence of plant effects (i.e., pre-construction floodplain).

2. Provide details of the methods used to determine the floodplains in response to 1. 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 Flood Insurance Administration (FIA), Housing and Urban Development (HUD) or the Corps of Engineers are available for the site or adjoining area, the details of analyses need not be supplied. You can instead provide the reports from which you obtained the floodplain information.

3. Identify, locate on a map, and describe all structures, construction activities and topographic alterations proposed in the floodplains.

4. Discuss the hydrologic effects on all items identified in 3. above. Discuss the potential for altered flood flows and levels, both upstream and downstream. Include the potential affect of debris accumulating on the plant structures. Additionally, discuss the effects of debris generated from the site on downstream facilities.

5. Provide the details of your analysis used in response to 4. above. The level of detail is similar to that identified in item 2. above.

6. Identify non-floodplain alternatives for each of the items (structures, construction activities and topographic alterations) identified in 3. above. Alternately, justify why a specific item must be in the floodplain.

7. For each item in 6. above that cannot be justified as having to be in the floodplain either show that all non-floodplain alternatives are not practicable or commit to re-locating the structure, construction activity or topographic alteration out of the floodplain.

RESPONSE

1. Two streams are adjacent to or within the CRBRP site: the Clinch River and Grassy Creek. In addition, there are eight small, intermittent drainageways that flow through the site area, as shown in Figure 240.1R-1 and Figure 240.1R-2. Storm runoff from these drainageways will be controlled by site grading and a storm drainage system as described in PSAR Section 2.4.2.3.

   The 1-percent-chance floodplain of the Clinch River at the site and along the access road and railroad leading to the site are delineated on figures 240.1R-1 through 240.1R-6. The 1-percent chance floodplain of Grassy Creek is controlled by the Clinch River flood level as shown in Figure 240.1R-3. Figure 240.1R-3 also provides the 1-percent-chance floodplain of the Clinch River in the vicinity of the barge unloading area.

2. Details of the analyses used in the computation of the 1-percent-chance floodflows and water elevations are described in the study "Flood Insurance Study, Roane County, Tennessee, (Unincorporated Areas)" made by TVA for FIA and published in March 1980. Copies of the sections of this report that describe the hydrologic and hydraulic analyses (pages 8-15), together with the list of report references (pages 29-30) and Clinch River profiles (figure 02P), are provided in Exhibit 1.

3. Construction activities proposed in the 1-percent-chance floodplain include a limited amount of clearing and grubbing and those associated with the construction of three runoff treatment ponds, the river water intake structure, the

barge unloading facility, discharge outfall facility and portions of the plant access road and railroad. These structures, along with the clearing and grubbing limits, are shown on figures 240.1R-1 through 240.1R-6.

4. & 5. The proposed construction activities or structures that are located in the floodplain will not alter floodflows or elevations. The drainage areas--3,380 square miles at Clinch River mile 15.5 and 3,368 square miles at Clinch River mile 17.8--are not altered and the reduction in flow area at the site is infinitesimal and at the fringe of the flooded area. The site will be well-maintained and any debris generated from it will be minimal and will present no problem to downstream facilities.

6. (a) River Water Intake Structure

No non-floodplain alternative exists for the River Water Intake (Figure 240.1R-1). The intake pipe must be located in the river in order to draw water. Maintenance of a 2:1 slope and placement of rip rap along the river bank leading from the intake structure will mitigate any impact from the 1 percent chance flood occurrence.

(b) Barge Unloading Facility

The primary function of the Barge Unloading Facility (Figure 240.1R-3) is to furnish an economical, practical transportation means for major plant components, e.g., reactor vessel, etc.

Alternate transportation systems, i.e., road and rail, can accommodate neither the component sizes nor the weights.

The facility must be located in the river in order to service the barges. As a result, no non-floodplain alternative exists for the Barge Unloading Facility. The 1 percent chance flood will intersect on roads leading to and from the facility and on the railroad all of which will have a 2:1 slope and grassed berms to mitigate any impact from the 1 percent chance flood occurrence.

(c) Discharge Outfall Facility

The function of the Discharge Outfall Facility (Figure 240.1R-1) is to integrate all plant discharges into the main body of the Clinch River as rapidly and as thoroughly as possible in order to minimize environmental impacts. Consequently, non-floodplain alternatives cannot satisfy the functional requirements of the Discharge Outfall Facility. Maintenance of a 2:1 slope and placement of rip rap along the river bank leading from the Discharge Outfall Facility will mitigate any impact from the 1 percent chance flood occurrence.

7. (a) Runoff Treatment Ponds

The prime function of the Runoff Treatment Ponds is to settle/filter surface runoff during both construction and plant operation to effect suspended solids removal prior to discharge to the Clinch River.

Runoff treatment ponds "A", "B" and "E" are located in low lying areas within the projected one-percent-chance floodplain. (Refer Figures 240.1R-7, 8 & 9, respectively.) Practical design constrains the pond bottom elevations to approximate the receiving water body (Clinch River) elevation. Such an arrangement affords a minimum pond expanse while eliminating downstream pond discharge problems associated with high discharge velocities.

Alternate location of presently proposed ponds and appurtenances are not practical for the following reasons:

Pond "A" -	Moving Pond "A" out of the flood plain would cause relocation of necessary construction laydown/storage and shop areas. Main fill extension to accommodate displaced laydown and shop needs would require substantial clearing/grubbing and earthwork. (Figure 240.1R-7.)
Pond "B" -	The sewage treatment plant, waste treatment lagoon/equalization basin and warehouse would have to be relocated to less desirable and practical sites. (Figure 240.1R-8.)
Pond "E" -	Physical constraints prevent this pond from being constructed within adjacent railroad/access road fill. Alternate railroad and access road siting would require drastic realignment either through hills toward the east or the flood plain on the west. Alternately, rugged upstream topography precludes suitable and practicable pond relocation. (Figure 240.1R-9.)

As an additional alternate, should Ponds "A" & "B" be relocated so as to be contained within nearby undisturbed natural high terrain (Figures 240.1R-7 & 8), the following consequences would result:

- the resulting toe of natural slope embankments would in turn be subject to the one-percent-chance flood backwaters
- additional construction expenditures would be required for clearing/grubbing, earthwork and rock excavation

Thus, any alternative location of these ponds will still require construction of either alternate structures and/or alteration of topographic features presently within or adjacent to the floodplain; be economically unsound and/or be an impracticable alternate from the standpoint of the functional requirements of the runoff treatment ponds. Therefore, there is no practical alternative to locating these ponds within the 1-percent-chance floodplain. Measures such as grated gravel, or crushed rock and grass will be placed to minimize adverse floodplain impacts to the runoff treatment ponds.

(b) Road and Railroad Alignments

Onsite Road

The plant access road and rail spur (Key Plan, Figure 240.1R-10) provide necessary transportation modes for material and personnel. The presently proposed onsite road alignment closely follows an existing river patrol road (Figures 240.1R-1 through 240.1R-6). Road gradients, geometric alignment, clearances, etc., must be upgraded to accommodate the transportation requirements for the project. Alternate road route(s) would either be located totally within the floodplain or pass through terrain requiring excessive clearing, excavation and fill for embankments.

Onsite Railroad

The onsite railroad work has been incorporated with the proposed access road earthwork (Figures 240.1R-3 and 240.1R-4). Such alignment minimizes floodplain encroachment by restricting the rail route to the floodplain perimeter. Alternate onsite routes would either pass totally within the projected floodplain or via adjacent steep hills, thereby necessitating extensive earthwork at excessive cost.

Offsite Railroad

Alternate offsite railroad routes were investigated during the design process. The selected offsite layout represents the most practical, feasible route free of the following physical constraints: (Figures 240.1R-10 through 14).

- o Gallaher bridge superstructure
- o Oak Ridge Turnpike embankment
- o Oak Ridge Turnpike overpass at Bear Creek Road
- o Bear Creek Road travelway and shoulder
- o Rugged topography of Pine Ridge (east side of Bear Creek Road in the vicinity of Oak Ridge Turnpike)

No practical alternate offsite railroad alignment exists. Adverse floodplain impacts will be minimized by:

- o Maximizing high ground routing where railroad is not adjacent to Bear Creek Road (Figures 240.1R-12 and 13.)

- o Placing required railroad supporting fill at the floodplain perimeter where the railroad is adjacent to existing Bear Creek Road (Figure 240.1R-14).

- o Providing the site access road and railroad berms with a 2:1 grassed slope, except for those areas of culvert crossing (Grassy Creek and upstream of Grassy Creek) which will be rip rap for interface between the river water and the road and railroad embankments.

While alternate transportation modes exist, not all required products and materials are adaptable to the alternate transportation modes. Point of origin, shipment size, shipping economics and specialty components, etc., determine the transportation method utilized, i.e., not everything can be transported via road or water. For example, turbine stators are historically rail shipped via special rail cars.

Consequently, non-floodplain alternatives cannot satisfy the functional and practicable requirements of railroad and access road, both alignment and mode.

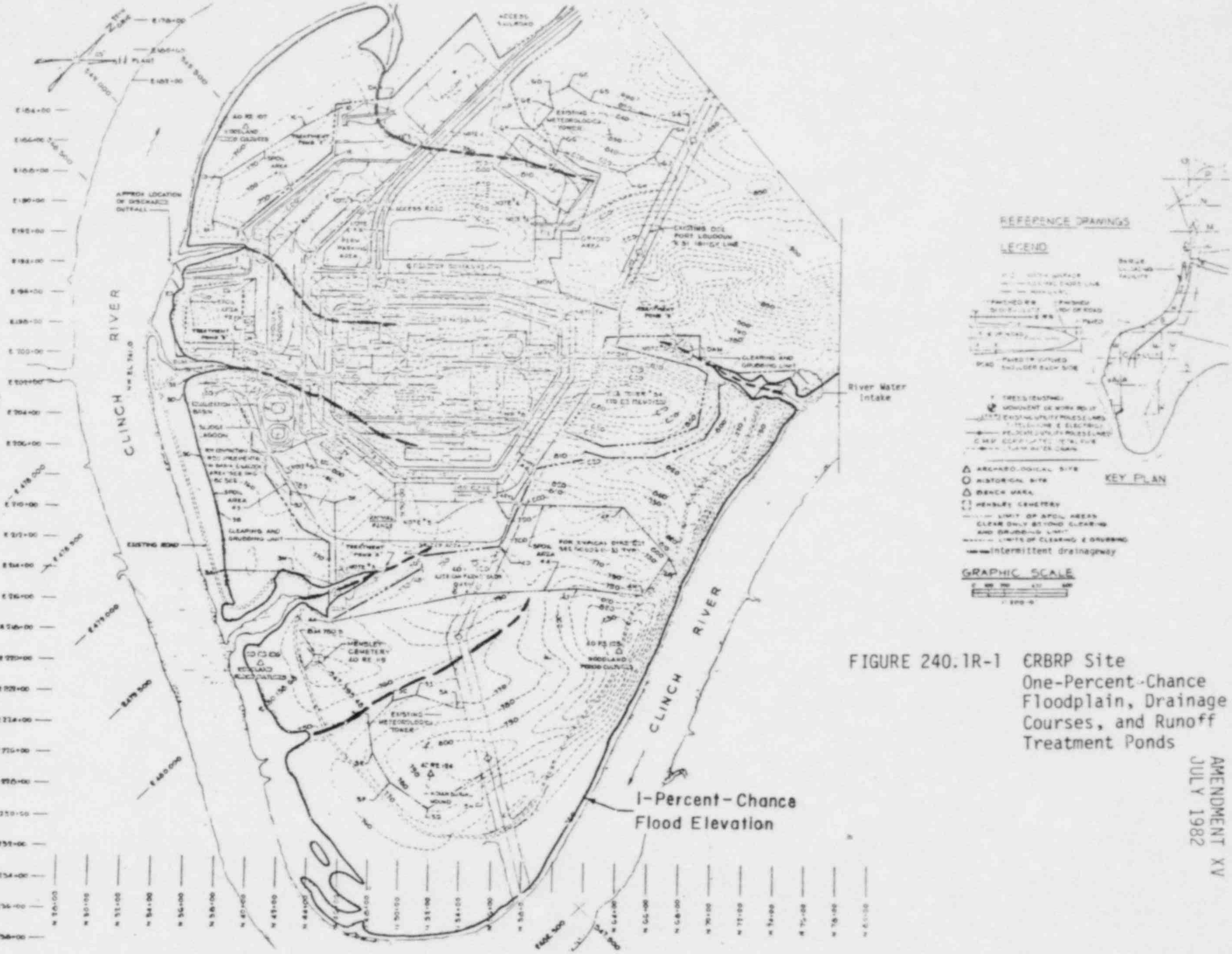


FIGURE 240.1R-1 CRBRP Site One-Percent-Chance Floodplain, Drainage Courses, and Runoff Treatment Ponds

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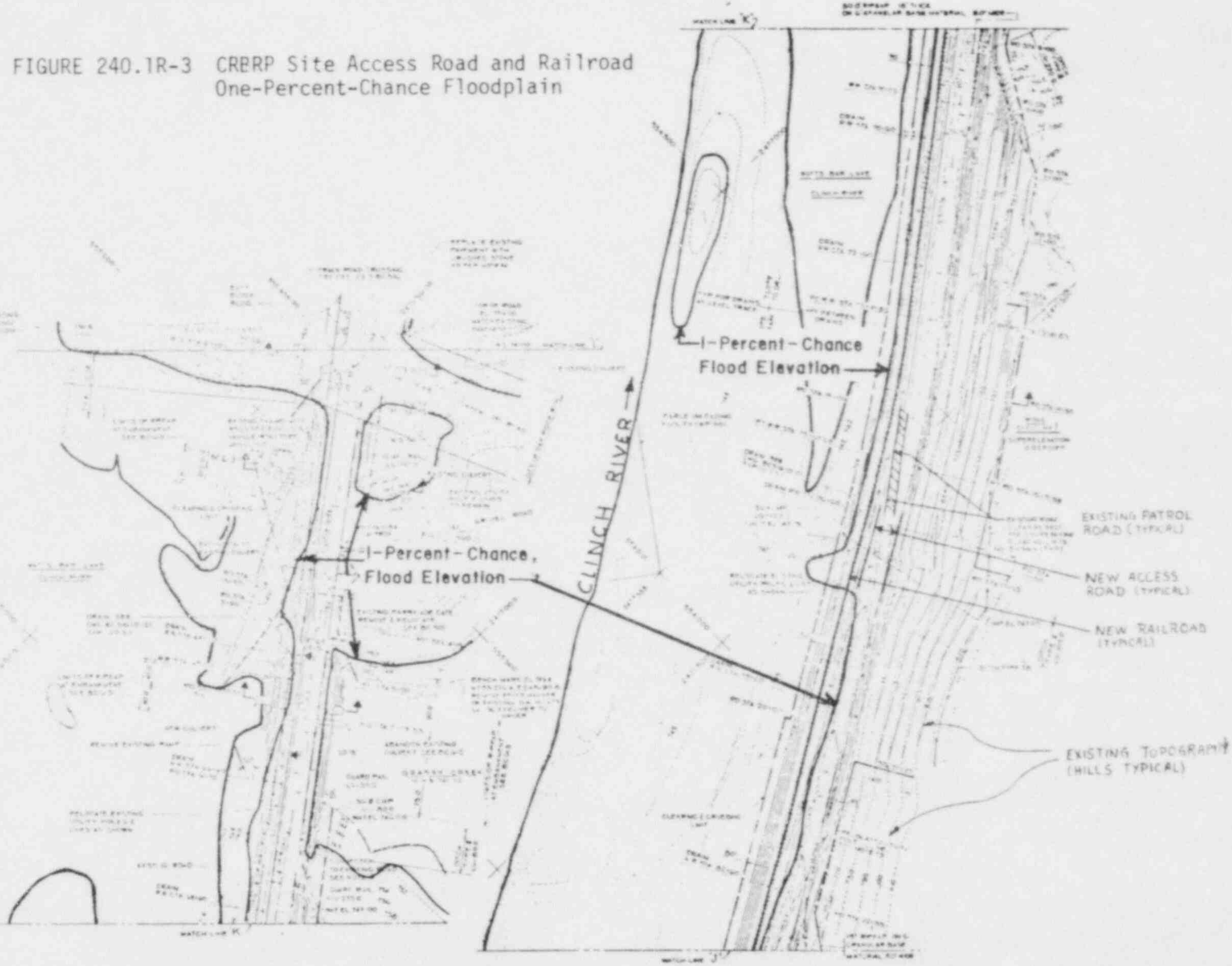
Figure 240.1R-2 CRBRP Site Access Road and Railroad One-Percent-Chance Flood Plain

FIGURE 240.1R-3 CRBRP Site Access Road and Railroad One-Percent-Chance Floodplain



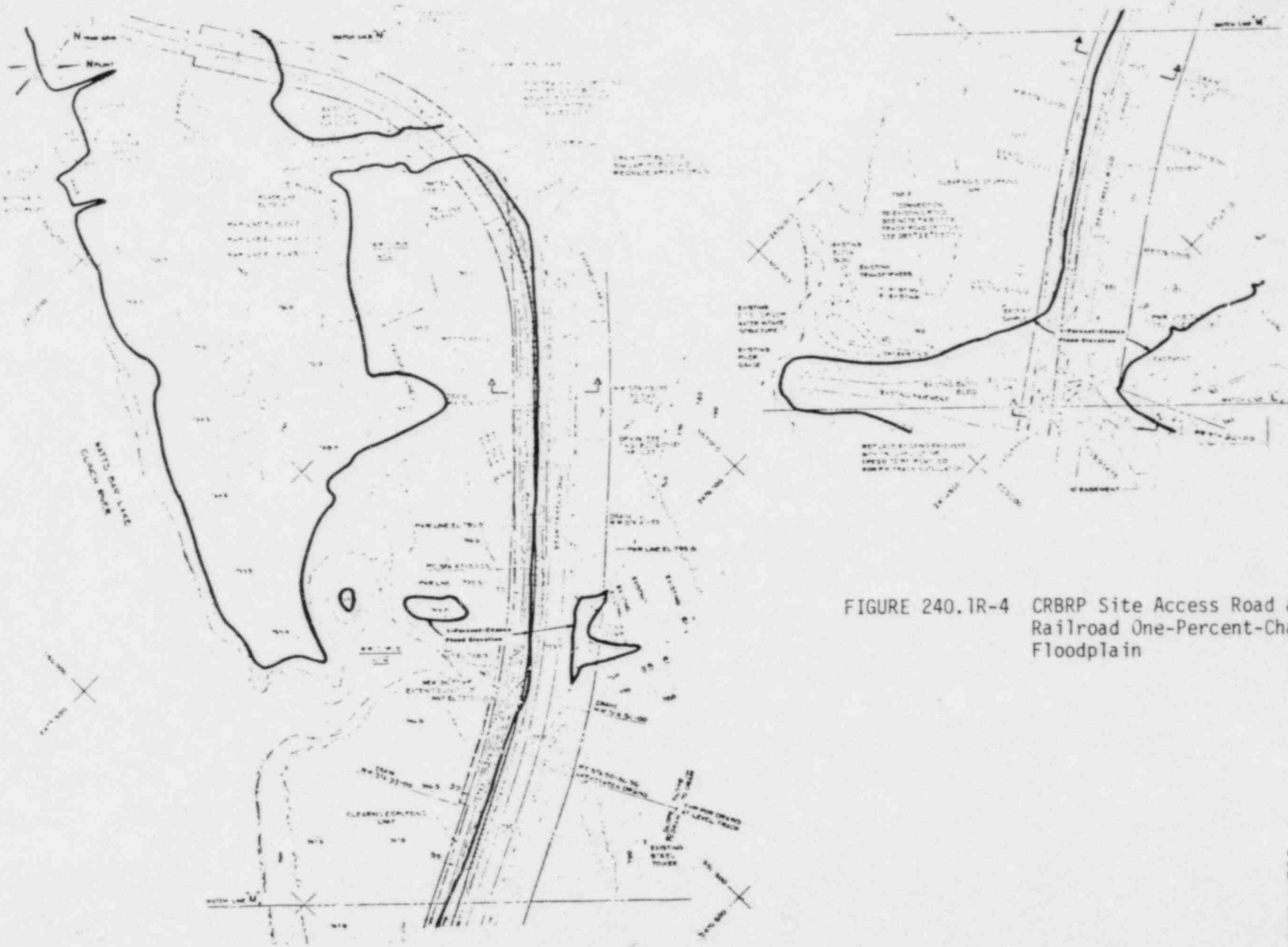


FIGURE 240.1R-4 CRBRP Site Access Road and Railroad One-Percent-Chance Floodplain

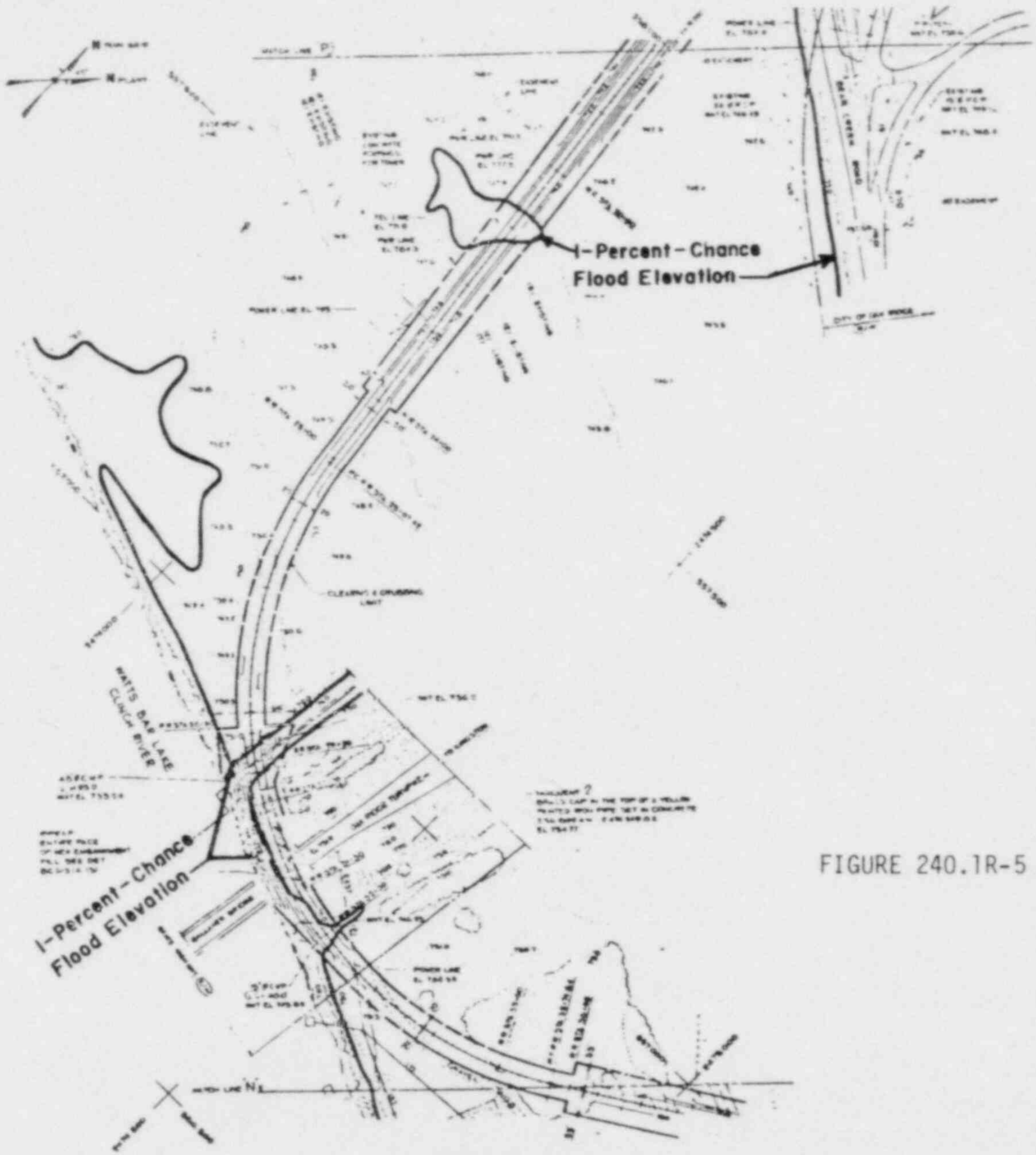


FIGURE 240.1R-5 CRBRP Site Access Road and Railroad, One-Percent-Chance Floodplain

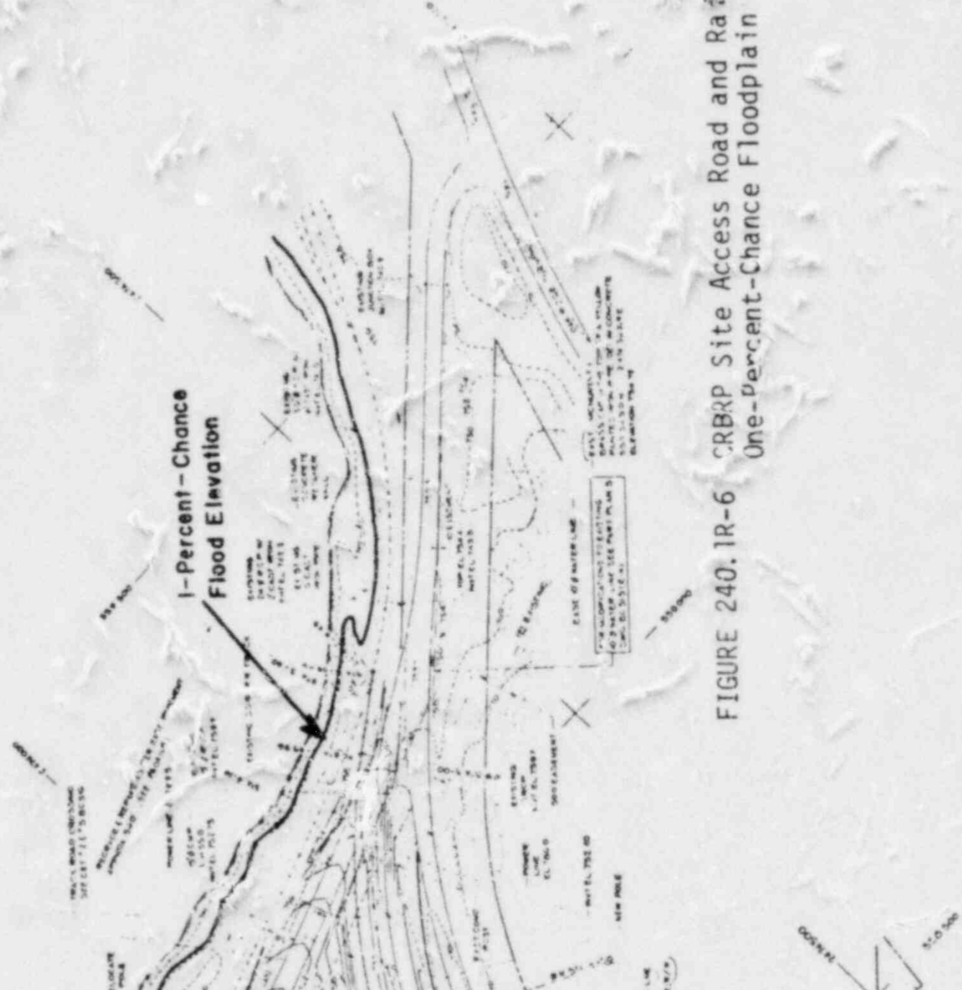


FIGURE 240.1R-6 CRBRP Site Access Road and Railroad One-Percent-Chance Floodplain

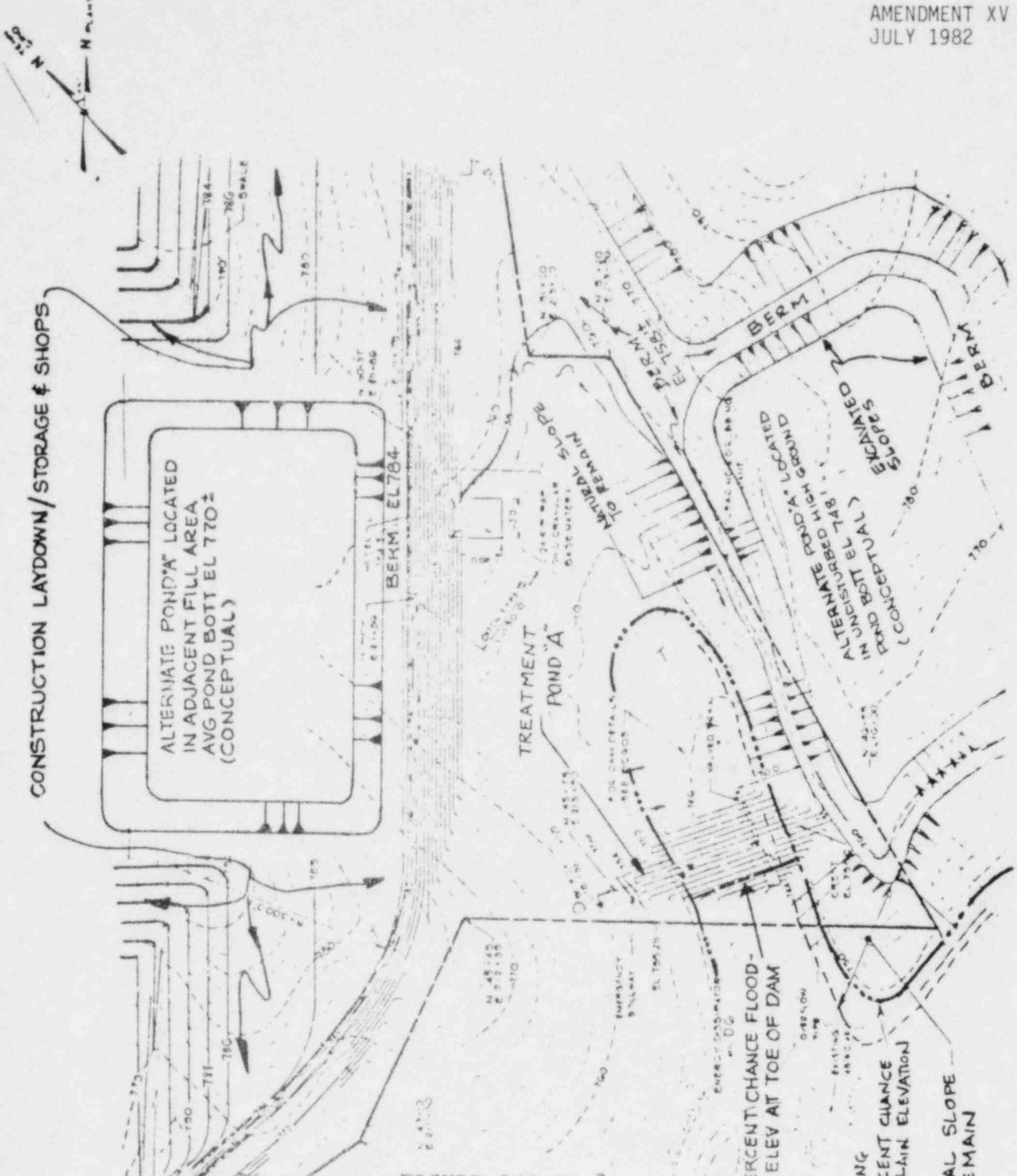


FIGURE 240.1R-7

Treatment Pond 'A' Vicinity

FIGURE 240.1R-8

Treatment Pond 'B' Vicinity

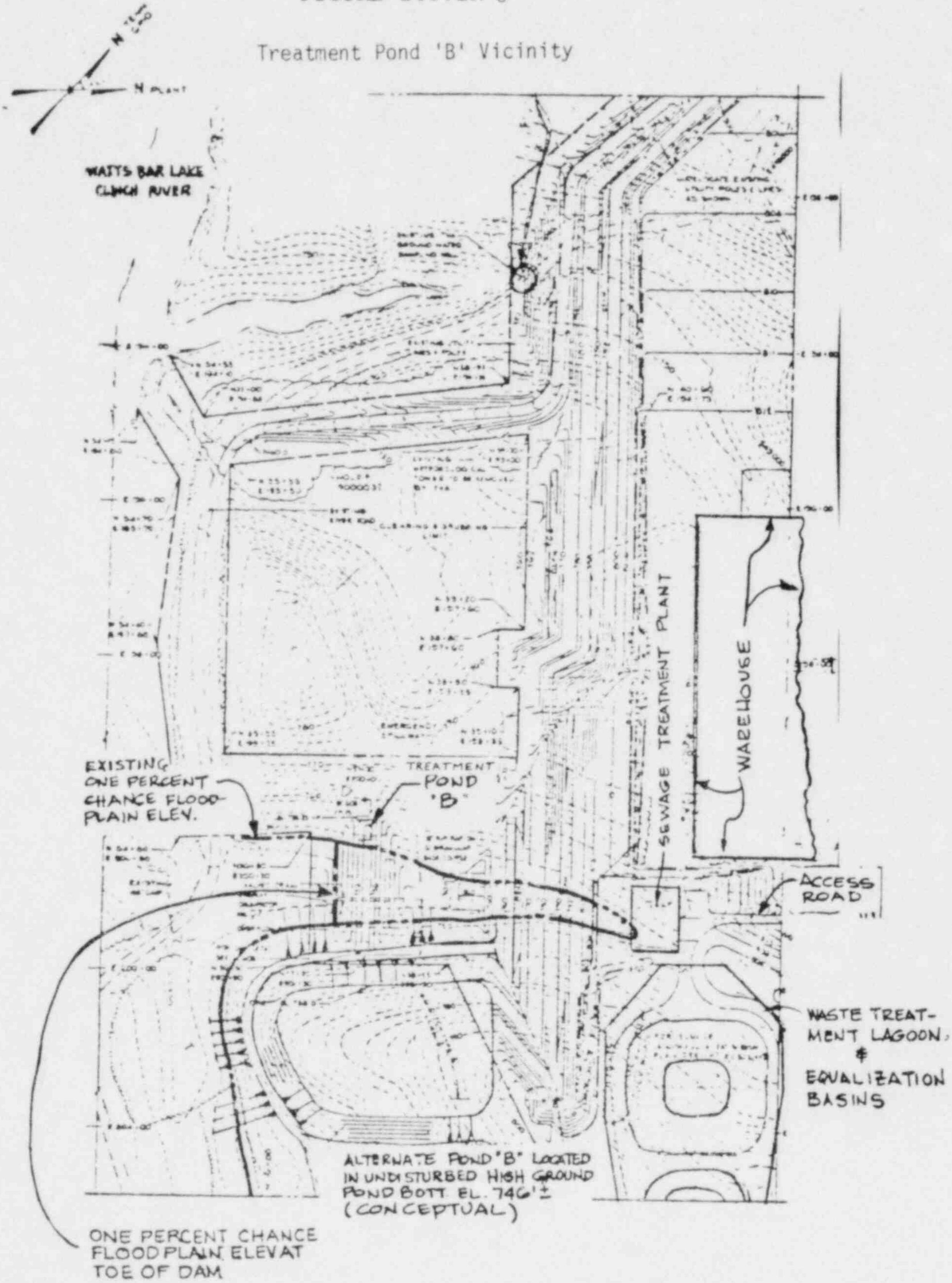


FIGURE 240.1R-9

Treatment Pond 'E' Vicinity

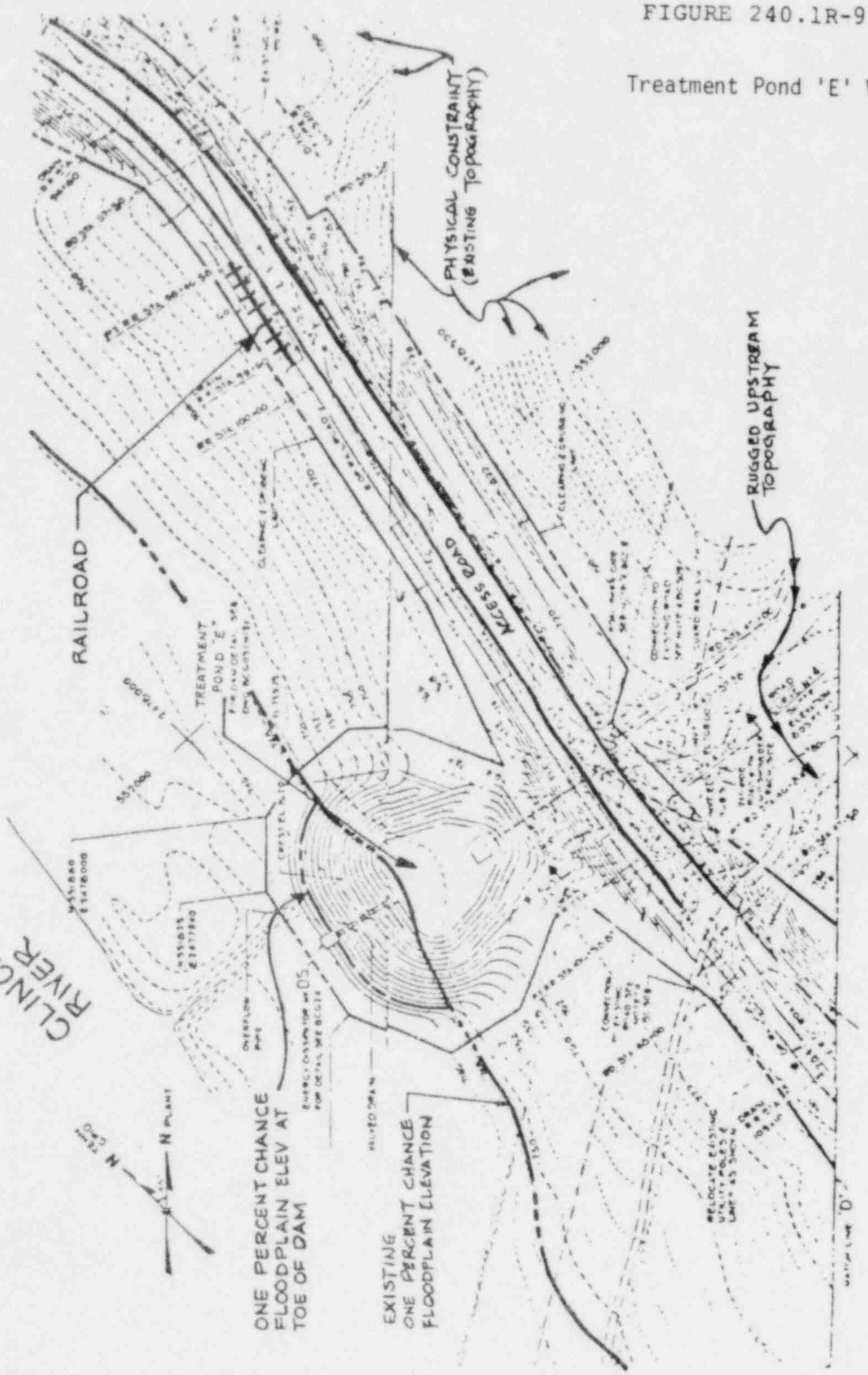


FIGURE 240.1R-10

Access Road and Railroad Key Plan

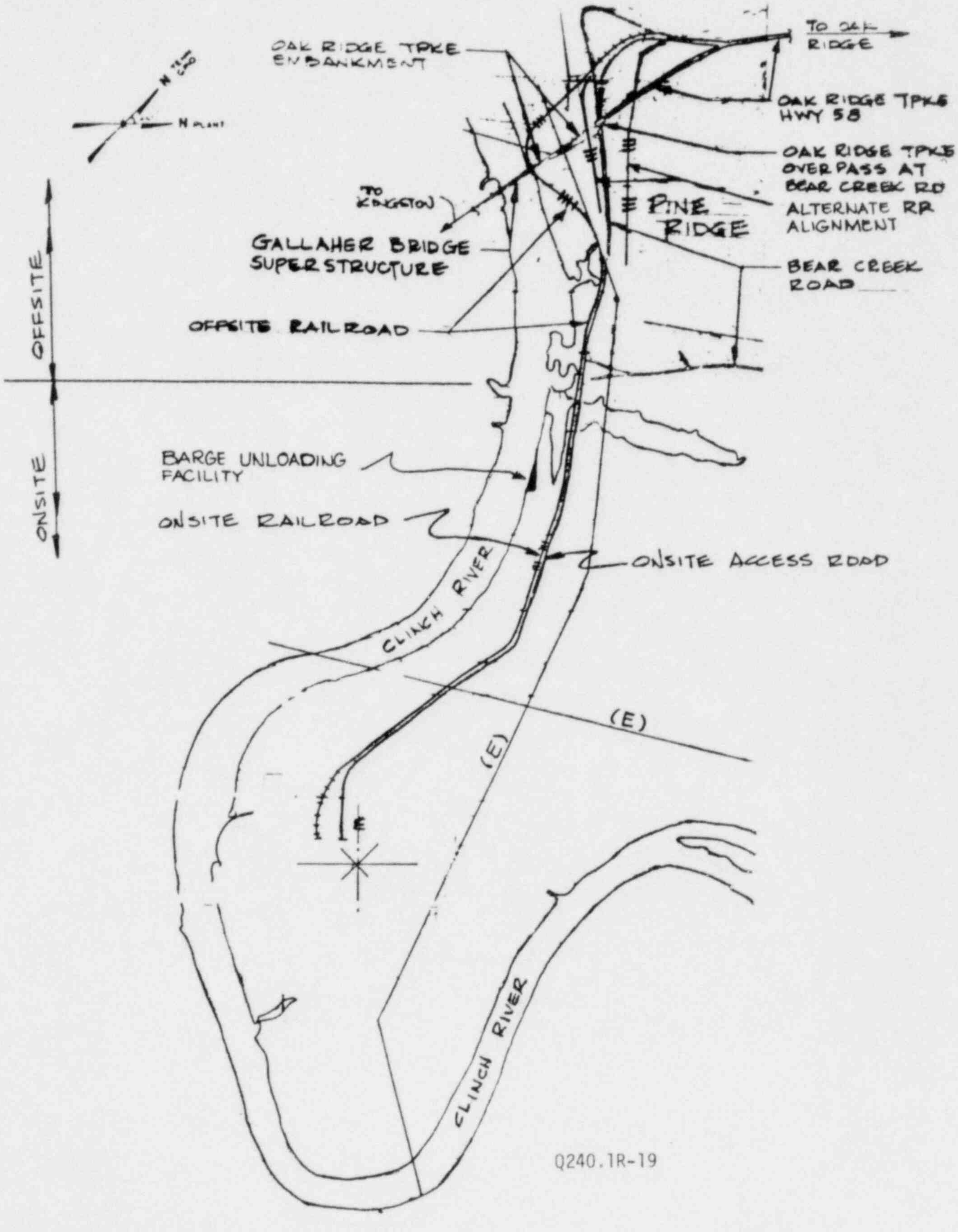


FIGURE 240.1R-11

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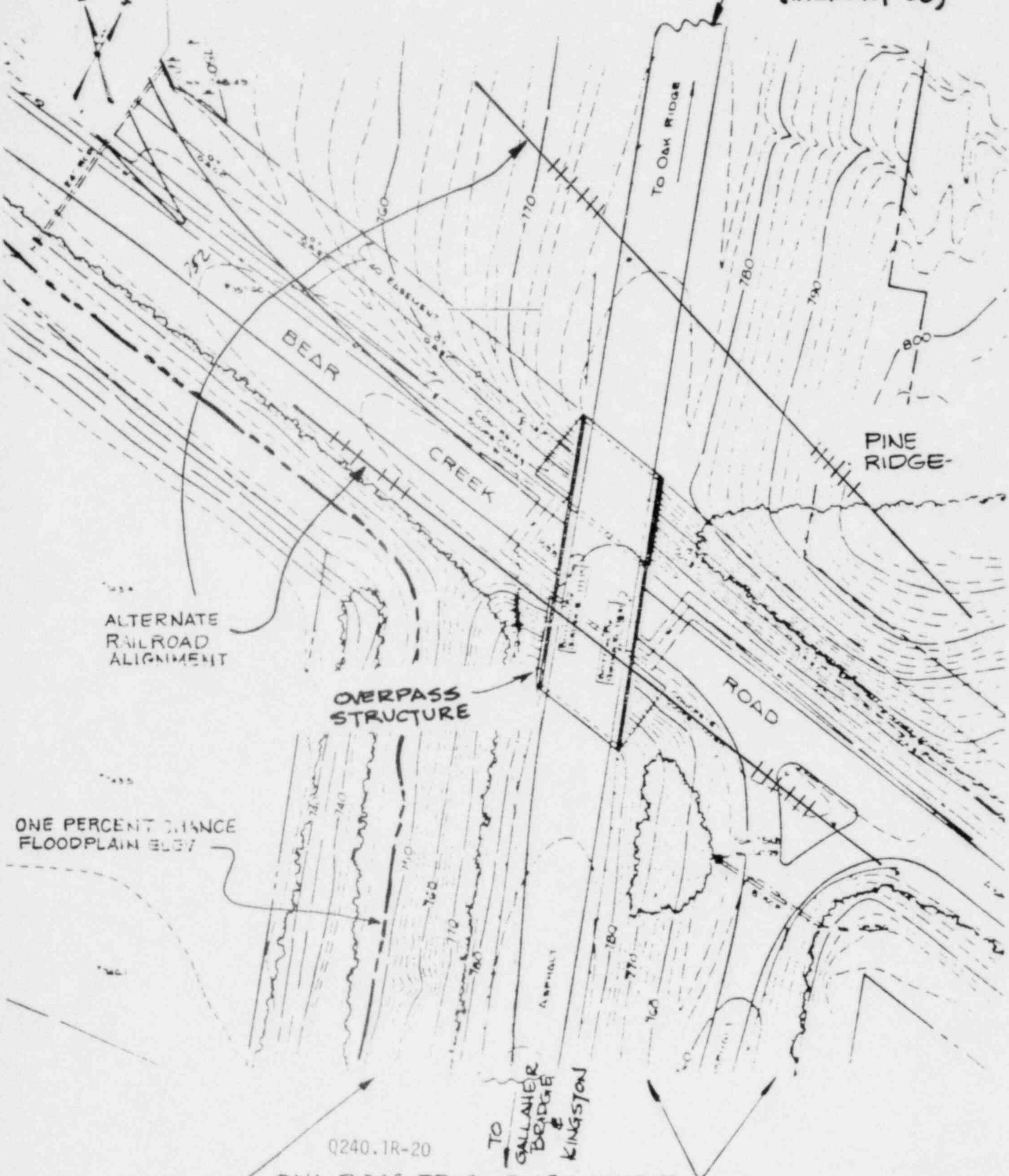
Intersection Bear Creek Road and Oak Ridge Turnpike



Q240.1R-20

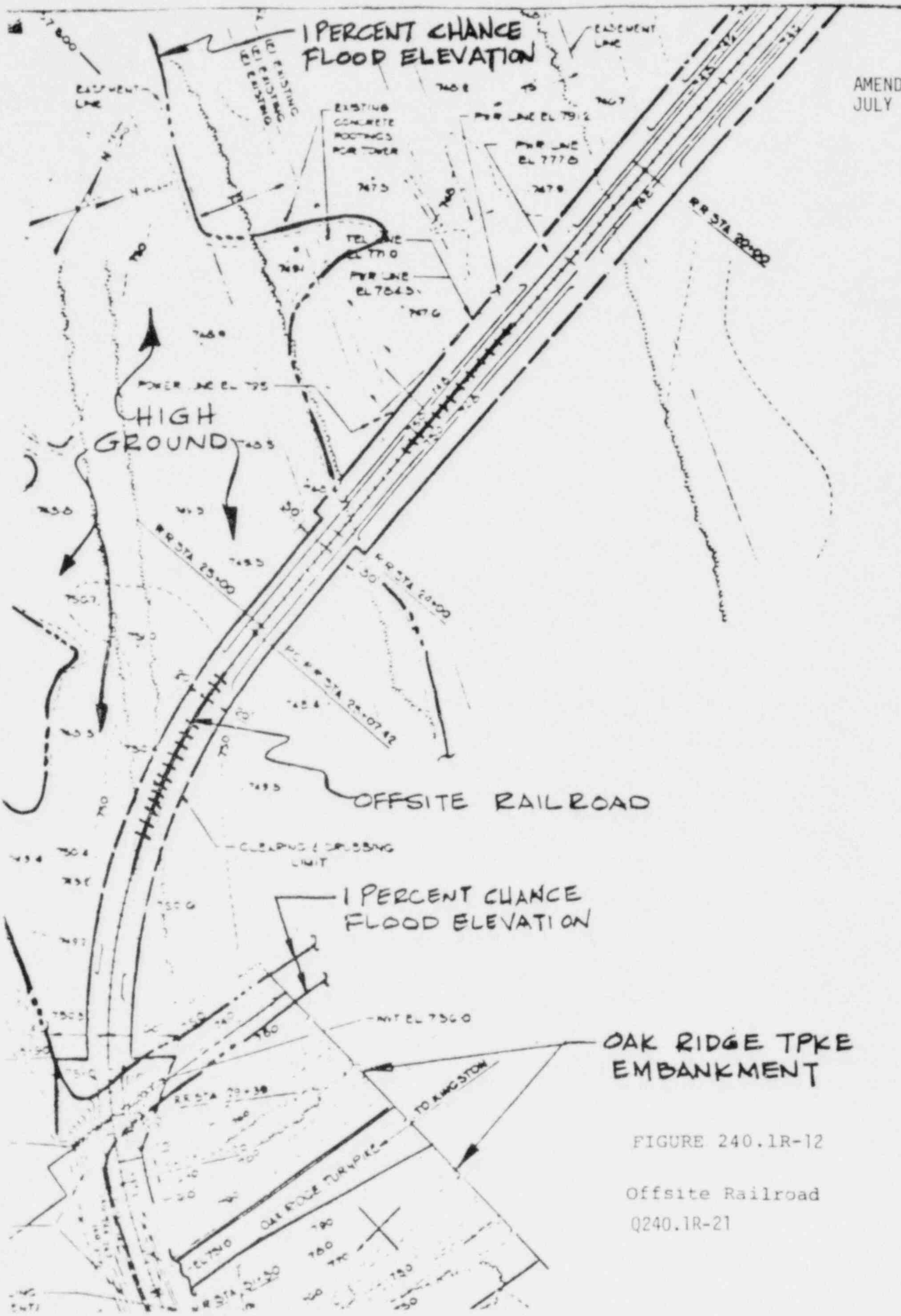


FIGURE 240.1R-12

Offsite Railroad

Q240.1R-21

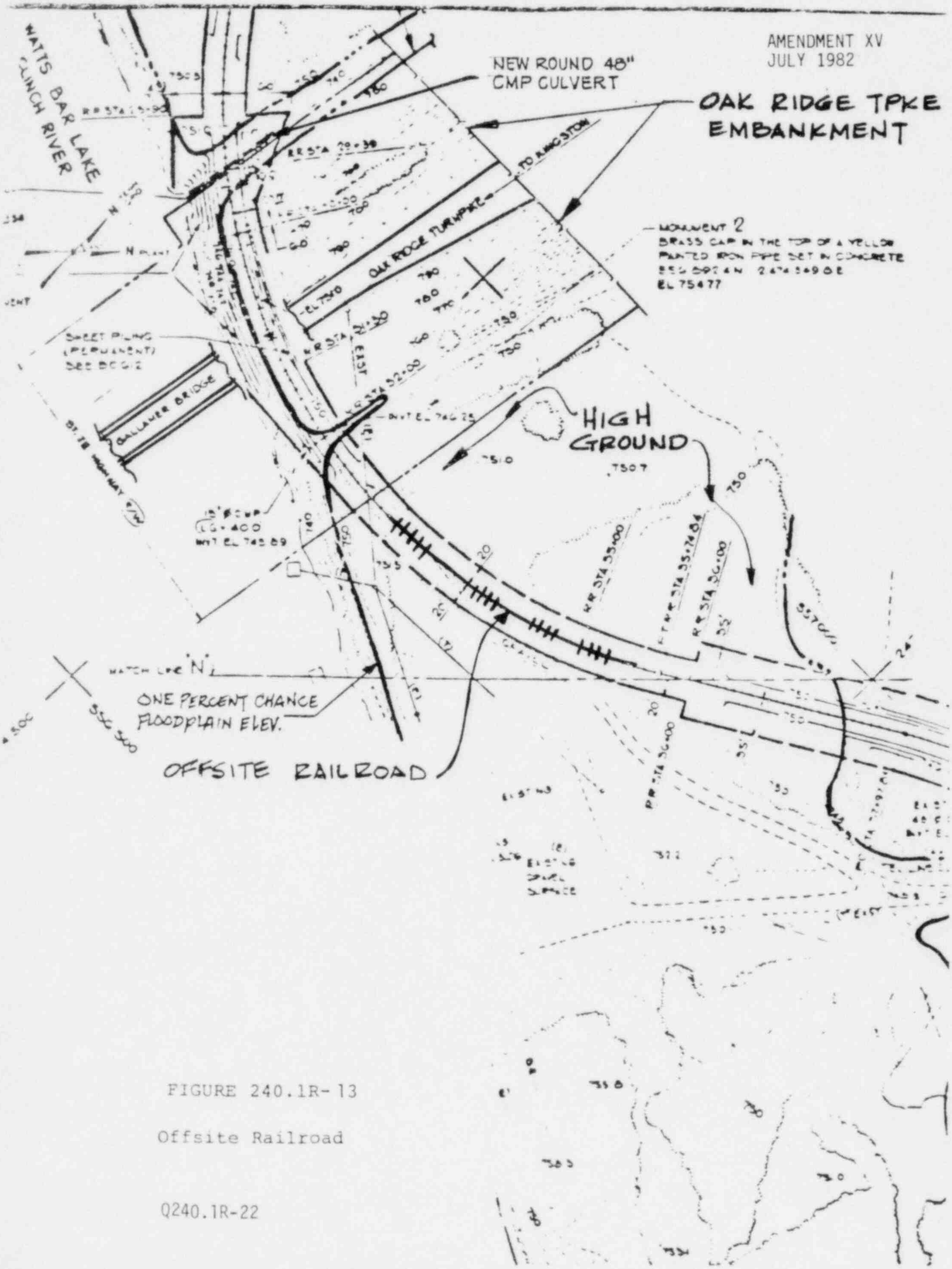


FIGURE 240.1R-13

Offsite Railroad

Q240.1R-22

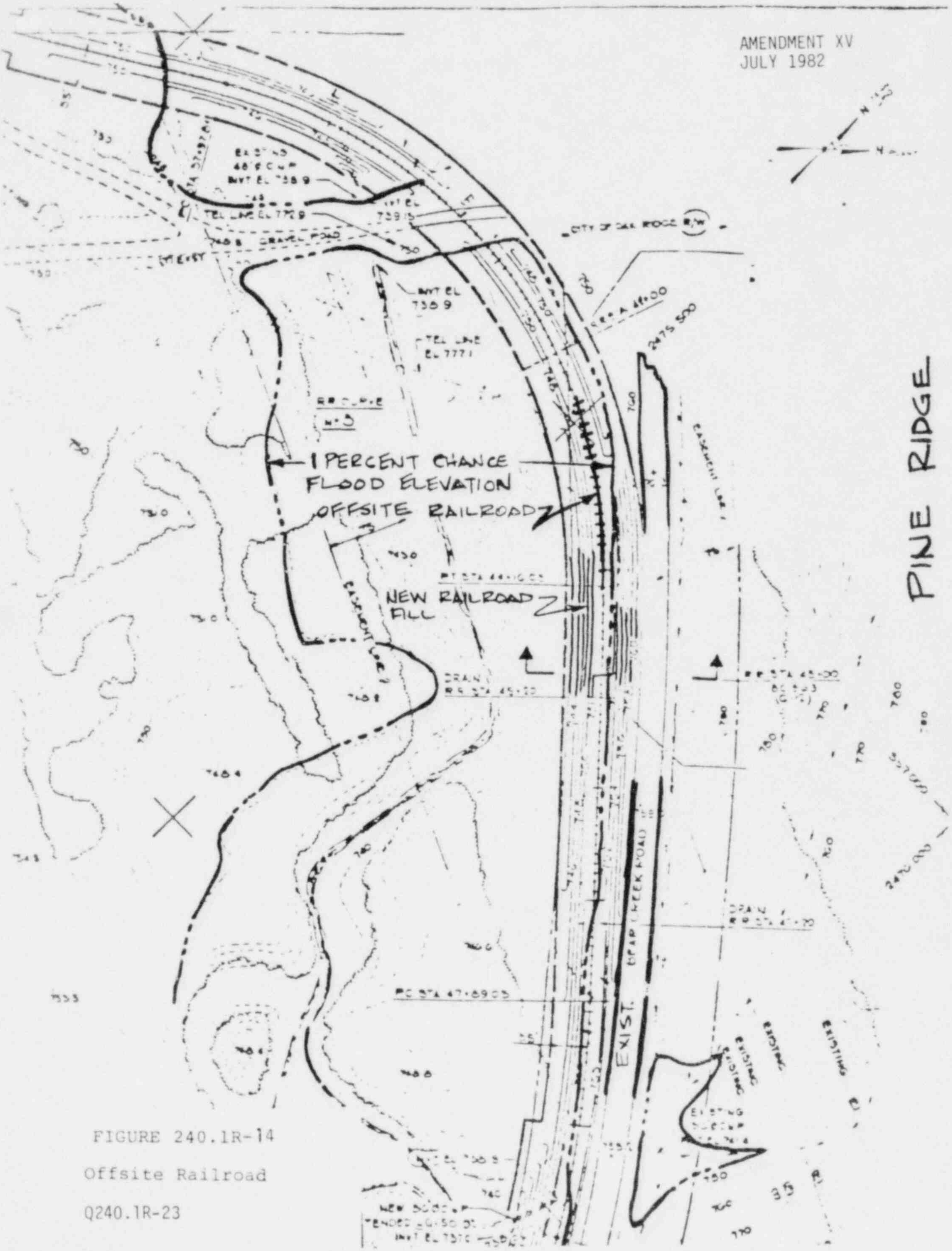


FIGURE 240.1R-14

Offsite Railroad

Q240.1R-23

QUESTION 240.2R

Information Requirements Relating to Liquid Pathway Releases

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 core debris was released to the ground. Doses should be compared to those calculated in the NRC 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 NRC Hydrologic Engineering Section be arranged so that we may share with you the body of information necessary to perform this analysis.

RESPONSE

The Clinch River Breeder Reactor has been designed to prevent initiators and event sequences which might lead to a core melt. Nonetheless, the project has evaluated hypothetical core disruptive accidents and has concluded that a postulated core melt resulting in penetration of the reactor vessel and guard vessel will not penetrate the basemat and enter the earth below. However, in order to provide a conservative assessment of the radiological consequences of a liquid pathway release following core melt, complete basemat penetration is assumed to occur. In the approach taken here, the more significant parameters and models used in NUREG-0440 to evaluate a liquid pathway release following the core melt of a land-based plant are compared to the corresponding parameters and models used for CRBRP.

With the exception of Cd-113 and Pu-238, the equilibrium core inventory values listed in NUREG-0440 are on the order of about 2 to 32 times higher than those for CRBRP (See Table I). The slightly larger CRBRP plutonium-238 inventory would not significantly influence the outcome of the overall dose comparison of NUREG-0440 to CRBRP. The radionuclide leach mechanism modeled in NUREG-0440 would be applicable to CRBRP, since the chemical form of a postulated CRBRP core melt would be essentially the same as that for a similar LWR core melt.

Parameters relating to the movement of radionuclides leached into the groundwater system are tabulated in Table II. Further pertinent data can be found in the Geology and Hydrology Sections (2.4 and 2.5) of the CRBRP Preliminary Safety Analysis Report. The radionuclide transport river model used in NUREG-0440 was based on studies of the Clinch-Tennessee-Ohio-Mississippi River systems. Therefore the model is appropriate for CRBRP which is located on the Clinch River. Although the combined sport and commerical harvest of fish expected downstream of the CRBRP site is approximately an order of magnitude larger than that assumed in NUREG-0440 (see response to NRC questions 240.6R and 290.7R, and NUREG-0440, Section 4.3.3.1), the total population dose from a hypothetical melt-through for a particular source would not be changed by more than about a factor of 2 (see NUREG-0660, Table 6.2.17).

In summary, the contained radionuclide source in the postulated CRBRP core melt would be significantly less than the source hypothesized for the NUREG-0440 study. In addition, the transportation of radionuclides via groundwater at the CRBRP site would be bounded by the assumptions of NUREG-0440, and the small river transport and dose conversion models from NUREG-0440 are appropriate for assessing CRBRP. Therefore, it is concluded that the doses from the postulated CRBRP core melt would fall within those calculated in NUREG-0440 for a LWR on a small river site.

TABLE I.

RADIONUCLIDE SOURCE TERM COMPARISON

Isotope	NUREG-0440 LWR Core Inventory (Ci)	CRBRP Core Inventory End of Cycle (Ci)	Ratio NUREG Value / CRBR Value
^{3}H	5.9×10^{4}	2.34×10^{4}	3
^{89}Sr	9.2×10^{7}	1.60×10^{7}	6
^{90}Sr	6.1×10^{6}	6.79×10^{5}	9
^{90}Y	6.4×10^{6}	7.11×10^{5}	9
^{91}Y	1.2×10^{8}	2.04×10^{7}	6
^{95}Nb	1.7×10^{8}	3.48×10^{7}	5
^{103}Ru	1.4×10^{8}	5.26×10^{7}	3
^{103m}Rh	1.4×10^{8}	5.26×10^{7}	3
^{105}Rh	6.7×10^{7}	3.85×10^{7}	2
^{106}Rh	7.6×10^{7}	1.96×10^{7}	4
^{106}Ru	5.1×10^{7}	1.96×10^{7}	3
^{110m}Ag	3.5×10^{5}	4.33×10^{4}	8
^{111m}Ag	4.3×10^{6}	2.57×10^{6}	2
^{113m}Cd	1.0×10^{3}	1.91×10^{3}	1/2
^{115m}Cd	6.2×10^{4}	3.55×10^{4}	2
^{115}Cd	8.8×10^{5}	5.46×10^{5}	2
^{123}Sn	9.4×10^{5}	3.62×10^{5}	3
^{125}Sn	1.5×10^{6}	7.58×10^{5}	2
^{125}Sb	7.4×10^{5}	3.96×10^{5}	2
^{125m}Te	2.5×10^{5}	7.88×10^{4}	3
^{127}Sb	8.3×10^{6}	3.76×10^{6}	2

TABLE I. (Continued)

RADIONUCLIDE SOURCE TERM COMPARISON

Isotope	NUREG-0440 LWR Core Inventory (Ci)	CRBRP Core Inventory End of Cycle (Ci)	Ratio NUREG Value / CRBR Value
^{127m}Te	$1.6x10^6$	$5.40x10^5$	3
^{127}Te	$8.1x10^6$	$3.69x10^6$	2
^{129m}Te	$6.6x10^6$	$2.65x10^6$	2
^{129}Te	$3.9x10^7$	$9.71x10^6$	4
^{129}I	2.9	$6.7x10^{-1}$	4
^{131}I	$1.0x10^8$	$3.00x10^7$	3
^{132}Te	$1.4x10^8$	$4.00x10^7$	4
^{133}I	$1.9x10^8$	$5.15x10^7$	4
^{134}Cs	$2.1x10^7$	$6.60x10^5$	32
^{136}Cs	$5.8x10^6$	$2.65x10^6$	2
^{137}Cs	$8.6x10^6$	$1.70x10^6$	5
^{140}Ba	$1.8x10^8$	$4.19x10^7$	4
^{140}La	$1.8x10^8$	$4.22x10^7$	4
^{141}Ce	$1.7x10^8$	$4.29x10^7$	4
^{144}Ce	$1.1x10^8$	$2.02x10^7$	5
^{144}Pr	$1.1x10^8$	$2.02x10^7$	5
^{238}Pu	$2.5x10^5$	$3.29x10^5$	4/5
^{239}Np	$2.1x10^9$	$9.48x10^8$	2

TABLE II

SITE SPECIFIC PARAMETER COMPARISON

Parameter	CRBRP Site Specific Value	NUREG 0440 Value
Length in feet from core base-mat melt point to river.	1600	1500
Average soil porosity	.3 (measured values, 5 to 33%)	.2
Permeability (flow velocity)	2000 ft/yr (1510 highest measured) or 6.56 ft/day	2446 ft/yr or 6.7 ft/day

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, and 500-year period (recurrence intervals), have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one percent chance of annual occurrence) in any 50 year period is about 40 percent (four in 10), and for any 90 year period, the risk increases to about 60 percent (six in 10). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail in Roane County.

Tennessee River discharges for the study limits mile 543.6-583.8 and the lower end of Clinch River have been progressively altered by the closure upstream main river and tributary dams. Further regulation will be attained with the closure of Tellico Dam on the Little Tennessee River at mile 0.3. Frequency is based upon anticipated post Tellico conditions.

Flood profiles panel 01P is a plot of elevation-frequency profiles for the Tennessee River from mile 543.6 to mile 583.8.

The standard log-Pearson Type III statistical analysis was not used for Tennessee River and Clinch River frequency studies because the method is not applicable to elevation data or where there is regulation from upstream dams.

Clinch River flows have been regulated by Norris Dam, Clinch River mile 79.8 since closure in March 1936. Closure of Melton Hill Dam, mile 23.1, in May 1963 has not altered discharge probabilities.

Clinch River flow-frequency relationships were determined from graphical analysis of records from 1941-1966 at the USGS gaging station at Scarboro, Tennessee, mile 29.0 (References 7 and 8) and from graphical analysis of unpublished TVA records of Melton Hill Dam discharge from 1964-1973.

Downstream from Melton Hill Dam to the mouth of Clinch River elevation-frequency was determined by backwater computations. Analysis began at the mouth of the Clinch River with elevations determined from records at the TVA gaging station near Kingston from 1944 to 1973 (Reference 9). Flood profile panel is a plot of elevation frequency profiles for the Clinch River from miles 0.00 to 21.15.

The Tennessee River study reach is in Watts Bar Reservoir; consequently, elevations are influenced by both discharge and Watts Bar Dam headwater elevations. Elevation frequency for this reach was determined by standard step method backwater analysis using a computer program developed by the TVA similar to but with some alteration to the COE HEC-2 backwater program (Reference 10) and by elevation-frequency curves determined graphically from the following records:

Location	Mile	Drainage Area, Sq. Miles	Period of Record	Agency
At Fort Loudon Dam Tailwater, Tennessee (unpublished)	602.3	9,550	1944-1973	TVA
At Lenoir City, Tennessee (Reference 8)	600.5	12,200	1944-1955	USGS
At Loudon, Tennessee (Reference 9)	591.6	12,220	1944-1955	USGS
Near Kingston, Tennessee (Reference 8)	568.2	12,470	1944-1973	TVA

The above four gages do not have gate numbers.

The following stream gages were used to determine a principal base for estimating flow frequency for Caney Creek, Whites Creek, and Emory River:

USGS gage number 03538130 at Caney Creek near Kingston
USGS gage number 03541500 at Whites Creek near Glen Alice
USGS gage number 03540500 at Oakdale, Tennessee (Emory River)

Flow estimates on these streams were determined using drainage area relationships drawn parallel to the regional relationship and through the flow-frequency valves at the gages as determined from the gaged records.

The computed frequency profiles for the Emory River were verified against an elevation-frequency curve by graphical analysis of stage records from 1945-1975 from the TVA gage at mile 12.1 (Reference 1).

The USGS gaging stations 03538225 on Poplar Creek near Oak Ridge and 03538200 on Poplar Creek at Oliver Springs were the principal data base for defining flow-frequency relationships for Poplar Creek. Discharge-frequency estimates for intermediate locations were determined by straight line interpolation between gage stations on a log-log plot of drainage area versus discharge graph.

The USGS and TVA do not maintain any stream gages on Little Emory River, Pawpaw, Black, Indian, and Tributary to Indian Creeks. In order to define discharge-frequency data for these streams a regional relationship of peak discharge and drainage area was developed from stream flow records at the gaging stations, Table 1 - Gaging Stations.

TABLE 1 - GAGING STATIONS

Gaging Station	Gage No.	Drainage Area Sq. Miles	Period of Record	Agency
Obed River Tributary near Crossville, Tennessee	03538800	.72	1955-1970	USGS
Forked Creek near Oakdale, Tennessee	03541200	2.44	1967-1975	USGS
Millican Creek near Douglas Dam, Tennessee	03469010	4.20	1942-1962	TVA
Rock Creek near Sunbright, Tennessee	03538300	5.54	1955-1971	USGS
Caney Creek near Kingston, Tennessee	03538130	5.50	1961-1975	USGS
East Fork Poplar Creek near Oak Ridge, Tennessee	03538250	19.50	1935-1975	USGS

Richland Creek near Dayton Tennessee	03544500	50.20	1935-1975	USGS
Poplar Creek near Oliver Springs, Tennessee	03538200	55.90	1954-1975	USGS
Poplar Creek near Oak Ridge, Tennessee	03538225	82.50	1961-1977	USGS
Emory River near Wartburg, Tennessee	03538500	83.20	1935-1975	USGS
Whites Creek near Glen Alice, Tennessee	03541500	108.00	1935-1977	USGS
Emory River at Oakdale, Tennessee	03540500	764.00	1928-1977	USGS

(References 11 and 12)

These stations are located on streams having similar hydrologic characteristics to the detail streams. A frequency curve was computed using the procedure outlined in Bulletin 17A (Reference 13) including the skew map, plate 1, and was adjusted for historical flood information wherever available. The adopted regional peak flow-drainage area relationship was compared with those developed by the USGS and Tennessee Department of Transportation (1976) (Reference 14). The regionalized relationship that was adopted produced discharge values about 50 percent greater than those of the USGS. The greater discharge values were caused by lengthy record which included the 1977 flood and attention paid to gaged watersheds near the study area.

Peak discharge rates for Black Creek where sufficient urbanization has occurred to alter flood peaks were estimated by using the following relationship,

$Q_{pu} = I^x Q_{pn}$, where:

Q_{pu} = Discharge for selected probability, p, for urban conditions.

I = Percent imperviousness or urban area.

x = A factor which varies with flood probability.

Q_{pn} = Discharge for selected probability, p, for natural conditions.

The relationships and values of x were developed from equations by Espey and Winslow (Reference 15) which relate discharge at selected frequencies to watershed and climatic factors and percent impervious I. The relationships and x values were compared and found to be consistent with studies by others. Percent imperviousness (I) was estimated using ratios of imperviousness to urban area (Reference 16) and urban areas determined from 7.5-minute topographic maps.

Indian Creek has limited historical flood information and only the 1928 and 1967 floodmarks were used in this study.

Peak discharge for the 10-, 50-, 100-, and 500-year floods for the detail streams are tabulated as follows:

TABLE 2 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
TENNESSEE RIVER					
Mile 544.8	16,980	164,000	190,000	200,000	260,000
Mile 578.9	12,360	88,000	130,000	150,000	220,000
CLINCH RIVER					
Mouth	4,413	120,000	185,000	220,000	300,000
Mile 4.4 (below mouth of Emory)	4,405	120,000	185,000	220,000	300,000
Above Emory	3,540	42,750	52,750	56,500	82,500
EMORY RIVER					
Mouth	865	112,000	172,000	205,000	285,000
Mile 5.2	811	107,000	163,000	197,000	275,000
LITTLE EMORY RIVER					
Mouth	41.7	6,300	9,900	11,500	16,500
Mile 1.6	40.6	6,000	9,400	11,100	16,000
Mile 3.0	35.7	5,500	8,700	10,100	14,900
Mile 4.2	34.3	5,300	8,500	9,800	14,500

TABLE 2 - SUMMARY OF DISCHARGES (cont.)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
WHITE CREEK					
Mile 6.1	120	31,000	54,000	64,000	98,000
Mile 6.6	108	28,000	48,800	59,600	90,130
Mile 8.0	102	27,500	48,000	58,000	89,100
BLACK CREEK					
Mile 0.0	11.8	3,250	5,100	6,400	8,500
Mile 3.0	8.0	2,400	3,900	4,800	6,600
Mile 4.70	5.9	1,900	3,100	3,800	5,500
CANEY CREEK					
Mile 0.0	8.27	2,300	3,050	3,300	4,500
Mile 0.8	7.80	2,200	2,400	3,200	4,300
Mile 1.6	6.55	1,950	2,550	2,800	3,800
PAWPAW CREEK					
Mile 0.0	10.3	2,250	3,650	4,300	6,200
Mile 1.53	8.71	2,000	3,200	3,800	5,500
Mile 2.5	5.20	1,400	2,250	2,690	3,900
POPLAR CREEK					
Mile 13.8	82.5	9,800	15,200	17,800	24,800
Mile 16.1	58.5	7,800	12,500	14,500	21,000
INDIAN CREEK					
Mouth	22.6	5,400	9,700	12,000	17,000
Mile 3.55	18.1	4,600	8,000	10,000	14,900
TRIBUTARY TO INDIAN CREEK	1.36	530	830	1,050	1,500

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding sources studied in detail in Roane County were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of the flood sources.

Water-surface elevations of floods for the selected recurrence intervals on the Clinch and Tennessee Rivers were computed through use of a step method backwater computer program developed by TVA similar to but with some alterations to the COE HEC-2 backwater program (Reference 10). Water-surface elevations on all other detailed streams were computed using the COE HEC-2N computer program (Reference 17). Stream cross sections for all streams except the Tennessee and Clinch Rivers were field surveyed at bridges and other strategic locations and supplemented with valley cross sections taken by photogrammetric methods at sufficiently close intervals to accurately compute water-surface elevations. The Tennessee and Clinch Rivers cross sections were based on silt range surveys and detailed topographic maps. Locations of selected cross sections used in the hydraulic analysis are shown on the Flood Boundary and Floodway Maps (FBFM) (Exhibit 3).

Channel roughness factors (Manning's "n") for these computations were determined on the basis of field inspection of channel and flood plain areas, on previous studies by TVA, and computed coefficients based on known flood profiles.

The range in values for Manning's "n" are tabulated below.

Stream	Channel	Overbank
Tennessee River	0.021-0.047	0.06-0.14
Clinch River	0.023-0.027	0.07-0.14
Emory River	0.02-0.045	0.060-0.15
Little Emory River	0.03-0.045	0.095-0.15
Whites Creek	0.022-0.07	0.09-0.19
Black Creek	0.029-0.09	0.057-0.195
Caney Creek	0.035-0.040	0.08-0.15
Pawpaw Creek	0.025-0.040	0.05-0.15
Poplar Creek	0.040-0.080	0.09-0.19
Indian Creek	0.030-0.072	0.058-0.15
Tributary to Indian Creek mile 2.33	0.04	0.070-0.105

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1). Starting elevations for flood frequency profiles on the Tennessee and Clinch Rivers were developed from known data. Watts Bar normal full pool elevation 741 was used as starting elevations for flood frequency profiles on Whites Creek, Caney Creek, and Little Emory River. Starting elevations for Black, Pawpaw, Poplar, and Indian Creeks were obtained by slope-area calculations using the slope of the streambed. Flood frequency profiles for Emory River and Tributary to Indian Creek were started using backwater elevations from the Clinch River and Indian Creek respectively.

All elevations are measured from National Geodetic Vertical Datum of 1929 (NGVD); elevation reference marks used in the study are shown on the maps.

The flood elevations as shown on the profiles are considered valid only if hydraulic structures in general remain unobstructed, operate properly, and do not fail.

No detailed studies were made for several smaller streams in Roane County, Tennessee, that were affected by Watts Bar backwater or where there was a lack of current or planned development.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the county.

For each stream studied in detail, the boundaries of the 100- and the 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using expanded topographic maps at a scale of 1:4,800 with a contour interval of 20 feet (Reference 18). In cases where the 100- and the 500-year flood boundaries are close together, only the 100-year boundary has been shown.

Small areas within the flood boundaries may lie above the flood elevations and therefore not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain

Poplar Creek near Oliver Springer, Tennessee:

Year	Discharge (CFS)
1902	10,230
1920	9,860
1926	10,580
1928	11,300
1929	10,940
1944	9,500

This study is authoritative for the purposes of the flood insurance program and the data presented here either supersede or are compatible with previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the office of the Federal Emergency Management Agency, Insurance and Mitigation Division, 1375 Peachtree Street, N.E., Atlanta, Georgia 30309.

8.0 BIBLIOGRAPHY AND REFERENCES

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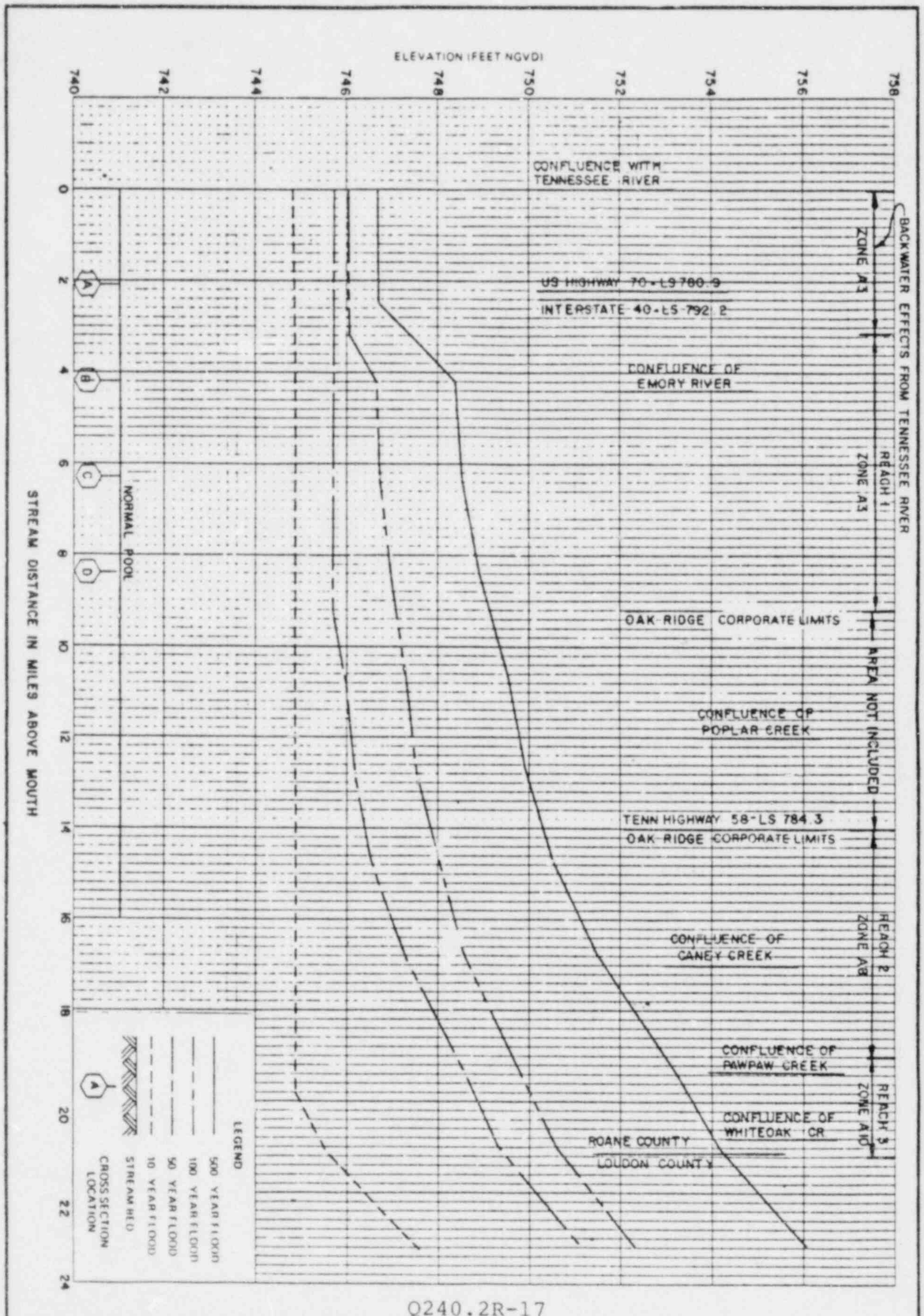

Q240.2R-17

FEDERAL EMERGENCY MANAGEMENT AGENCY Federal Insurance Administration ROANE COUNTY, TN (UNINCORPORATED AREAS)	FLOOD PROFILES CLINCH RIVER	02P

Question 290.1R

Provide a succinct summary and discussion in table form, by ER section, of differences between currently projected station design and environmental effects (including those that would degrade, and those that would enhance environmental conditions) and the effects discussed in the environmental reports submitted in 1975, Amendments 1 through 7.

Response

The changes to CRBRP design which have occurred since 1977 and the expected environmental effects of these changes are summarized succinctly by ER section in the attached table, entitled "CRBRP ENVIRONMENTAL REPORT REVIEW."

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
1.1	1.1-1, -2	Introduction	Rewritten to reference LMFBR Program	Environmentally inconsequential.
1.2	1.2-1	Objectives	Rewritten to reference LMFBR Program	Environmentally inconsequential.
1.3	1.3-1 thru 1.3-6	Meeting Objectives	Rewritten and updated	Environmentally inconsequential.
1.4		Consequences of Delay	Deleted	
1.5		Summary	Deleted	
2.1	2.1-1 thru 2.10	Plant	Construction site acreage increased. Plant arrangements updated. Five impounding ponds were identified and located on Figure 2.1-3.	See Section 4.0
2.2	2.2-1 thru 2.2-67	Demography, Land & Water Use	Regional demography, land and water uses were updated using preliminary results of the 1980 U.S. Census. The revised figures showed population growth slightly below projections of 1976. However, the deviations would make CRBRP-inspired growth more easily assimilated.	A slightly favorable environmental effect.
2.3	2.3-1 thru 2.3-25	Regional Cultural Historic & Archeological Features	Updated to reflect an evaluation of previously unsurveyed cultural, historic and archeological features. The evaluation is consistent with the provisions of the National Historic Preservation Act of 1979, as amended. No new significant data were developed.	Environmentally inconsequential.
2.4	2.4-15 thru 2.4.22	Geology	Changed to provide data for 24 additional boreholes, taken from September 1976 to June 1977.	Environmentally inconsequential.
2.5				
2.5.1	2.5.1 thru 2.5-10	River	Updated river levels, flows, temperatures, etc.	Environmentally inconsequential.

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
2.5.2				
2.5.2.1			No change.	
2.5.2.2			No change.	
2.5.2.3			No change.	
2.5.2.4	2.5-18	Ground-water	Established piezometric gradient.	Environmentally inconsequential.
2.5.2.5			No change.	
2.5.2.6			No change.	
2.5.2.7			No change.	
2.6	2.6-1 thru 2.6-63	Meteor-ology	Updated to include data accumulated using permanent meteorological tower.	Environmentally inconsequential.
2.7				
2.7.1				
2.7.1.1	2.7-1a	Forest Manage-	Incorporates ORNL forest management activities from 1976 through 1980.	No change in estimated environmental effects for CRBRP. Mitigation measures for Southern Pine Beetle and Pitch Canker infestations.
2.7.1.2			No change.	
2.7.1.3	2.7-7 thru 2.7-9	Flora	Update vegetation inventory reporting.	Environmentally inconsequential.
	2.7-24, -37	Flora	Correct pine designation.	Environmentally inconsequential.
	2.7-38l, -38m	Flora	Revise category designation from "threatened" to "rare" to reflect current terminology.	Environmentally inconsequential.
2.7.1.4	2.7-38o thru 2.7-38t	Fauna	Update wildlife occurrence data.	Environmentally inconsequential.
	2.7-38ee	Insects	Update reporting concerning insect pests.	Environmentally inconsequential.

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
	2.7-38ff	Fauna	Revised to include possibility of eastern cougar occurrence on Oak Ridge Reservation.	Occurrence on CRBRP site not confirmed. Also, cougar home range is sufficiently extensive to absorb effect of CRBRP installation. Environmentally inconsequential.
	2.7-38gg	Avifauna	Adds mention of osprey nest occurrence at Watts Bar Lake.	Osprey nesting at CRBRP site has not been observed. Environmentally inconsequential.
2.7.1.5			No change.	
2.7.1.6	2.7-38tt	Avifauna	Update classification of American osprey.	Occurrence of nesting at site has not been observed.
2.7.1.7	2.7-38ww	Surveys	Report on 1980 reconnaissance surveys.	Environmentally inconsequential.

Q290.1R-4

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
2.7.2				
2.7.2.1			No change.	
2.7.2.2			No change.	
2.7.2.3			No change.	
2.7.2.4	2.7-87g	Fish	Report of occurrences of the blue sucker in Watts Bar Lake. Blue sucker is identified as a threatened species.	Occurrence not reported near Site. Environmentally inconsequential.
2.7.2.5	2.7-87h -87i	Aquatic Surveys	Report on 1980 reconnaissance surveys.	Stocking activities have resulted in reported increases in gamefish. No change in estimated environmental effects due to CRBRP.
2.8	2.8-1 thru 2.8-109	Background Radiation	Complete update reflecting latest ORNL, TVA and similar organization studies and scientific papers.	Data better characterizes the actual site and the surrounding areas. Environmentally inconsequential.

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
3.0				
3.1	3.1-1	External Appearance	A five foot high animal fence was added at a distance of 33 feet from the security fence.	Preclude small animals from plant site and and restrict them to more natural environs. Environmentally inconsequential.
3.1.1	3.1-2	Plant Bldg. & Facilities	Gatehouse, circulating water pump house and fire protection pump house were identified. The switch yard relay house was added.	Environmentally inconsequential.
			The configuration and location of the emergency cooling tower structure were revised.	Environmentally inconsequential.
3.1.2	3.1.4	Plant Site	Five foot high animal fence added.	Environmentally inconsequential.
3.1.3	3.1-4	Other Facilities	The size of paved parking area was reduced for accommodation of 155 cars instead of 250 before.	Environmentally inconsequential.
3.2				
3.2.1			No change.	
3.2.2	3.2-3	Core	Replaced homogeneous core with heterogeneous arrangement resulting in eliminating one fuel enrichment zone (was 2, now 1), reducing number of fuel assemblies from 198 to 156, reducing number of radial blanket assemblies from 150 to 126, adding 82 inner blanket assemblies, and increasing Pu enrichment in fuel assemblies from 18.7-32% to 32-33%.	Net change judged to be insignificant.
3.2.3			No change.	
3.3				
3.3.1	3.3-1	Overall Plant	Average annual consumptive water use figures were revised to be consistent with those in Tables 3.3-1, 3.3-2 and 3.3-3.	Environmentally inconsequential.
3.3.2	3.3-2	Cooling Tower	Flowrate to cooling tower from condenser increased from 209,200 gpm to 212,200 gpm.	Slight increase in plume size will not produce significant environmental impact.
3.3.3	3.3-2	Process Water Treatment System	Added makeup water treatment system	Environmentally inconsequential.

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AMENDMENT XV
JULY 1982

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
3.3.4	3.3-3	Waste Water Disposal System	All process waste water including floor drains, go to Waste Water Disposal System instead of being routed to either cooling tower basin or neutralization and settling facilities.	Results in higher quality of water discharged.
3.3.5	3.3-3	Radwaste Systems	Updated description.	See Section 3.5.
3.3.6	3.3-4	Potable Water Sources	Potable water is supplied by DOE's Bear Creek Road Filtration Plant instead of the Make-up Water Treatment System.	Environmentally inconsequential.
Table 3.3-1	3.3-5	Plant Flowrates During Maximum Power	Increase in plant make-up flow rate from 5835 gpm to 6145 gpm.	Environmentally inconsequential.
			Increase in cooling tower evaporation rate from 3475 gpm to 3623 gpm.	Environmentally inconsequential.
			Increase in cooling tower drift rate from 105 gpm to 106 gpm.	Environmentally inconsequential.
			Increase in cooling tower blowdown rate from 2210 gpm to 2306 gpm.	Environmentally inconsequential.
			Decrease in Process Waste Treatment flow rate from 125 gpm to 110 gpm.	
			Waste Water Disposal System Flowrate designed at 100 gpm.	Environmentally inconsequential.
			Increase in plant discharge rate from 2,251 gpm to 2,411 gpm.	Environmentally inconsequential.
			Increase in total consumptive use of river water from 3,584 gpm to 3,733 gpm.	Environmentally inconsequential.
Table 3.3-2	3.3-6	Plant Flow-rates During Minimum Power	Increase in Plant Make-up Flowrate from 2,361 gpm to 2,527 gpm.	Environmentally inconsequential.
			Increase in cooling tower evaporation rate from 1,390 gpm to 1,450 gpm.	Environmentally inconsequential.
			Increase in cooling tower blowdown rate from 884 gpm to 925 gpm.	Environmentally inconsequential.
			Decrease in process water treatment flow-rate from 125 gpm to 110 gpm.	Environmentally inconsequential.
			Waste Water Disposal System flowrate designed at 100 gpm.	Environmentally inconsequential.
			Increase in plant discharge rate from 925 gpm. to 1.030 gpm.	Environmentally inconsequential.
			Increase in total consumption use of river water from 1,436 gpm to 1,496 gpm.	Environmentally inconsequential.

Q290.1R-7

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
Table 3.3-3	3.3-7	Plant Flow-rates During Tem-porary Shutdown	Increase in plant makeup flowrate from 625 gpm to 715 gpm.	Environmentally Inconsequential.
			Increase in cooling tower blowdown flowrate from 221 gpm to 231 gpm.	Environmentally Inconsequential.
			Increase in cooling tower evaporation rate from 348 gpm to 363 gpm.	Environmentally Inconsequential.
			Decrease in process water treatment flowrate from 125 gpm to 110 gpm.	Environmentally Inconsequential.
			Waste Water Disposal System flowrate designed as 100 gpm.	Environmentally Inconsequential.
			Increase in plant discharge flowrate from 262 gpm tp 336 gpm.	Environmentally Inconsequential.
			Increase in total consumptive use of river water from 363 gpm to 378.	Environmentally Inconsequential.
Table 3.3-4	3.3-8	Plant Water Usage Seasonal Variation	Seasonal Flowrates in Table have been adjusted to reflect present design.	Environmentally Inconsequential.
3.4.1	3.4-1	Cooling Tower	Updated Makeup water addition from 5835 to 6035 gpm.	Environmentally Inconsequential.
3.4.2	3.4-3	River Water Pumps	Design flowrate for river water pumps decreased from 10,000 gpm each to 9,000 gpm each.	Environmentally Inconsequential.
3.4.3			No change.	
Table 3.4-1	3.4-5	Heat Dissipa-tion Design Parameters & Conditions	Heat rejected from a cooling tower increased from 2.172×10^9 BTU/HR to 2.256×10^9 BTU/HR.	Environmentally Inconsequential.
Table 3.4-2	3.4-6	Component Descriptions	Updated Design Parameters.	Environmentally Inconsequential.
Table 3.4-4	3.4-8	Cooling Tower Blowdown Temp.	Average monthly cooling tower blow-down temperatures increased slightly.	Environmentally Inconsequential.

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
3.5				
3.5.1		No change.		
3.5.1.1	3.5.2	Decontamination Factor	Update for iodine and tritium.	Environmentally inconsequential.
3.5.1.2	3.5-3	IALL	Updates description of cleaning process. A filter deleted from the liquid radwaste system. Revises description of shielding. Updates filter handling.	Environmentally inconsequential.
3.5.1.3	3.5-5, -6	LALL	Updates parameters applied to Low Activity Level Liquid System.	Environmentally inconsequential.
3.5.1.4	3.5-6	Assumptions	Revises assumptions used as the bases for calculations.	Environmentally inconsequential.
3.5.2				
3.5.2.1	3.5-7	Noble Gases	The ^{39}Ar and ^{41}Ar produced by direct activation of ^{38}Ar and ^{40}Ar is now included in the radioactive source terms used for design work.	The additional Argon from this source is negligible and the environmental impact is considered insignificant.
3.5.2.2	3.5-8	Treatment and Release System	Design has been changed so that $^{85}K_r$ from RAPS is no longer bottled but is processed thru CAPS and released to H&V.	The site boundary beta skin dose is increased by approximately a factor of 2, but the potential for accidental exposure due to $^{85}K_r$ storage and shipping is removed. The net change in environmental effects is judged to be insignificant.
			Previously all leakages of cover gas or recycled cover gas were processed thru CAPS Now most of the cells containing components which could leak cover gas vent to H&V.	The site boundary beta and gamma doses are increased; a slightly adverse effect. The beta dose increased by approximately 1.5, gamma dose by approximately 4.
3.5.2.3	3.5-9, 10	RAPS & CAPS	Process flow for RAPS & CAPS updated. Tritium removal unit has been redesigned in CAPS. Venting to atmosphere incorporated.	The site boundary beta and gamma doses are increased; a slightly adverse effect. The beta dose increased by approximately 1.5, gamma dose by approximately 4.
3.5.2.4	3.5-11	Head Seals	The reactor cover gas leakage rate was reduced from 0.012 SCC per minute to 0.0044 SCC per minute. The diffusion of Tritium through piping walls into PHTS and auxiliary Na cells has been added to design assumptions. Any significant amount of Tritium has been included in the current radiological source terms.	The site boundary beta and gamma doses are decreased; a slightly favorable environmental effect. The additional radioactivity contributed by the small amount of Tritium diffusing through piping walls is insignificant compared to the radioactivity contained in the cover gas which is assumed to leak into cells at the rate of 1 cc/min. The impact is judged insignificant.

Q290.1R-9

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
3.5.2.5	3.5-12 thru 3.5-14	Release Points	Ventilation exhaust rates at radiological release points have been revised. Examples are the release point in the SGB Intermediate Bay which increased from 50,000 scfm to 54,500 scfm and the exhaust point on top of the RCB which decreased from 415,000 scfm to 400,000 scfm.	Higher exhaust rates could potentially have more environmental impact due to shorter hold-up of radionuclides. However, the doses resulting from plant releases remain well below guideline limits.
			Ventilation exhaust temperature ranges at radiological release points have increased. An example is a release point in the RSB that did have a range of 65°F to 120°F and now ranges from 55°F to 140°F.	This change in temperature range will have no impact. Density variations which could release more or less radioactive material are accounted for in the preceding changes in exhaust rates.
			The CAPS Reactor Service Building H&V Exhaust has been deleted. CAPS now exhausts through the RSB exhaust with safety-related exhaust radiation monitors.	No environmental impact for normal release. Improved protection against release of above normal radioactivity from the plant due to off-normal conditions - a slightly favorable effect.
			RAPS process components have been moved from the RSB to the RCB.	No environmental impact for normal operation. Improved protection against release of radioactivity from the plant following RAPS accidents - a slightly favorable effect.
			Release point descriptions have been further updated to reflect latest design changes.	Environmentally inconsequential.
3.5.2.6	3.5-14, -15	Assumptions	Revises gaseous release data based on relocated RAPS, updated burnup and release point data, and most recent meterology.	No environmental impact for normal operation. Improved protection against release of radioactivity from the plant following RAPS accidents - a slightly favorable effect.
3.5.2.7	3.5-15, -16	Balance of Plant	Turbine generator building ventilation exhaust location change from elevation 905'6" to 878'0", release rate decrease from 17,500 cfm to 8,000 cfm, exhaust flow velocity increase from 585 feet/min. with a temperature range of 85 to 120°F to 900 feet/min. with a temperature range from 55°F to 120°F.	Environmentally inconsequential.
			Plant Service Building ventilation exhaust location changed from elevation 830'0" to 831'2". Number of release points decreased from 2 to 1.	Environmentally inconsequential.

Q290.1R-10

AMENDMENT XV
JULY 1982

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
3.5.3 (3.5.3.1 3.5.3.2)	3.5-16, -17	Solid Radwaste System Equip-ment	Solid radwaste equipment is now is now identified as including a cement filling station, a decanting station, a concentrated waste collection tank, a drumming station, a filter handling machine and a compactor. (See also Tables 3.5-10 and 3.5-11).	Environmentally inconsequential.
3.5.3.3	3.5-18	Noncom-pactible Solids of Rad-waste Sys.	There will be a total of 112 (instead of 202) 55 gallon drums per year used to store the low activity, non-compactible solids after treatment at the solid radwaste system.	Environmentally inconsequential.
3.5.3.4	3.5-18	Radio-active Sodium	There are now 2 drums of waste metallic sodium per year with an activity level of 20 Ci/drum instead of 6 drums/year with an activity level of 1.5 Ci/drum stored and/or processed on site.	Environmentally inconsequential.
3.5.3.5	3.5-19	Sodium Bearing Solids	The disposal of sodium bearing waste, which was not previously identified, has been selected. No currently licensed off-site disposal facility will accept sodium bearing wastes, therefore, for off-site disposal of these wastes, the sodium will be removed. Where sodium removal is not practical, the waste will be stored on-site.	Environmentally inconsequential.
		Activ-ity	Individual primary cold trap contained activity of Tritium increased from 8.7×10^{3} Ci to 1.85×10^{5} Ci, and activity of fission and corrosion products increased from 1×10^{3} Ci to 1.41×10^{5} Ci. The contained activity will not be removed or released from the cold traps. The EVST cold trap contained activity increased from 6.7×10^{3} Ci to 7.6×10^{3} Ci. The Tritium activity increased from 150 Ci to 180 Ci.	Environmentally inconsequential.

Q290.1R-11

Q290.1R-12

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
Table 3.5-1	3.5-20,-21	IALL System	Some of the assumptions that Table 3.5-1 had been based upon have changed: 1) Intermediate activity concentration for the first rinse computed assuming 10% (instead of 40%) of plated out activity and 100% of sodium activity adhering to the process components is dissolved in 100,000 (instead of 37,000) gallons of water per year. 2) Processed components involve an average annual volume of 1,600 (instead of 14,700) gallons.	Environmentally inconsequential.
Table 3.5-2	3.5-22, -23	IALL System	Some of the assumptions that Table 3.5-2 had been based upon have changed: 1) Iodine DF=10^4 included. Monitoring tank volume decreased from 2,500 gallons to 2,400 gallons. 2) Iodine DF=10^4 included.	Environmentally inconsequential.
Table 3.5-3	3.5-24, -25	IALL System	Some of the assumptions that Table 3.5-3 had been based upon have changed: <u>Low Activity Liquid Waste Assumptions</u>: 1) Iodine DF=10^4 and Tritium DF=1 included. <u>Intermediate Activity Liquid Waste Assumptions</u>: 1. Liquid waste discharged to the common plant discharge header (instead of the coolant water blowdown stream). Iodine DF=10^4 and Tritium DF=1 included.	Environmentally inconsequential.
Table 3.5-10	3.5-33	Expected Weight, Volume and Activity of Solid Radwaste	Values in table have been changed to reflect current design. Total estimated volume of solid radwaste generated decreased from 3,094 ft^3/yr to 2,365 ft^3/yr. Total estimated activity of solid radwaste generated decreased from 6.6×10^4 Ci/yr. to 3.4×10^3 Ci/yr.	Environmentally inconsequential.

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
Table 3.5-11	3.5-34	Expected Solid Radwaste Shipments Per Year	Expected containers per year of solidified liquid radwaste decreased from 170 to 136. Expected containers per year of filters and resins decreased from 120 to 34. Table expanded to include other solidified liquids.	Environmentally inconsequential.
Figure 3.5-1	3.5-35	Basic Flow Design	Inlets of collecting tanks now include filters.	Environmentally inconsequential.
Figure 3.5-5	3.5-39	Basic Flow Design	Completely revised to reflect vendor design.	Environmentally inconsequential.
3.6			No change.	
3.6.1			No change.	
3.6.2	3.6-3	Sodium Hypo-chlorite Injection	Capability of injecting sodium hypo-chlorite into cooling tower basin, on a continuous or intermittent basis.	Environmentally inconsequential.
3.6.3	3.6-4	Demin-eralizer	Delete limits on demineralizer chemicals.	Environmentally inconsequential.
3.6.4	3.6-5	Sewage Disposal	Chlorine limits set to meet NPDES permit limits.	Environmentally inconsequential.
Figure 3.6-1	3.6-7		Incorporate changes as described in text.	Environmentally inconsequential.
3.7			No change.	
3.7.1	3.7-1	Sanitary Sewage System	Addition of pretreatment and extended aeration of activated sludge. Compares effluent concentrations to NPDES permit limits (Table 3.7-1).	Environmentally inconsequential.
3.7.2	3.7-3	Trash Disposal	Specifies off-site trash disposal by licensed contractor. Updates effluents from routine Diesel unit testing.	Environmentally inconsequential.

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ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
3.8				
3.8.1.1	3.8-1, -2	Core Design	Replaced homogeneous core arrangement with heterogeneous core arrangement resulting in reducing the number of fuel assemblies from 198 to 156, increasing the Pu enrichment from 18.7 to 32% fissile to 33.2% total.	Decreases the heavy metal commitment (U or U + Pu) in the axial blankets and core from 5.4 MT to 4.2 MT and from 6.5 MT to 5.2 MT, respectively. Environmentally inconsequential.
			Deleted option to use natural uranium as alternate material to depleted uranium as feed material for fuel pellets.	Environmentally inconsequential.
			Revised refueling scheme from replacing approximately one-third annually to batch replacement of all the fuel and inner blanket assemblies at two year intervals with mid-interval replacement of 6 inner blankets with fresh fuel assemblies.	Average number of yearly shipments of fresh fuel would therefore become about 14. Environmentally inconsequential.
3.8.1.2	3.8-2	Core Design	Replaced homogeneous core arrangement with heterogeneous core arrangement resulting in increasing the total number of blanket assemblies from 150 (radial) to 208 (82 inner and 126 radial).	Increases the heavy metal (U) commitment from 16.4 MT to 21.6 MT. Environmentally inconsequential.
			Revised dimensional parameters of blanket rods (outside diameter decreased from 0.520 in. to 0.506 in.) and assembly weight increased (from 525 lbs. to 536 lbs.).	Environmentally inconsequential.
			Revised refueling scheme from annual refueling to batch refueling at two-year intervals.	Average number of yearly shipments of fresh blanket assemblies will therefore become 12. Environmentally inconsequential.
Figure 3.8.1	3.8-10	Reactor	Revised to show heterogeneous core layout.	Environmentally inconsequential.
Figure 3.8.2	3.8-11	Fuel	Dimensions removed.	Environmentally inconsequential.

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ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
3.8.2.1	3.8-3, -4	Core Design	Replaced homogeneous core arrangement with heterogeneous core arrangement and revised refueling scheme from annual refueling to batch refueling at two year intervals resulting in increasing the average number of fuel assemblies discharged yearly from 66 to 81, decreasing the fuel assembly burnup from 200,000 MWD/Ton average to 80,000 MWD/Ton average, and the peak burnup to 110,000 MWD/Ton, decreasing the average burnup in the axial blankets from 4,000 MWD/Ton to 2,200 MWD/Ton, and reducing the amount of bred fissile Pu from 1 kg/assy. to 0.3 to 0.4 kg/assy.	Shipping schedule for spent fuel increases from 8 to 12 shipments per year to an estimated 14 shipments per year. Changed judged to be slightly adverse.
			Revised weight and dimensions of spent fuel shipping cask.	Environmentally inconsequential.
3.8.2.2	3.8-4, -5	Core Design	Replaced homogeneous core arrangement with heterogeneous core arrangement and revised refueling scheme from annual to batch resulting in increasing the number of blanket assemblies discharged from the plant per year from 25 to 69, increasing the burnup per assembly from 5,70u MWD/Ton to 8,000 MWD/Ton, increasing the average and peak heat generation from 1 kw average (radial) to 2.6 kw (inner) and 1.6 kw (radial) and from 7 kw peak (radial) to 19.7 kw (inner) and 12 kw (radial).	Increases the number of spent blanket assembly shipments from 3 to 6-7 per year. Change judged to be slightly adverse.
3.8.3				
3.8.3.1	3.8-5 thru 3.8-7	Core Design	Replacement of homogeneous core arrangement with heterogeneous core arrangement results in reducing the number of primary control assemblies from 15 to 9 and in increasing the number of secondary control assemblies from 4 to 6.	Change judged to be slightly favorable.
			If lifetime considerations permit, control rods could remain in the reactor for two cycles, also the driveline lifetime has been increased from 10 to 15 years.	Change judged to be slightly favorable.

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
			Revised configuration of radial shield assembly from stacked hexagonal plates to closely packed rods in a hex duct and decreased assembly weight from 750 to 360 lbs.	Environmentally inconsequential.
			Because of the change to the heterogeneous core arrangement the lifetime of the first row of shield assemblies has increased from 3 to 10-to-15 years, part of the second row lifetime has increased from 6-to-12 to 10-to-25 years, and the third and fourth rows are not expected to require replacement during plant lifetime.	This greatly reduces the number of shipments of irradiated shield assemblies. Change judged to be favorable.
3.8.3.2	3.8-8	Waste Handling	Updated to agree with Section 3.5	Environmentally inconsequential.
	3.8-8,	Primary Cold Trap	The tritium levels were updated from 1.8 x 10^4 Ci to 1.85 x 10^5 Ci and the fission products and corrosion products increased from 1 x 10^3 Ci to 1.41 x 10^5 Ci.	Material will not be released so the changes are judge to be environmentally inconsequential.
			Cold traps are to be stored on site since no currently licensed disposal site will accept sodium-bearing wastes.	
3.9				
3.9-1			No change.	
3.9-2			No change.	
3.9-3			Updated to describe Forest Management	Environmentally inconsequential.
3.9-4	3.9-3,-4	Flora	Updated to account for ORNL forest management activities since 1976.	No change in environmental effects due to CRBRP.
3.9-5			No change.	
3.9-6			No change.	
3.9-7			Updated to describe transmission line configuration and acerage affected.	Environmentally inconsequential.
3.9-8			Revised to delete details of tower configuration.	Environmentally inconsequential.
3.9-9			Circuit spacings have been increased, requiring widening of rights-of-way.	Environmentally inconsequential.

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
4.1	4.1-1, -2	Site Prep. and Plant Cons-truc-tion	Deletion of borrow area, increase of site temporary acreage to 292 acres from 195 acres required for plant construction, 37 acres identified inside security barrier, quarry increase from 25 acres to 45 acres, provide crusher facility at quarry (Table 4.1-1, Figure 4.1-1).	Environmentally inconsequential.
4.1.1				
4.1.1.1	4.1-2	Clearing	Choice to use open burning during site clearing.	Change judged to have a slight negative environmental effect.
		Concrete Batch Plant	Batch plant description	Environmentally inconsequential
	4.1-3, -4	Quarry	Excavation depths increased. Eliminate consideration of borrow pit. Described concrete batch plant.	Change judged to be slightly favorable. Onsite availability of material will reduce offsite hauling requirements.
4.1.1.2			No change.	
4.1.1.3	4.1-5	Access Facility	Modify Barge Unloading Facility.	Change judged to be slightly favorable. Redesign minimizes dredging.
4.1.1.4			No change.	
4.1.1.5			No change.	
4.1.1.6	4.1-7 thru 4.1-8b	Site Extent	Update terrestrial ecological effects of site clearing and construction. (Table 4.2-1 and Table 4.1-3)	Change judged to have slightly negative environmental effect due to increased acreage.
			Include ORNL forest management plan.	No change to estimated environmental effects due to CRBRP.
			Updates impacts on wildlife.	No change to estimated environmental effects due to CRBRP.
4.1.1.7	4.1-11	Human Activ-ities	Peak construction force estimate increased to 5400.	Environmentally inconsequential.
			Eliminates borrow area. Reduces construction activities near cemetery.	Change judged to be slightly favorable; borrow area was in vicinity of Hensley family cemetery.
4.1.1.8	4.1-11 thru 12a		Provides soil erosion and sediment control measures	Change judged to be favorable in reducing soil erosion to Clinch River

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ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
4.1.2				
4.1.2.1	4.1-13	Water Use	Construction water consumption estimates have been increased from 40,000 gallons per day to 60,000.	Environmentally inconsequential. Additional water consumption still is only a very small fraction of the available Clinch River flow.
4.1.2.2			No change.	
4.1.2.3	4.1-15	Barge Unload-ing Facility	Relocation and redesign will reduce dredging.	Change judged to be slightly favorable.
4.1.2.4	4.1-15a	Runoff Treat-ment pond	Provides description of runoff treatment pond design feature which limits suspended solids discharge to Clinch River to less than 50 mg/l.	Change judged to be favorable
4.2	4.2-1,-6,-8		Transmission corridor acreages and affected community plant coverage undated	Environmentally inconsequential.
Table 4.2-1	4.2-9	Trans-mission Corridor	Transmission corridor acreages and affected community plant coverage undated	Environmentally inconsequential.
4.3	4.3-1 thru 4.3-3	Re-sources	Updated to account for revised affected areas, and addition of quarry.	Net effect of all changes is judged to be environmentally inconsequential.

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
5.1			No change.	
5.1.1			No change.	
5.1.1.1	5.1-3, -4	Cooling System	Updated to reflect effects of cooling system redesign.	Change demonstrates that latest design produces effects that are enveloped by previous (approved) designs.
5.1.1.2	5.1-5	"No Flow" Plumes	Updated plume configurations to reflect effects described in 5.1.1.1.	Change falls within effects that are enveloped by previous approvals.
5.1.2	5.1-6, -7	Thermal Dis-Charge Standards	Revised to include reference to NPDES Permit requirements	NPDES requirements exert positive controls on effluent quality.
5.1.3			No change.	
5.1.3.1	5.1-12 thru	Fish Habitat	Discusses recent studies of fish (striped bass and sauger) behavior in the Clinch River. Includes habitats, migration and spawning.	Environmentally inconsequential.
5.1.3.2			No change.	
5.1.3.3			No change.	
5.1.3.4			No change.	
5.1.3.5			No change.	
5.1.4			No change.	
5.1.5	5.1-22	Con-denser Entrainment	Update condenser water design flow rate. Also updates Clinch River flow data.	Environmentally inconsequential.
5.1.6			No change.	
5.1.7			No change.	
5.1.8			No change.	
Table 5.1-13	5.1-51	Cooling Systems	Updated Cooling System parameters	Environmentally inconsequential.
5.2	5.2-1 thru 5.2-41	Radiological Impact	This section has been completely rewritten to include impacts on both man and organism other than man. The revised calculations result in reduced dose estimates.	Change judged to be favorable.

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ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
5.3			Deleted. Included in new Section 5.2	
5.4	5.4-1	Effects of Chemical & Biocide Discharges	Editorial change to clarify and explain that an acid feed system is provided. Its use would adjust pH for control of corrosion and scaling, and to assure that the blowdown is in compliance with the the Draft NPDES permit limits.	Environmentally inconsequential.
			Defined the limits of chlorine concentration.	Environmentally inconsequential.
5.4.1	5.4-2	Waste Water Disposal	Adds discussion of changes to waste water disposal system that have been previously described.	Environmentally inconsequential.
5.4.1.1	5.4-4a	Coolant System Discharge	Total volume discharged increased slightly with no changes in chemical concentrations.	Environmentally inconsequential.
5.4.1.2	5.4-5 thru 5.4-8	Discharge Plume	Changed per cent differential between ambient and blowdown concentrations.	Environmentally inconsequential.
		Striped Bass	Described bass response to chemical plume.	Environmentally inconsequential.
		Water Quality	Identifies elements not meeting drinking water standards at 6% isopleth during periods of extended no flow.	Environmentally inconsequential.
			Included consideration of the more stringent of state or federal requirements. (Tables 5.4-1, 5.4-2 and 5.4-5).	Environmentally inconsequential.
5.4.2	5.4-12	Effects of Biocide Discharges	Includes discussion of trihalomethanes (THM's) (Table 5.4-1)	Environmentally inconsequential.
5.4.3	5.4-12a	Storm Water	Instead of being directly discharged to the Clinch River via catch basins, storm water collected by the roof and yard drains is sent via the storm drainage system to runoff treatment ponds for settlement and filtering prior to discharge to the river.	The incorporation of this system provides further assurance that the final effluent discharged to the river via the runoff treatment pond is within applicable effluent standards. The effect is judged to be environmentally favorable.
5.4.4			No change.	
5.4.5			No change.	

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ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
5.5			No change.	
5.5.1	5.5-1, -2	Effects from Sanitary Wastes	Editorial change to clarify that a package treatment plant will be used during the construction period. A slow sand filter unit will be installed following the CRBRP construction period to form a part of the permanent plant for the normal operation of the plant.	Environmentally inconsequential.
			Third paragraph deleted since the description of the treatment plant is given in Section 3.7.	Environmentally inconsequential.
			Treated effluent discharges will be processed to meet the Draft NPDES permit limits instead of "all State and Federal discharge regulations".	Environmentally inconsequential.
			Discharges from cooling tower blowdown were revised to be consistent with Table 3.3-4.	Environmentally inconsequential.
5.5.2			Revised to update Diesel unit emissions and add the third Diesel generator unit. Emissions are lowered.	Environmentally inconsequential.
5.6			No change.	
5.7	5.7-1	Other Operating Effects	No change.	
5.7-1	5.7-1 thru 5.7-58	Fuel Cycle	Completely rewritten and expanded to discuss the fuel fabrication, fuel reprocessing, waste management and transportation phases. For each phase, potential facilities, effluent types and quantities, radiological effects, safeguards provisions and financial cost estimates were evaluated.	Environmentally inconsequential.
5.7-2	5.7-68 thru 5.7-73	Noise Impacts.	Updated US Department of Housing and Urban Development external noise exposure categories.	Environmentally inconsequential.
5.8			No change.	
5.8.1	5.8-1	Plant Site	Total acreage committed updated. Changes will be provided in a future amendment.	Environmentally inconsequential.

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ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
5.8.2	5.8-2	Water Resources	Water consumption updated to reflect latest estimates.	Environmentally inconsequential.
5.8.3	5.8-2 thru 5.8-4	Core Design	Replaced homogeneous core arrangement with heterogeneous core arrangement resulting in reducing the number of fuel enrichment zones from 2 to 1, increasing the Pu enrichment in the fuel from 18.7-to-27.1 to 33.2%, reducing the number of fuel assemblies from 198 to 156. This change also increases the number of blanket assemblies from 150 (radial) to 208 (inner and radial).	Change decreases the heavy metal commitments in the fuel (U + Pu) from 6.5 MT to 4.2 MT, reduces the stainless steel commitments in the fuel from 26.3 MT to 20.7 MT. The heavy metal commitment in the blanket went from 21.7 MT (radial & axial) to 25.2 MT (inner, radial & axial), and increases the stainless steel commitment in the blankets from 17.3 MT to 26.8 MT. Change judged to be environmentally inconsequential.
			Revised Pu isotopic composition to be similar to FFTF grade instead of characteristic of LWR discharge.	Environmentally inconsequential.
			Revised refueling scheme from annual to batch which results in increasing the total number of fuel assemblies, required during plant life, from 2,300 to 2,427; increasing the total number of blanket assemblies from 850 to 2,106.	This results in increasing the total heavy metal commitments based on a once through fuel cycle: from 20 MT Pu to 27 MT Pu, from 210 MT U to 332 MT U and from 410 MT stainless steel to 595 MT. If reprocessing is assumed, then the total net heavy metal commitment of uranium decreases from 17.7 MT to 14.2 MT and the net gain of bred plutonium increases from 2.9 MT to 3.2 MT. Change judged to be slightly adverse.
5.8.4			No changes.	
5.9	5.9-1	Plant Site	Permanent plant acreage is increased.	Environmentally inconsequential.

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ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
6.0			No change.	
6.1	6.1-1	Pre-construction Monitoring Program	Changed to indicate that program was conducted.	Environmentally inconsequential.
6.1.1				
6.1.1.1	6.1-1 thru 6.1-24	Baseline Monitoring Program	Completion of baseline aquatic monitoring program description (results of baseline program reported in Section 2.7).	Environmentally inconsequential.
6.1.1.2	6.1-25 thru 6.1-28e	Pre-construction Aquatic	Provides a summary description and conclusions of the pre-construction aquatic environmental monitoring.	Environmentally inconsequential. Change provides data base for determination of environmental effects dueu to construction as monitored by the construction environmental monitoring program.
6.1.2	6.1-29	Groundwater	Updated to incorporate reference to the pre-construction monitoring program (1976-1977).	Environmentally inconsequential.
6.1.2.1	6.1-29, -29a	Pre-construction Groundwater Quality	Provides summary conclusions of the pre-construction groundwater quality monitoring program.	Environmentally inconsequential. Change provides data base for the construction monitoring program.
6.1.3	6.1-30 thru 6.1-33	Meteorology	Updates meteorological description to incorporate description, instrumentation and data acquisition system for the on-site permanent meteorological monitoring stations.	Environmentally inconsequential. Permanent meteorological facilities will be used during plant construction and operation for on-site meteorological analyses.
			Deletes description of on-site temporary meteorological monitoring station.	Environmentally inconsequential.
6.1.4				
6.1.4.1	6.1-35 thru 6.1-37	Geology	Provides update of site geology investigation (results provided in Section 2.4).	Environmentally inconsequential.
6.1.4.2	6.1-38, -39	Land Use & Demographic Surveys	Discusses the evaluation of demographic changes. The data are presented in Section 2.2.	Environmentally inconsequential.

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ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
6.1.4.3	6.1-39 thru 6.1-41	Terrestrial Ecology	Provides update discussion of baseline terrestrial monitoring program. (Conclusions provided in Section 2.7).	Environmentally inconsequential.
	6.1-42	Construction Monitoring	Provides reference to on-site construction environmental monitoring program.	Environmentally inconsequential.
6.1.5			No change.	
6.1.5.1	6.1-42a thru 6.1-43	Preconstruction Radiological Monitoring	Provides complete description and results of pre-construction radiological (river water, groundwater, sediment) monitoring program.	Change is judged to be slightly favorable. Provides basis for improved determination of radiological disturbance as monitored during the construction radiological monitoring program.
6.2			No change.	
6.2.1				
6.2.1.1	6.2-1 thru 6.2-2b	Gaseous Effluents	Updates plant gaseous effluent monitoring locations (32 locations from 13 locations.) 1 - steam generator building 9 - reactor containment buildings 2 - reactor service building 1 - radwaste area 1 - plant service building 12 - turbine generator buildings 6 - steam generator buildings	Change is judged to be slightly favorable. System will provide - continuous monitors at those locations which could conceivably undergo significant increase in detectable levels - periodic sampling for areas as necessary.
		PSB Liquid Effluents	Liquid effluents go to liquid radwaste system for reprocessing.	Environmentally inconsequential.
6.2.1.2	6.2-3 thru 6.2-10	Pre-operational Radiological Monitoring	Provides current (atmospheric, terrestrial, aquatic, groundwater) radiological monitoring programs for the pre-operational and operational phases.	Environmentally inconsequential.
6.2.2			No change.	
6.2.3			No change.	
6.2.4			No change.	
6.2.5			No change.	
6.3	6.3-1	Other Monitoring Programs	Deletes monitoring stations at TVA's Kingston's steam plant and Bull Run steam plant.	Environmentally inconsequential.

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ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
7.1				
7.1.1				
7.1.1.1	7.1-2	Meteor-ology	Meteorology data contained in Section 2.6 provided by Amendment IX are used in the computations.	Environmentally inconsequential.
7.1.1.2	7.1-2 thru 7.1-6	Method-ology	Beta dose calculations deleted.	Environmentally inconsequential.
7.1.1.3	7.1-6	Sodium Fire Analysis	Updates description of computer code capabilities.	Environmentally inconsequential.
7.1.2				
7.1.2.1			No change.	
7.1.2.2	7.1-7, -8	Steam Drum Valve (2.1)*	The amount of tritiated water released to the environment is 353,000 lbs. instead of 450,000 lbs. The tritium concentration has increased from $.25 \times 10^{-6}$ Ci/g to $.62 \times 10^{-6}$ Ci/g.	The combined effect of these changes is to increase the site boundary whole body dose from 1.77 mrem to 5.50 mrem; both are environmentally inconsequential.
		Conden-sate Storage Tank Leak (2.2)	The tritium concentration in the Condensate Storage Tank increased to $.62 \times 10^{-6}$ Ci/g from $.25 \times 10^{-6}$ Ci/g.	The short-term downstream tritium concentration in the Clinch River increased from 1.18×10^{-12} Ci/g to 2.89×10^{-12} Ci/g after the postulated leak; both are environmentally inconsequential.
7.1.2.3	7.1-9 thru 7.1-14	RAPS	Describes cell containment provisions. RAPS components moved to RCB. The accident postulations are adjusted to reflect this change.	The environmental effects are judged to be favorable. RAPS leakage is processed through the RCB HVAC.
		Radwaste System Failures (3.1)	The tritium concentration in the storage tank water has increased to $.62 \times 10^{-6}$ Ci/g from $.25 \times 10^{-6}$ Ci/g. Storage tank cell parameters have changed such as the floor area increase to 1,000 ft^2 from 800 ft^2 and the volume increase to 39,000 ft^3 from 30,000 ft^3. Sump pump flow capacity increased to 50 gpm from 10 gpm.	The combined effect of these changes is to reduce the postulated spill cleanup time and increase the whole body dose at the site boundary to 1.01×10^{-5} mrem from 9.4×10^{-6} mrem, but both are environmentally inconsequential.

*Refer to accident number in Environmental Report.

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ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
		Liquid Radwaste System Tank (3.2)	Tritium concentration in storage tank water has increased due to change in interface diffusion coefficients. Concentration is now .62 x 10^{-6} Ci/g in SGS.	The combined effect of these changes is to increase the site boundary whole body dose from this postulated accident to 2.13 x 10^{-2} from 5.0 x 10^{-3} mrem; both are environmentally inconsequential.
			Spill cleanup time is reduced to 6.7 hours by using higher capacity sump pumps.	
		RAPS Noble Gas Storage Vessel Rupture (3.3)	Accident redefined due to relocation of RAPS components.	The environmental effects are judged to be favorable.
		Rupture of Equalization Line (3.4)	Deleted. Noble Gas Storage Vessel Rupture replaces Equalization Line Rupture as enveloping postulated accident for the RCB.	
7.1.2.4	7.1-14 thru 7.1-20	Sodium Fire Accidents (4.1) (4.2)	Analyses revised to update computations.	For Accident 4.1, the resultant whole body dose increases from 1.4 x 10^{-2} rems to 2.37 x 10^{-2}. For Accident 4.2 the whole body dose decreases from 1.5 x 10^{-2} to 8.75 x 10^{-3} rems. Both are environmentally inconsequential.
7.1.2.5	7.1-22 thru 7.1-24	Fuel Failures (5.1)	The current plant design has a higher purge rate of the cover gas which has reduced the available Xenon and Krypton activity to 56,600 Ci from 65,816 Ci.	The net effect of the changes is to reduce the site boundary whole body dose to 8.4 x 10^{-5} mrem from 3.4 x 10^{-4} mrem; both are environmentally inconsequential.

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ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
		Steam Generator Tube Rupture (5.2)	A revised DBL for the steam generator results in 465 lbs. of sodium mixing with with water instead of 337 lbs. of sodium. The tritium concentration in SGS is now .62 x 10^{-6} Ci/g and in the IHTS is .13 x 10^{-6} Ci/g.	The net effect of the changes is to increase the site boundary whole body dose to 8.3 x 10^{-2} mrem from 2.1 x 10^{-2} mrem: both are insignificant.
			Deleted the centrifugal separator from the Sodium-Water Reactor Pressure Relief Subsystem (SWRPRS).	This change is judged to be adverse, since this could potentially result in the release of more sodium-water reaction particulates into the atmosphere.
			The duration of the SWRPR venting to the atmosphere was increased from 15 to 28 seconds as a result of an updated TRANSWRAP code analysis of this event. This more detailed analysis tracks the primary sodium which might leak into the intermediate sodium. It considers the length of piping between the IHX and the superheater inlet, and the reduced sodium flow during blowdown and predicts that no primary sodium will reach the superheater during this event for subsequent release to the atmosphere.	No change to estimated environmental effects.

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ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
7.1.2.6	7.1-26 thru 7.1-31	Spent Fuel Cladding Failure in the EVTM (6.1)	Earliest scheduled time for fuel assembly handling is increased to 8 days from 87 hours. Revised ORIGEN isotope library was used to generate fission product inventories.	The combined effect of the changes is to increase the site boundary whole body dose from 1.5×10^{-2} mrem to 2.13×10^{-2} mrem; both are environmentally inconsequential.
		Spent Fuel Cladding Failure in the EVTM (6.2)	The same changes that applied to Accident 6.1 apply here. mentally inconsequential.	The net result of the changes is to increase the site boundary whole body dose for this postulated accident from 1.5 mrem to 2.1 mrem, both are environ-
		Accidentally Opening a Floor Valve (6.3)	Revised ORIGEN isotope library was used to generate fission product inventories Revisions were based on newer calculational schemes.	The combined effect of the changes to increase the site boundary whole body dose to 1.08 mrem from .07 mrem; both are environmentally inconsequential.
7.1.2.7	7.1-32	Spent Fuel Cask Drop (7.1)	Isotope inventories were revised using updated ORIGEN libraries. The ORIGEN changes were due to revisions in the library calculational schemes. The fuel has undergone an 80 day cooling period instead of 100 days. The loading is changed to 6 fuel assemblies and 3 blanket assemblies from 5 and 4, respectively.	The combined effect of the changes is to decrease the site boundary whole body dose to 2.8×10^{-4} mrem from 9.3×10^{-3} mrem; both are environmentally inconsequential.

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ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
7.1.2.8	7.1-33 thru 7.1-43	Primary Sodium Drain Tank Failure (8.1)	Primary sodium isotope inventory has changed due to revisions in the ORIGEN library calculational schemes. Cell 102A dimensions have changed. For example, the cell volume is 45,000 $ft.^3$ and was 68,000 $ft.^3$. The potential sodium spill volume has increased to 35,000 gallons from 32,000 gallons.	The combined effect of the changes is to reduce the site boundary whole body dose from 9.7×10^{-4} rem to 8.4×10^{-5} rem; both are environmentally inconsequential.
		Primary Coolant Sodium Spill (8.2)	The postulated sodium spill has been reduced to 135,000 lbs. from 193,000. It was conservatively assumed that the aerosol leaked to the RCB was vented directly to the environment. Previously a leak rate of .1 vol%/day at 10 psig. was assumed as the leak rate.	The combined effect of the changes is to increase the site boundary whole body dose from 8.3×10^{-4} rem. to 1.25×10^{-2} rem; both are environmentally inconsequential.
		Ex-Containment Primary Coolant Sodium Spill (8.3)	The postulated spill has been reduced from 90,000 gal. to 45,000 gal. of sodium. This is the result of a failure of one of two storage vessels in the cell rather two. The leak rate of aerosol was based on the cell design leak rate of .6 vol%/day at 3.9 psig. rather than 100 vol%/day at 10 psig which was previously used.	The net effect of the changes is to reduce the site boundary whole body dose from 1.3×10^{-3} rem to 4.2×10^{-5} rem; both are environmentally inconsequential.
		Ex-Vessel Storage Tank Coolant Rupture (8.4)	Aerosol leakage to the RSB from the cell was calculated based on a cell design leak rate of .36 vol%/day at 12 psig. rather than 100 vol%/day at 10 psig. This approach will release less aerosol into the environment. Cell dimensions were updated.	The net effect is to increase the site boundary whole body dose from 2.1×10^{-4} mrem to 4.3×10^{-4} mrem; both are environmentally inconsequential.
		Large Steam Line Break (8.5)	The SGS tritium concentration has increased to $.62 \times 10^{-6}$ Ci/g from $.25 \times 10^{-6}$ Ci/g. This is the result of changes in diffusion coefficients across system interface boundaries. The newer design basis results in 312,000 lbs. of water being released from the PRV instead of 479,000 lbs. The power relief vent period has been increased from 1.5 to 5.7 hours.	The combined effect is to increase the site boundary whole body dose to 4.7 mrem from 1.9 mrem; both are environmentally inconsequential.

Q290.1R-29

AMENDMENT XV
JULY 1982

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
7.1.3			No change.	
7.2.1	7.2-1	Hydrogen Gas Storage	The total amount of hydrogen gas stored has not changed; however, the volume has been restated in terms of standard volume (28,000 SCF) rather than bottled storage capacity.	Environmentally inconsequential.
7.2.2	7.2-5a, -5b	Oil and Hazardous Material Spills	Systems/Buildings involved with the storage, transfer, or loading/unloading of any oil or hazardous material are provided with secondary containment systems capable of containing the largest source of an oil or hazardous material spill without any adverse environmental impact.	Incorporation of these features in station design provides further protection against spill of oil and hazardous material reaching the local environment. Environmentally inconsequential.

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
8.0			No change.	
8.1 8.2 8.3	8.1-1 thru 8.3-22	Socio-economic	Complete assessment of socio-economic parameters of CRBRP plant construction and operation is provided. The assessment is based on current construction manpower requirements, 1980 census and 1981 community service and infra-structure data.	This change is judged to be slightly favorable. It provides current data base for evaluation of socio-economic assessment.

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
9.1	9.1-1	Alternative Approaches	This section has been revised to reference the supplement to the LMFBR Program Final Environmental Statement (PFES).	Environmentally Inconsequential.
9.2	To Be Provided	Alternative Sites & Plant Arrangements	This section will be addressed in the supplement to the LMFBR Program Final Environmental Statement (FES). For discussion of Hook-on arrangements refer to response to Question 320.1R and 320.2R. Further discussion of candidate sites will be provided in the near future. Section 9.2.5.3.4 will be updated to reflect response to Question 230.5R.	Environmentally Inconsequential.

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
10	10.0-1	Plant Design Alternatives	Revised to establish position that the the relative effectiveness rankings of the various design alternatives have not changed over the past five years, and that a comprehensive update of all the alternatives is not required. The descriptions of the chosen alternatives were updated to be consistent with the rest of the ER.	Environmentally inconsequential.
10.1	10.1-9	Cooling System	Updated description of the mechanical draft wet cooling tower in a linear arrangement.	Environmentally inconsequential.
	10.1-21		Deleted discussion of relative merits of circular versus linear cell array since the linear arrangement has been selected.	Environmentally inconsequential.
10.2	10.2-14	Intake System	Revised discussion of entrainment effects to indicate that studies are now complete and the effects are acceptable.	Environmentally inconsequential.
	10.2-18		Updated to reflect completion of baseline surveys. Game fish species present went from 2 to 3.	Environmentally inconsequential.
	10.2-20		Deleted reference to baseline surveys being in progress. Revised to include results of completed studies.	
10.3	10.3-1, -2	Discharge System	Revised to update Clinch River parameters and specify requirement for discharges to comply with NPDES Permit limitations.	Environmentally inconsequential.
	10.3-5		Increase pipe diameter from 12 to 20 inch diameter.	Environmentally inconsequential.
10.4	10.4-1 thru 10.4-18	Waste water Treatment System	Revised throughout to change system designation from Chemical Waste Treatment to Waste Water Treatment. Updated the discussion of aste streams, the description of the process, the alternatives and the bases for selecting the chosen system.	Environmentally inconsequential.
10.5	10.5-6,-7	Biocide System	Revised discussion of blowdown flow control to assure control of high chlorine concentration. Updated flow rates.	Environmentally inconsequential.
10.6	10.6-1 thru 10.6-10a	Sanitary Waste System	Revised to include discussion of an extended aeration/chlorination system that is the current chosen alternative.	Environmentally inconsequential.

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
10.7	10.7-1a	Liquid Radwaste System	Incorporated reference to Section 3.5	Environmentally Inconsequential.
	-4		Update component designations and system details.	Environmentally Inconsequential.
10.8	10.3-1 thru 10.8-12a	Gaseous Radwaste System	Incorporated System 6, patterned after the FFTF system, as the chosen system. Editorial changes to assure proper designation of System 4 as the "originally selected" system.	Change judged to have a slightly negative environmental effect.
10.9		Transmission Facilities	No change.	
10.10	10.10-2	Other System	Revised to provide for three diesel generator units.	Environmentally Inconsequential.

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
11			No change.	No change.

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
12	12.0-1 thru 12.0-7	Permits	Provides revised listing of Non-NRC permits, purpose, legislation, and regulation enacting permit approval or notificatio .	No changes in estimated environmental effects due to this tabulation.

Q290.1R-36

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
13	13.0-3 thru 13.0-50	References	Update to include appropriate references.	No environmental effects.

0290.1R-37

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE	ENVIRONMENTAL EFFECT
14 (Appendix to Section 2.5)	14.1-2 thru 14.1-81	Clean Water Act of 1977	Incorporates 1977 amendment to the State of Tennessee Water Quality Criteria Incorporates the 1977 clean water act amendments to the Federal Water Pollution Control Act.	The change is judged to be slightly favorable. It provides criteria for CRBRP design for reduction of impact on the environment.
14 (Appendix to Section 2.7)	14.3-3	Sauger	Provides update information on spawning of sauger.	No environmental effects.
14 (Appendix to Sections 5.2 and 5.3)	14.4-1	Dose Calculation Models	Deleted. Incorporated into revised Section 5.2	Environmentally inconsequential.
14 (Appendix to Section 10.3)	14.6-3	Cooling Tower	Updates cooling tower blowdown rate provides current design blowdown temperature values.	The increase in cooling tower blowdown is judged to be insignificant compared to the Clinch River flow rate.
Appendix C	C-1 thru C-71	Socio-Economic	Reports the results of a qualitative assessment of the socio-economic effects of CRBRP construction and operation assuming inmover migration rates of 26% and 40%. The effects of the 1981 assessment are compared to those estimated in 1976.	

Indicator	Difference (1980-1976) for 26%	for 40%	Environmental Effect
Population	800	1840	Environmentally inconsequential
Housing	456	924	Housing demand for 40% inmover case may create tight housing market
Education			
Students	97	321	Environmentally inconsequential
Classrooms	1	11	Environmentally inconsequential
Health Care			
Hosp. Beds	-2	-	Environmentally inconsequential
Drs.&Dentists	-	1	Environmentally inconsequential

Q290.1R-38

ER SECTION	REVISED	ITEM	DESCRIPTION OF CHANGE			ENVIRONMENTAL EFFECT
		Public Safety	Data not comparable			EI
		Water Supply	53	161	(10^3gpd)	EI
		Waste Disposal				
		Liquid Wastes	60	184	(10^3gpd)	EI
		Solid Wastes	31	74	(10^2#/d)	EI
		Commuter Traffic	B to C	C to D	Level of of Service	Change judged to be only slightly adverse. Effects are mitigated by possible use of staggered shifts, recent intersection improvements, etc.
			Level of service on SR 95 between I-40 and Bear Creek Rd. could be Level E during peak commuter times			
		Expenditures and Revenues	Changes discussed elsewhere in ER			Environmentally Inconsequential

Q290.1R-39

QUESTION 290.2R

Describe any changes in station design that would result in a change in the water quality of the station blowdown or stations water use, or in water intake or discharge structures.

RESPONSE

The only significant change in station design has been the redesign of the Waste Water Disposal System.

Previously, station wastes were handled as follows:

1. Floor and equipment drainage wastes were treated and discharged to the Cooling Tower Basin.

2. Process water wastes (primarily ion exchange regeneration wastes) were treated, integrated with Cooling Tower Basin Blowdown and discharged to the river.

Presently, the design provides for pretreatment of segregated waste streams as follows:

1. Floor and equipment drainage is processed by an oil/water separator

2. Process water wastes are neutralized

3. Clarifier blowdowns and filter backwashes are routed to sludge lagoons.

These waste streams are routed to the equalization basins for equalization of chemical characteristics and temperature.

Following equalization, plant wastes are processed by the Waste Water Disposal System to meet the following NPDES Permit effluent limits;

> Oil and Grease: 15 mg/l daily average, 20 mg/l daily max., Total Suspended Solids: 30 mg/l daily average, 100 mg/l daily max., PH: Shall not be less than 6.0 nor greater than 9.0, and there shall be no discharge of floating solids or visible foam in other than trace amounts.

Thereafter, the plant wastes are either blended with Cooling Tower Basin blowdown for discharge to the river, or recycled to the Cooling Tower Basins as makeup to the Circulating Water System. While this change to station design will result in a significant improvement to the water quality of the individual waste streams, the impact on station blowdown will be minimal since these wastes streams combine with the cooling tower blowdown which has a very large flow rate.

Station water use, and consequently discharge to the river, has increased by approximately 5% due to refinement in design numbers resulting from design development. This increase has not impacted the design of water intake or discharge structures.

Question 290.3R

Identify and make available for staff inspection during the site visit any new or updated information pertaining to water quality, water use, aquatic, biology, or terrestrial resources in the vicinity of the site published or generally available since submission of the ER. Sources of this information should include, but not limited to, DOE, ORNL, TVA, University of Tennessee at Knoxville, State of Tennessee, U.S. Department of the Interior, local governments, or regional planning groups.

RESPONSE

An evaluation of the current aquatic and terrestrial ecological status of the Clinch River site was transmitted to the NRC on October 16, 1981, as part of Amendment IX to the Environmental Report. This evaluation included data from recent generally available ecological studies made by such organizations as ORNL, the Tennessee Technological University, TVA and similar organizations. A bibliography of the sources cited in support of that evaluation was provided in revised Section 13 of the ER. New sources added as part of the revision were identified in the margins of the replacement pages. These added studies constitute the principal sources of new and updated information pertaining to the aquatic, biological or terrestrial resources in the vicinity of the site.

This and other material as well as staff expertise in the areas of interest were made available during the NRC site visit on October 27, 1981.

Question 290.4R

Identify and describe any post 1976 differences in use of the Clinch River by others. Provide current plans of TVA for regulation of flow in the Clinch River noting especially any plans for maintenance of a minimum flow past the site.

RESPONSE

Environmental Report Tables 2.2-15 and 8.1-16 (Amendment X) provide recent industrial and municipal supply capacity and use. There has been no significant change in the industrial water supplies within a 20 mile radius of the Site since 1976. Most municipal water systems have increased their capacities in Anderson, Roane and Knox counties while Loudon county has remained unchanged.

Recent Clinch River flow hydrology is provided in Section 2.5 of the ER (Amendment IX). Periods of zero release from the Melton Hill Dam are identified in Table 2.5-2. At this time TVA has no plans to maintain a minimum flow (discharge) from Melton Hill Dam.

Question 290.5R

Provide any additional information on the population levels, spawning activity, or other site specific information on Corbicula sp. known to inhabit the Clinch River in the vicinity of the site.

RESPONSE

Benthic macroinvertebrate fauna in the vicinity of the proposed CRBRP was sampled on a monthly basis in 1975 and a seasonal basis in 1976 and 1977 using a Ponar grab sampler. Corbicula manilensis was collected more frequently than any other taxa during all three years. Percent occurrence for Corbicula manilensis was 91, 81, and 75 percent for 1975, 1976, and 1977, respectively. Abundance of Corbicula ranged from $0.0/m^2$ at several stations to $141.3/m^2$ at CRM 19.0 in September 1976 (Ref. 1).

The relatively low density of Corbicula in the vicinity of the CRBRP site is primarily because of the predominance of hardpan substrate, deep water, and cold releases from Melton Hill Dam.

Spawning generally begins when water warms to about 16° C in the spring and continues intermittently until late autumn. Although the abundance of Corbicula is low at the plant site, there are large populations of asiatic clams in overbank areas upstream, and these can be expected to contribute large numbers of larvae near the CRBRP site.

Ref. 1 This information is taken from Ref. 111 listed in Chapter 13 of the ER (Amend. IX), which is: Woosley, L. H., Jr., Taylor, M. P., Toole, T. W. and Wells, S. R., Status of the Nonradiological Water Quality and Nonfisheries Biological Communities in the Clinch River Prior to Construction of the Clinch River Breeder Reactor Plant, 1975-1978, Tennessee Valley Authority, Chattanooga, Tennessee and Muscle Shoals, Alabama, February 1979, 143 pp. and appendices.

Question 290.6R

Provide an estimate of the maximum probable yearly recreational harvest of finfish, shellfish, and molluscs harvested from waters downstream of the station to the Mississippi River that potentially could be contaminated by radionuclides due to a maximum probable accident. The harvest estimates should be summarized by species and location of capture (water body segment) and provide an explanation of how the estimate was obtained.

RESPONSE

The Clinch River Breeder Reactor Plant has been designed such that no "maximum probable accident" can result in significant radionuclide release to the adjacent water body. Even so the requested estimates are provided.

Estimates of maximum sport fish harvest of individual species were obtained from most recent creel data available for Watts Bar, Chickamauga, Nickajack, Wheeler, and Kentucky Reservoirs. These estimates have been increased by 40% to conservatively account for the uncertainty of the information. While harvests from individual bodies of water may exceed the estimated total, the system-wide total is considered realistic. Total harvests were then estimated for Guntersville, Wilson, and Pickwick Reservoirs based on harvest in adjacent reservoirs and a subjective comparison of the relative quality of their fisheries (Table 290.6R-1).

There is no known harvest of shellfish or molluscs for sport in the Tennessee Valley.

Since a conservative margin of 40% has been applied to the information gathered on sport fish harvests and since the approximately 40 mile reach of the Ohio River between its mouth and the mouth of the Tennessee River represents less than 10% of the total river miles considered, it is concluded that the absence of specific fisheries information for the Ohio River will not seriously affect the information presented here. Furthermore, this portion of the river is farthest from the Plant site (approximately 580 river miles) and therefore, would receive the greatest benefit from the effects of dilution.

TABLE 290.6R-1 - MAXIMUM PROBABLE SPORT FISHING HARVEST IN THE TENNESSEE RIVER BELOW CRBRP SITE

Species	Harvest Pounds								Grand Total
	Watts Bar Reservoir	Chick-mauga Reservoir	Nick-ajack Reservoir	Gunters-ville Reservoir	Wheeler Reservoir	Wilson Reservoir	Pickwick Reseroir	Kentucky Reser-voir & Tailwaters	
Paddlefish	1,764	2,440	732					28,064	
Buffalo		11,956						600	
Carp	2,940	5,612	2,928					145,716	
Flathead Catfish	1,176	25,376	2,562		902			98,070	
Blue Catfish	11,466		6,954		5,884			741,039	
Channel Catfish	50,568		14,823		39,780			369,735	
Bullhead			183		263			6,500	
Drum	6,762	6,588	28,182		1,824			119,613	
Rainbow Trout	264		183					600	
Striped Bass	15,876	33,916	732					8,064	
White Bass	27,048	28,548	6,588		4,248			225,678	

TABLE 290.6R-1 - MAXIMUM PROBABLE SPORT FISHING HARVEST IN THE TENNESSEE RIVER BELOW CRBRP SITE

Species	Harvest Pounds								Grand Total
	Watts Bar Reservoir	Chick-mauga Reservoir	Nick-ajack Reservoir	Gunters-ville Reservoir	Wheeler Reservoir	Wilson Reservoir	Pickwick Reseroir	Kentucky Reser-voir & Tailwaters	
Yellow Bass	294	488	5,307					9,864	
Sauger	28,812	24,400	1,098		150			1,066,810	
Largemouth Bass	48,216	33,184	21,777		15,961			209,664	
Smallmouth Bass	8,820	3,172	183		4,869			4,032	
Spotted Bass	294	4,880	1,647		75			20,160	
White Crappie	51,450	36,600	28,300		100,730			1,559,803	
Black Crappie	2,940	4,636	1,098					28,224	
Blue Gill	33,516	17,080	54,351		8,422			135,456	
Red Ear Sunfish		244	12,444		1,541			90	
Other Sunfish		4,148	2,013		1,578			16,428	

TABLE 290.6R-1 - MAXIMUM PROBABLE SPORT FISHING HARVEST IN THE TENNESSEE RIVER BELOW CRBRP SITE

Species	Harvest Pounds								Grand Total
	Watts Bar Reservoir	Chick-mauga Reservoir	Nick-ajack Reservoir	Gunters-ville Reservoir	Wheeler Reservoir	Wilson Reservoir	Pickwick Reseroir	Kentucky Reser-voir & Tailwaters	
Rock Bass			732		620			740	
Wall Eye	1,764	732	183		20				
	294,000	244,000	193,000	280,000	187,000	119,000	252,000	4,795,000	6,354,000

Question 290.7R

Using data from the last 5 years from National Marine Fisheries, or the States within the Tennessee and tower Ohio watersheds, provide an estimate of the maximum probable yearly commercial harvest of finfish, shellfish, and molluscs harvested from waters downstream of the station to the Mississippi River that potentially could be contaminated by radionuclides due to a maximum probable accident. The harvest estimates should be summarized by species and location of capture (water body segment). Provide an explanation of how the estimate was made.

RESPONSE

The Clinch River Breeder Reactor Plant has been designed such that no "maximum probable accident" can result in significant radionuclide release to the adjacent water body. Even so the requested estimates are provided.

Commercial fish harvest estimates were made by taking most recent harvest data for each region of the Valley. These estimates have been increased by 40% to conservatively account for the uncertainty of the information. The estimates are then apportioned among the reservoirs of each region, based on the knowledge of the standing crop of fish in each reservoir and data from individual fish markets serving each reservoir (Table 290.7R-1).

There is no known shellfish or mollusc harvest for food in the Tennessee Valley. Shells of freshwater mussels are harvested to be used as nuclei for cultured pearls in Japan. No estimates are available for individual bodies of water, but based on our current knowledge of the resource, total maximum expected harvest for the Tennessee River below the CRBRP site is about the amount of 1978 harvest (1000 tons).

Since a conservative margin of 40% has been applied to the information gathered on commercial fish harvests and since the approximately 40 mile reach of the Ohio River between its mouth and the mouth of the Tennessee River represents less than 10% of the total river miles considered, it is concluded that the absence of specific fisheries information for the Ohio River will not seriously affect the information presented here. Furthermore, this portion of the river is farthest from the Plant Site (approximately 580 river miles) and therefore would receive the greatest benefit from the effects of dilution.

TABLE 290.7R-1 - MAXIMUM EXPECTED COMMERCIAL FISH HARVEST FOR LOWER EIGHT TENNESSEE RIVER RESERVOIRS

	RESERVOIR								
Commercial Fish Groups	Kentucky (Pounds)	Pickwick (Pounds)	Wilson (Pounds)	Wheeler (Pounds)	Guntersville (Pounds)	Nickajack (Pounds)	Chickamauga (Pounds)	Watts Bar (Pounds)	TOTAL
Paddlefish	249,830	21,713	7,812	33,807	34,206	12,631	43,117	47,502	450,618
Carp	140,104	44,288	15,936	68,960	69,775	9,146	31,223	34,398	413,830
Buffalo	2,059,114	781,593	281,246	1,216,982	1,231,378	109,813	374,674	414,960	6,469,760
Catfish	1,513,737	337,919	121,596	526,157	532,382	24,172	82,270	90,636	3,228,868
Drum	27,423	18,858	6,786	29,364	29,711	851	2,974	3,276	119,243
TOTAL	3,990,208	1,204,371	433,376	1,875,270	1,897,452	156,613	534,258	590,772	10,682,319

Question 290.8R (NRC letter dated 10/26/81, response letter dated 12/22/81)

Indicate if any federally recognized threatened or endangered species have either been reported from the site or the immediate vicinity or historically known from the site and recently placed on the list of protected species since issuance of the ER.

RESPONSE

Reconnaissance field surveys of the Clinch River site were conducted in August, 1980. The purpose of these surveys was to evaluate current conditions at the Site relative to those described in the CRBRP Environmental Report and in the NRC's final Environmental Statement which was issued in Febuary, 1977. Based on the surveys and an evaluation of recent published literature, it was established that no changes have occurred on site since that time with respect to recognized threatened or endangered species. This determination and the supporting data were provided to the NRC as part of Amendment IX to the ER.

Question 290.9R

Give the status of the NPDES Permit, the Clean Water Act 401 Certification, and other permits and approvals required prior to station operation.

Response

The specific details of individual permits and approvals are as follows:

1. U.S. Environmental Protection Agency (Region IV)

   a. Permit - The National Pollutant Discharge Elimination System (NPDES) Permit

   b. Status - A Draft NPDES Permit was initially issued November 4, 1976, however, due to the National Policy Debate concerning the future of the CRBRP Project, the draft permit was not further resolved. An up-to-date draft of the NPDES Permit application was prepared in late November 1981 and was transmitted to the EPA and the State of Tennessee in early December 1981. Recent discussions with the EPA indicate that a final draft NPDES permit is expected to be completed for inclusion in the NRC update to the CRBRP Final Environmental Statement (NUREG-0139), which is scheduled for publication on June 22, 1982.

2. State of Tennessee, Bureau of Environmental Health Sciences, Division of Water Quality Control

   a. Permit - Clean Water Act - Section 401 Certification

   b. Status - The State was provided information in early December 1981 relative to Section 401 Certification of the NPDES Permit. The State will review the information to assure compliance with applicable State requirements and to assure resolution of State concerns prior to issuance of the final draft NPDES permit. The State has indicated that a Section 401 Certification will be issued for the CRBRP NPDES Permit.

3. State of Tennessee, Department of Conservation, Division of Water Resources.

   a. Approvals - Registration of withdrawal of 50,000 or more gallons of water per day from the waters of Tennessee.

   b. Status - The registration form may be sent in as early as February 15, 1982 or whenever site work dictates a 50,000 gallons per day river water demand.

4. Federal Aviation Administration, Air Space and Procedures Branch

   a. Permit - Permits for tall structures--necessary for any structures 200 feet in height above the ground level at its base.

b. Status - Permits have been obtained for those structures presently existing on site. No additional structures requiring such permits are presently planned.

5. Federal Aviation Administration, Air Space and Procedures Branch

a. Permit - Permit for landing area (i.e., heliport) construction.

b. Status - Permits necessary for such construction will be initiated at least 60 days prior to heliport construction.

6. Federal Communication Commission (FCC), National Telecommunication and Information Agency (NTIA)

a. Permits - (1) Assignment of frequency authorization and approvals to operate two-way radios during the plant's construction phase.

(2) Assignment of a frequency authorization and approvals to operate a radio communications (i.e., microwave receiver/ transmitter system) system during the plant's operational phase.

b. Status - (1) The frequency authorization and the approval to operate two-way radios for the construction phase have been secured. Other necessary frequency authorizations will be secured as appropriate.

(2) The frequency authorization for the plant's operational phase will be secured prior to plant operation.

7. U.S. Coast Guard, Aids to Navigation Branch

   a. Approval - An approval that insures that adequate lights and other markings are provided on structures near navigational channels such as the barge facility.

   b. Status - U.S. Coast Guard approval was given November 30, 1981 that the Project's planned actions were adequate.

8. State of Tennessee, Bureau of Environmental Health Services, Division of Air Pollution Control

   a. Permits - Permits are needed to both construct and operate the following emission sources:

      Concrete Batch Plant
      Rock Crusher Facility
      Cooling Towers
      Diesel Generators
      Any stationary internal or external combustion units

   b. Status - The necessary information for these permits is being assembled and the proper procedures for complying with their requirements are being followed. An assessment has been conducted which identifies the potential to emit air contaminants from all sources. Individual permits will be processed to secure permits in a timely manner.

9. U.S. Army Corps of Engineers, Operation Division, Regulatory Function Branch

   a. Permits - A permit is required to perform the following:

      (1) to discharge dredge or fill materials into navigable waters,

      (2) to construct water intake and discharge facilities,

      (3) to construct barge facilities, and

      (4) to provide an access road and railroad fills. (below normal water level, elevation 741 feet, 225.86 meters).

   b. Status - The Corps of Engineers Permit (No. 42,362) was initially issued May 6, 1977 and was extended on January 29, 1981, and will remain valid until May 4, 1984.

10. Tennessee Valley Authority, Division of Land and Forest Resources

   a. Permit - A TVA Section 26a Permit is needed to perform the following activities:

      (1) construction of water intake and discharge structures,

(2) construction of the barge facilities, and

(3) construction of access road and railroad fill permits.

b. Status - The TVA Section 26a Permit was initially issued April 19, 1977 and was extended on June 10, 1981, and will remain valid indefinitely; however, it is subject to revocation.

11. U.S. Coast Guard and U.S. Army Corps of Engineers

a. Permit - Permit to place thermal monitors in the Clinch River.

b. Status - A computerized model is being developed by the TVA for use in their nuclear plants. This model performs thermal monitoring of river water using intake temperature and outfall temperature only. It is anticipated that this technique will be used at CRBRP and would eliminate the need for installing monitoring stations in the river. However, if this technique cannot be used, permits will be obtained and time is available to do so.

12. Tennessee Department of Transportation

a. Permit - Permit for excess weight/size vehicles.

b. Status - Permits for excess weight/size vehicles on the State highway system are secured on a case-by-case basis by the activity responsible for use of such vehicles. The vehicle/load description is provided to TDOT twenty-four hours in advance. TDOT provides a written (teletype) permit. To date, five permits have been requested and received for movement of five sodium pump drive motors.

13. Tennessee Department of Transportation

    a. Permit - Grant of easement.

    b. Status - The CRBRP railroad crossing of the Highway 58 right-of-way and beneath Gallagher Bridge is the only identified requirement of this type. TDOT has reviewed the location and design drawings of the crossing of the right-of-way and found them acceptable. Change to the existing grant of easement to the State for Highway 58 through Federal property is being developed.

14. City of Oak Ridge

    a. Permit - Grant of easement.

    b. Status - Two changes to the City of Oak Ridge's grant of easement from DOE for Bear Creek Road have been identified - one for the CRBRP water line crossing and one for the CRBRP railroad spur paralleling Bear Creek Road. Changes to the existing grant of easement will be initiated shortly with the City of Oak Ridge.

Question 290.10R

Provide an estimation of the # of acres of prime and unique farmlands (Fed. Reg. 4030-4033 Vol. 43, #21, January 31, 1978), on the Clinch River site. Also indicate how many acres of prime and unique farmlands, if any, will be disturbed by construction activities.

RESPONSE

The CRBRP site is predominately rolling (8 to 15% slope) to hilly (15% to 30% slope) and is not classed as prime or unique farm land. The Roane County soil survey issued May, 1942 by the U. S. Department of Agriculture in cooperation with the Tennessee Agricultural Experiment Station and TVA shows two main soil types. One type is the Clarksville Cherty Silt Loam Hilly Phase and is derived from the Cherty Limestone and would be classed as poorly suited for agricultural crops. The second type, the Upshur Silty Clay Loam Valley Phase soil type is a very shallow soil that is derived from shaley limestone, contains outcrops of limestone, and is considered poor for cultivated crops.

QUESTION 290.11R

The U.S. Fish and Wildlife Service has notified the NRC that 11 species of endangered freshwater mussels may be present in the vicinity of the CRBR site. The 11 species of mussels are Plethobasis cooperianus, P. cicatricosus, fusconaia cuneolus, E. f florentina, Lampsilis virescens, L. o. orbiculata, Dromus dromas, Pleurobema plenum and Conradilla caelata. Provide any records of any of these species taken from the Clinch River in the vicinity of the site, or from Watts Bar Reservoir. Include the date, the location and the number of specimens collected. Describe the program that resulted in the collection of these species. Provide a discussion on the potential for the presence of any of these species on the shallow submerged island located in the Clinch River just downstream of the planned discharge structure.

RESPONSE

Freshwater mussel populations in the lower reach of the Clinch River have not been the specific subject of any investigation in over 50 years; however, several studies have evaluated macroinvertebrate fauna in the vicinity of the Clinch River Breeder Reactor Project (CRBRP) site (Project Management Corporation, 1975; Exxon Nuclear Company, Inc., 1976; TVA, 1979). Although several endangered mussel species inhabit the Clinch River system, and in time past have occurred near the CRBRP site (Attachment 1), none have recently been recorded in the lower portion of the river. Recent studies by TVA (1979) and Oak Ridge National Laboratory (1981) identified only two silt tolerant species (Quadrula pustulosa and Anodonta sp.) in the vicinity of the Site. TVA divers (biologists) working at the Site have reported the benthic substrate as unsuitable for significant mussel populations with the major (channel) part of the river having a bottom of bedrock and localized overbanks being composed of sand. Due to the limited amount of suitable substrate and the failure of several surveys to encounter significant mussel populations, potential for the occurrence of endangered mussels in the vicinity of the CRBRP site is remote.

REFERENCES

Exxon Nuclear Company, Inc., 1976. Nuclear Fuel Recovery and Recycling Center Environmental Report, Vols. I and II. Docket No. 50-564, December 16, 1976.

Oak Ridge National Laboratory, 1981. Ecological studies of the Biotic Communities in the vicinity of the Oak Ridge Gaseous Diffusion Plant. Environmental Science Division. Pub. No. 1744, October 1981.

Project Management Corporation, 1975. Clinch River Breeder Reactor Environmental Report, Vols. I and II. Docket No. 50-537, April 10, 1975.

Tennessee Valley Authority, 1979. Status of the Nonradiological Water Quality and Nonfisheries Biological Communities in the Clinch River Prior to Construction of the Clinch River Breeder Reactor Plant, 1975-1979, pp. 145.

ATTACHMENT 1

Records of presently-listed endangered freshwater mussels collected within 40 river miles of the CRBR Site (Clinch River Mile 15-17).

Species	Stream & Site	Date & Reference
3) Fusconaia cuneolus	Clinch River (Solway) Rm 44	1914-Ortmann, 1918
	Poplar Creek (Roane Co.) at mouth at Rm 12.0	Before 1918-Ortmann, 1918

	Emory River (Harriman) Rm 11	1915-Ortmann, 1918
4) Fusconaia edgariana	Clinch River (Pattons Ferry)	Before 1918-Ortmann, 1918
	Poplar Creek (Roane Co.) at mouth Rm 12.0	Before 1918-Ortmann, 1918
	Clinch River (Edgemoor) Rm 48	1915-Ortmann, 1918
7) Plethobasus cooperianus	Clinch River (Pattons Ferry) Rm 14	Before 1918-Ortmann, 1918
	Tennessee River Rm 595.0	1978-Gooch, et. al. 1979
	Clinch River (Edgemoor) Rm 48	1915-Ortmann, 1918
1) Dromus dromas	Clinch River (Solway) Rm 44	1914-Ortmann, 1918
	Clinch River (Edgemoor) Rm 38	1915-Ortmann, 1918
5) Lampsilis orbiculata	Clinch River (Solway) Rm 44	1914-Ortmann, 1918
	Tennessee River Rm 588.4	1978-Gooch, et. al. 1979

6)	Lampsilis virescens	Emory River (Harriman) Rm 11	1915-Ortmann, 1918
2)	Epioblasma turgidula	Emory River (Harriman) Rm 11	1915-Ortmann, 1918

REFERENCES

Ortmann, A. E., 1918, The Nayades (Freshwater Mussels) of the Upper Tennessee Drainage. With notes on synonymy and distribution. Proceedings of the American Philosophical Society, 57:521-626.

Gooch, C. H., Pardue, W. J. and Wade, D. C., 1979. Recent mollusk investigations of the Tennessee River, 1978. Draft report of the Water Quality and Ecology Branch, Division of Environmental Planning, Tennessee Valley Authority, pp. 126.

Follow on information on QUESTION 290.11R

Additional information relating to this response has been provided, as follows:

1. Narrative comments about substrate characteristics and likelihood of finding endangered mussels were supplied by Donald C. Wade, TVA biologist. The tabular list of

endangered mussel records was compiled by John J. Jenkinson, TVA biologist (malacoligist).

2. Literature citations for Ortmann, 1918 and Gooch, et. al., should have been attached to the end of the table. They are as follows:

Ortmann, A. E., 1918. The Nayades (freshwater mussels) of the Upper Tennessee Drainage. With notes on synonymy and distribution. Proceedings of the American Philosophical Society, 57:521-626.

Gooch, C. H., Pardue, W. J. and Wade, D. C., 1979. Recent mollusk investigations of the Tennessee River, 1978. Draft report of the Water Quality and Ecology Branch, Division of Environmental Planning, Tennessee Valley Authority, 126 pp.

3. All twelve freshwater mussel species on either the U.S. Fish and Wildlife Service or on the TVA generated lists are typically found on stable gravel or cobble substrates. Marginal habitats for the Plethobasus species, Lampsilis orbiculata, Dromus dromas and Pleurobema plenum might extend to sand or clay substrates if the bottom material was current-swept, stable and penetrable enough to allow the mussels to dig in. Solid bedrock or shifting mud or sand substrates, which characterize the river bed in the vicinity at and downstream of the CRBRP site, are unsuitable habitats for nearly all freshwater mussel species including all of the species on either of the lists prepared by the CRBRP site.

4. Known ranges of species involved (live records 1975-date):

Conradilla caelata	-middle reach of the Powell River (RM 95-120)
	-middle reach of the Clinch River (RM 184-219, 253, 273)

	-middle reach of the Elk River (RM 70 and 83) - not live but fresh, empty shells. -middle reach of the Duck River (RM 132-179)
Dromus dromas	-middle reach of the Clinch River (RM 170-190) -middle reach of the Powell River (RM 67-136) -one short reach of the Tennessee River below Watts Bar Dam (RM 520-521) -one site on the Cumberland River below Cordell Hull Dam (RM 296)
Epioblasma florentina florentina	-no recent records; presumed to be extinct
Epioblasma torulosa gubernaculum	-one site record from the middle reach of the Clinch River (RM 187)
Epioblasma turgidula	-last collected (1972) on the Duck River (RM 250) in an area now covered by Normandy Reservoir; presumed extinct
Fusconaia cuneolus	-middle reach of the Powell River (specific sites not available) -extensive reach of the Clinch River (RM 156-226, 268-322) -one site on the Paint Rock River (RM 48)

Fusconaia edgariana	-middle reach of the Powell River (RM 67-136) -an extend d reach of the Clinch River (RM 184-279) -upper reach of the North Fork Holston River (RM 84-92) -upper reach of the Paint Rock River (RM 44-59) -middle reach of the Elk River (RM 70-118)
Lampsilis orbiculata	-one site on the Clinch River (RM 185) -a number of separated sites on the Tennessee River (RM 22, 164-170, 183, 197-202, 251-252, 334-33 , 344-346, 417, 518-528, 588-592) -a single record from the Ohio River near Paducah, Kentucky (near Rm 940) -several sites in the reach of the Cumberland River that has been studied (RM 275-305) -nine sites in the lower 55 miles of the Merawec River, Missouri. Also reported from the Little Black River, St. Francis River, Sac River, Gasconade River and Osage River--all in Missouri.
Lampsilis virescons	-upper Paint Rock River system (RM 59-60 and Hurricane Crock)
Plethobasus ciatricosus	-one record from the Tennessee River near Savannah, TN (near RM 190)

<u>Plethobasus cooperianus</u>	-a few widely scattered sites on the Tennessee River (RM 153, 170, 183, 197, 205, 345, 595) -a single record from the Ohio River near Paducah, Kentucky (near RM 940)
<u>Pleurobema Plenum</u>	-two sites on a middle reach of the Clinch River (RM 179 and 185) -at least one non-specific record from the Tennessee River near Savannah, Tennessee (near RM 190) -records also exist for the Green River, Kentucky

QUESTION 310.2R

Provide current data on labor force requirements and schedules, intra-structure capacity and demand, tax rates and fiscal resources, population, land use and competing construction projects.

RESPONSE

The requested information was updated to a 1980-1981 data base in ER Amendments X and XIV, dated December, 1981 and May, 1982, respectively.

QUESTION (1)

Section 2.2.1.3

The Applicant should describe the methods and assumptions used to derive resident equivalents from the data on transportation, daily, and seasonal transients.

RESPONSE (1)

The translation of transportation, daily, and seasonal transients into resident equivalents (i.e., the number of persons who would be in the area all year) requires a number of assumptions:

- Transportation Transients

  The main sources of transportation transients within five miles of the site are local highways. Using the Average Daily Traffic (Table 2.2-4) for the highways discussed in Section 2.2.1.3, the following calculations were made:

  - The length of the various highway segments is:

I-40	--11 miles
Tenn 58	---8 miles
Tenn 95	---5 miles

  - Assuming the average speed of vehicles if 55 miles per hour, this distance translates into an average vehicle transit time for each highway.

I-40	--12 minutes
Tenn 58	---9 minutes
Tenn 95	---6 minutes

- The product of the proportion of a day that a vehicle is within 5 miles of the site and the total traffic volume is the resident equivalent. For example, for I-40, the calculation is:

$$\frac{12 \text{ minutes}}{(24 \text{ hours})\ (60 \text{ minutes/hr})}(21{,}130 \text{ vehicles}) = 176 \text{ vehicles}$$

- To convert vehicles to persons, it is assumed that there are 2.0 persons per vehicle.

$$(176 \text{ vehicles})(2.0 \ \frac{\text{persons}}{\text{vehicle}}) = 352 \text{ persons}$$

Table 2.2-5 shows the resident equivalents due to transportation, and the population wheel sectors into which they fall.

- o Daily Transients

  The major source of daily or commuter transients within ten miles of the site is the Oak Ridge complex. There are three major industrial facilities; the Oak Ridge Gaseous Diffusion Plant (ORGDP), the Oak Ridge National Laboratory (ORNL), and the Y-12 plant. Table 2.2-6 shows the employment at these facilities. Each facility has people present all day, every day of the week. The resident equivalents were calculated in two ways:

- For the weekday and shift personnel, the fraction is 40/168 = 0.24 workhours/week. Thus there are (0.24)(4820) = 1157 or 1160 persons for the regular shift.

- For the weekend shift personnel, the fraction is only 16/168 or .095 workhours/week. Thus (.095)(120) = 11 persons.

  The distributuion of the resident equivalents for the Oak Ridge complex is given in Table 2.2-7.

o Seasonal Transients

  Table 2.2-8 presents estimated average peak hour visitation and visitation projections for recreation areas within ten miles of the CRBRP. Almost all of these areas will be used for only part of the day. It is estimated that visitors will stay less than four hours at these areas. Use of peak hour estimates is conservative in that actual use of the facilities is overestimated.

  Conversion of the estimates into transient equivalents was accomplished by:

- Using the peak hour estimates for each recreational site, e.g., the commercial campground (Site 1). Most campers are present overnight and in the camp for 12 hours or more. Using the peak hour estimate thus overestimates the number of campers present all day.

- Multiplying all visitation estimates for sites other than Atomic Speedway and the commercial campground by four. Considering that most visitors are present at the facility less than four hours, this step overestimates the number of persons present each 24-hour day.

Atomic Speedway was not included in the calculations. Use of the speedway is very sporadic, and it is felt that its resident equivalent is negligible compared to the other facilities.

The equivalents for seasonal transients are presented in Table 2.2-9.

QUESTION (2)

Section 2.2.1.5

The Applicant should explain the apparent discrepancy between the number of schools operating in 1981 and the number of schools indicated in Table 2.2-11.

RESPONSE (2)

The number of schools operating in 1981 within a 10-mile radius of the site listed in the text of Section 2.2.1.5 should be twenty-one schools rather than twenty-two schools as shown. The number of schools listed in Table 2.2-11 is correct. These corrections were provided in Amendment XIII.

QUESTION (3)

Section 2.2.2

The Applicant should explain the apparent discrepancy between the following two sentences in the noted section:

> "No wildlife preserves, sanctuaries or hunting areas are within 10-mile radius of the site. A waterfowl refuge which is part of the Long Island Wildlife Managment area is located on the Tennessee River approximately eight radial miles..."

RESPONSE (3)

In section 2.2.2, the first sentence which describes the type, location, and distance of wildlife preserves, sanctuaries, or hunting areas from the site should be changed to read as follows:

> "No wildlife preserves, sanctuaries, or hunting areas are within a 5-mile radius of the Site."

All of the sentences that follow this sentence within section 2.2.2 regarding wildlife management areas are correct as presented. This change was made in Amendment XIII.

QUESTION (4)

Section 2.2.2.2.

In what year was the Clinch River Consolidated Industrial Park established? Of the 33 acre total, how many acres are occupied by Eagle Picher, Inc.? Does Eagle Picher have tax exempt status or benefit from any state and/or local development subsidy? What are the prospects for additional industrial development of the site?

RESPONSE (4)

The Clinch River Consolidated Industrial Park was established in 1972. Eagle Picher, Inc. currently occupies 10 acres and has an option on 20 additional acres within this 112 acre park. Eagle Picher does not have a tax exempt status and does not benefit from any state and/or local development subsidies. The prospects for additional industrial development of the park are believed to be excellent if the CRBRP is constructed according to the Oak Ridge Chamber of Commerce.

Question (5)

Section 2.2.3.1

Are there any recreational or commercial fishing uses of surface? If either or both activities occurs, the applicant should describe the activities in detail.

RESPONSE (5)

Total recreational and commercial fish harvest from Watts Bar Reservoir were provided in response to Questions 290.6R and 290.7R, respectively. For fish management purposes, Melton Hill Reservoir is currently closed to commercial fishing. Watts Bar Reservoir is closed to fishing with entanglement gear, and current commercial activity on the reservoir is restricted to trot lines, snag lines, slat boxes, and hoop nets. Commercial fishing pressure in the area of the CRBRP is generally low because of the cold nature of the Melton Hill Reservoir releases and low populations of catfish in that portion of the reservoir. There is some seasonal fishing for paddlefish using snag lines and buffalo using bait lines. This activity is generally of short duration and limited to periods when these fish are migrating past the proposed site (late winter and spring).

The most recent information available on sport fishing in Watts Bar Reservoir is a 1980 creel survey done by the Tennessee Wildlife Resources Agency. Data from this survey indicates that there were about 17,700 fishing trips made in the Clinch River arm of Watts Bar Reservoir, and anglers harvested an estimated 42,700 fish weighing 31,500 pounds. These numbers are derived from estimates for the upper portion of Watts Bar Reservoir which includes both the Clinch River and Tennessee River arms and assumes that 50 percent of this pressure occurs in the Tennessee River.

Most of the fishing pressure in the Clinch River arm of Watts Bar Reservoir, particularly in the vicinity of the CRBRP site, occurs in winter and early spring when sauger and white bass migrate through the area. Although no specific data are available to document the magnitudes of differences, most of the fishing pressure occurs close to Melton Hill Dam and at Kingston Steam Plant while pressure around the CRBRP site is much lower than at either of these areas.

QUESTION (6)

Table 2.2-1

This table and others which follow are based on preliminary 1980 Census data. As final 1980 data are available, the Applicant should supply revised tables.

RESPONSE (6)

The final 1980 Census Report was not available for use when the socioeconomic update was prepared (amendment X). The preliminary 1980 population numbers for the 20 cities and towns presented in Table 2.2-1 and the final 1980 Census numbers are almost identical (less than a 1 percent difference) except for Kingston, Oliver Springs, Dayton, and Etowah. The final population numbers for Kingston, Oliver Springs, and Etowah are different from the preliminary numbers by about 1.6 percent. Only the city of Dayton, located 45 radial miles from the Site is significantly different on the final report (14.4 percent higher). Because the final population numbers are so close to the preliminary report numbers used in the analysis, it seems reasonable and appropriate to maintain the use of population census data presented in Table 2.2-1. Use of the final 1980 Census numbers would not result in any minor or major differences in information and conclusions presented in amendment X to the CRBRP ER.

QUESTION (7)

Section 6.1.4.2.2

The Applicant should update population projections for Tennessee by using the latest population projections prepared by the State Department of Public health on June 17, 1981.

RESPONSE (7)

Section 6.1.4.2.2 Population Projections, was prepared prior to the update population projections prepared by the State Department of Public Health on June 17, 1981. Appropriate state and local agencies were contacted to obtain their available population projections prior to beginning the CRBRP population projection work. The data used in this population work has been coordinated with local and district planning agencies prior to finalizing the work presented in amendment X. Because the projections prepared by the Public Health Department are viewed as department projections rather than final state projections, it is not believed they are any more reliable than those used in the CRBRP analysis.

QUESTION (8)

Section 8.1.3.2

Information in this section is apparently focused on publicly supported schools. The Applicant should furnish information on private sectarian and non-sectarian schools.

RESPONSE (8)

There are 128 approved private or parochial elementary and secondary schools in the State of Tennessee. Overall, private schools in the State have approximately 3.5 percent of the total student enrollment. In the four-county affected area, approximately 2 percent of elementary and secondary students are enrolled in approved private and parochial schools.

QUESTION (9)

Section 8.1.3.6

The information in this section is directed toward public recreational facilities. The Applicant should identify opportunities available at privately supplied recreational activities (e.g., movies, bowling, hunting, fishing).

RESPONSE (9)

It seems inappropriate to attempt to quantify the number, type, and location of privately-owned recreation facilities within the study area. The focus of the analysis was on impacts to public services, facilities, and programs. Privately supplied recreational activities were not quantified. The size of the inmoving population is extremely small compared to the population size of the metropolitan area, which will result in insignificant effects to privately-owned recreation activities. It would be sufficient merely to mention that there are many privately-owned recreational facilities located throughout the four-county area.

QUESTION (10)

Section 8 The Applicant should describe the planning institutions in the four-county area, specifically:

(a) The control of land use decisions and zoning;
(b) special purpose ordinances, e.g., mobile homes, farmland preservation, floodplains; and
(c) comprehensive plans and planning.

RESPONSE (10)

The following discussion summarizes the planning function in the four-county area:

(a) In Anderson County all cities and towns have adopted comprehensive plans, zoning ordinances, and subdivision regulations. The county does not have an adopted comprehensive plan at this time. Neither cities nor the county have specific farmland preservation ordinances. Mobile home use is restricted in Oak Ridge but generally allowed everywhere else in mobile home parks.

(b) Knox County and Knoxville city have comprehensive plans, zoning ordinances, subdivision regulations but neither the county nor the city have a specific farmland preservation ordinance. In Knoxville, mobile homes are restricted to mobile home parks, while in Knox County, mobile homes are treated like any other single family dwelling regarding site restrictions.

(c) In Loudon County, all municipalities and the county have comprehensive planning, zoning ordinances, and subdivision regulations. A farmland preservation ordinance has not been passed by any planning commission in Loudon County. Mobile homes in both municipalities and the county are treated like any other single-family dwelling regarding site restrictions.

(d) The major municipalities and towns in Roane County all have comprehensive plans, zoning ordinances, and subdivision regulations. The county has never adopted a comprehensive plan, but sectors of the county do have subdivision regulations. In Rockwood, mobile homes are generally allowed everywhere, whereas in Oliver Springs, Harriman, and Kingston, their location is restricted to mobile home parks or certain residential districts.

All four counties and cities within the four-county area have floodplain ordinances to control land development in floodplain areas.

All communities and counties in the study area have active planning commissions. Cities like Knoxville and Oak Ridge have their own staff-supported planning agencies. However, in most cases throughout the study area, planning guidance and technical assistance is provided by contracted service with either the East Tennessee Development District or the Tennessee State Planning Office.

QUESTION (11)

Table 8.1-3

The State of Tennessee Department of Public Health State Center for Health Statistics has revised 1980 projections for the four-county impact area. Because these data are based on the 1980 Census, the staff believes that projections based on the state's data would be more accurate than those presented in the table cited above. Therefore, the Applicant should provide a revised Table 8.1-3 using the most recent data from the state.

RESPONSE (11)

See response to question 6 regarding the use of department projections in place of the preliminary projections prepared by the Bureau of the Census.

QUESTION (12)

Table 8.1-4

This table indicated declining population in the 5-19 (school-age) cohort; the state's latest projections for 1985 and 1990 also indicate declines in the school-age cohort at the county level (6/17/81). However, with two exceptions, Appendix Table 2.2-7 indicates that school superintendents expect increasing enrollment, exclusive of project-related children. The Applicant should explain this apparent discrepancy.

RESPONSE (12)

The Applicant does not have a specific explanation for this discrepancy.

QUESTION (13)

Table 8.1-17

In the NRC Final Environmental Statement (February 1977), the treatment capacity and average daily flow of the Kingston system were 1,500,000 gpd and 750,000 gpd, respectively. As these figures are considerably higher than those now presented by the Applicant, the Applicant should explain this discrepancy.

RESPONSE (13)

The treatment capacity and average daily flow numbers for the Kingston system presented in Table 8.1-17 amendment X were rechecked January 7, 1982, and determined to be correct. The treatment capacity and average daily flow numbers presented in the original ER Table 8.1-17 of 1,500,000 and 750,000 gpd, respectively, were apparently listed incorrectly.

QUESTION (14)

Section 8.2.2.1

The income data in this section implies a large impact on the four-county area. However, some portion of the total income earned will be spent outside the area by inmovers with families, by inmovers who are unaccompanied by family members, and by daily commuters from outside the four-county area (See FES-CP, Section 4.5.4). In addition, the amount of income earned by residents (nonmovers) should be reduced by an amount equal to their earning potential in the absence of CRBR. The Applicant should use these considerations to develop an income figure which indicates the net dollar impact within the four-county area.

RESPONSE (14)

The numbers presented in section 8.2.2.1 are gross employment and income totals which will be spread over the project recruitment area. Therefore, the positive impact received from CRBRP project-related employment and income in the four-county area would be less than the gross totals presented in this section.

QUESTION (15)

Section 8.2.2.2

In view of the Appalachian Regional Commission's research on the study area, what is the Applicant's rationale for using a lower multiplier than those developed in the ARC study?

RESPONSE (15)

The ARC multipliers are more indicators of the type of economy each county has than indicators of the size of employment change which would be brought about by a change in basic employment. That is, the ARC multipliers include secondary employment from such things as central trades and service functions (e.g., banking and stock exchange); inleakage from nearby counties to major stores or restaurants; and expenditures by tourists. The applicant concluded that the Chamber of Commerce multiplier was a better estimate to use for this analysis but to be conservative, it was rounded downward to 1.6.

QUESTION (16)

Section 8.2.2.3

What is the current status of P.L. 81-875 for FY 1982?

RESPONSE (16)

We understand that the public law number should have been 81-874. The totals for P.L. 81-874 are 4 percent below the levels approved in the Office of Management and Budget (OMB) 1982 budget document dated March 1981. The U.S. House of Representatives Appropriations Committee staff has not yet received an actual breakdown of the various funding categories. Based on the Continuing Resolution figures, below are rough estimates as to levels of payment:

--"A" payments: approximately 85 percent of FY 81 payments

--"B" payments: 65 percent to 70 percent of FY 81 levels in districts 20 percent or more of average daily attendance (ADA) comprised of "B" children

--"B" payments: 30 percent to 35 percent of FY 81 levels in districts with less than 20 percent "B" children

--"(3)D(2)B" payments: payments for those districts with 50 percent or more of "A" and "B" children is "fully funded" and "not pro-rated" based on the 1982 request

Notwithstanding the Continuing Resolution, OMB is calling for a recission of all impact aid money, except $185 million for payments to super A districts at 84 percent of the FY 81 A payment level. Therefore, all B money and all non-super A (super A district being a school with 20 percent or more of ADA comprised of A pupils) would be eliminated.

QUESTION (17)

Tables 8.2-1 and 8.2-2

Do these tables reflect the onsite employment of maintenance, security, and other contract personnel? If they do not reflect these categories of workers, the tables should be revised.

RESPONSE (17)

Tables 8.2-1 and 8.2-2 do reflect the onsite employment maintenance, security, and other contract personnel.

QUESTION (18)

Section 8.3.2.1

The Applicant should provide copies of references 2 through 7 cited in this section.

RESPONSE (18)

These references have been provided to the NRC in a letter to Paul Check from John Longnecker "Response to NRC Questions 1-39," January 22, 1982.

QUESTION (19)

Section 8.3.2.1

What are the bases and assumptions for the specific assignments of in-moving workers to the individual jurisdictions?

RESPONSE (19)

The specific assignment of in-moving workers to individual jurisdictions is based on a comparative case study of the residential patterns experienced at six nuclear plants being constructed by TVA (references 2-7 provided in response to question 18). Factors such as municipal population size, distance to the site, housing add-ons by type, and location and capacity of highways, etc., were evaluated to determine similarities and differences in settlement patterns that could occur in the CRBRP four-county impact area. Knowledgeable planners from local planning agencies were consulted prior to finalizing the settlement pattern presented in amendment X.

QUESTION (20)

Section 8.3.2.1.2

As previously indicated (see comment no. 8), the information in this section should reflect conditions at private schools. Therefore, the Applicant should supply information on private sectarian and non-sectarian schools.

RESPONSE (20)

See response to question no. 8.

QUESTION (21)

Section 8.3.2.1.3

The Applicant assumes that three highway "intersections will be upgraded to sufficiently accommodate the projected traffic." Specifically, what improvements would have to be made to achieve the stated objective? Are these improvements currently programmed by appropriate authorities? If these improvements are not currently programmed, what is the likelihood that they would be implemented?

RESPONSE (21)

Reconstruction of the intersection of S.R. 58 and S.R. 95 to provide separated grades and ramps is underway.

The specific improvements proposed for the intersection of Bear Creek Road and S.R. 58 are the addition of ramps to the existing separated grade intersection. The schedule for accomplishing the improvement is to be developed with the Tennessee Department of Transportation.

Studies to determine specific improvements at the intersection of Bear Creek Road and S.R. 95 are underway.

QUESTION (22)

Section 8.3.2.1.3

Does the Applicant foresee an increase in either accidents or road maintenance as a result of increased traffic volumes? With respect to road maintenance, do the counties and/or state have load limits for roads?

RESPONSE (22)

The amount of road maintenance and the number of accidents are both anticipated to increase with increased traffic volumes. The State of Tennessee does have load limits for roads. The maximum allowable weight limit for five-axle tractor trailer rigs traveling on Tennessee state roads is 80,000 pounds. Weight limits for trucks other than five-axle vehicles on state roads are lower than the 80,000 pound maximum limit and vary in accordance with the type of truck. Load limits are also required on country roads and are based on the type of vehicle.

QUESTION (23)

Section 8.3.2.1.5

What is the Applicant's basis for concluding that no "recreation program will be significantly adversely affected"? What is the analysis which indicates that Roane County's recreational facilities are already in short supply?

RESPONSE (23)

The conclusion that no recreation program will be significantly adversely affected is based on the expectation of a relatively small peak population influx in the four county area. The conclusion regarding existing shortages in Roane County's recreational facilities was based on comparisons between the current population, limited existing facilities (Table 8.1-20), and standards of the National Recreation and Park Association.

QUESTION (24)

Section 8.3.2.1.5

Would the site be visible from nearby vantage points such as historic sites, areas of recreation, or housing developments? Would the containment building be visible from such vantage points?

RESPONSE (24)

The CRBRP site will be visible from various vantage points near the plant site. Both the site and the containment building will be visible from portions of both I-40 and S.R. 58. Both the site and the containment building will be visible from recreation sites 1 and 2 listed on Table 2.2-8. The site will not be visible from any housing development within the study area but will be easily seen from many of the single-family homes from across the Clinch River. Finally, to the best of our knowledge, neither the containment building nor the plant site will be visible from any significantly offsite historical site or structure within the study area. (See also ER Sections 2.3 and 5.6.2.4).

QUESTION (25)

Appendix-Introduction

The Applicant should prepare a table similar to Table 8.3-2 but assuming Migration Condition B.

RESPONSE (25)

CRBRP ESTIMATED POPULATION EFFECTS PEAK YEAR OF CONSTRUCTION FOR MIGRATION CONDITION B+

Projected Employment	5,400
Population Effects	
Number of movers	1,990
Movers with families (70%)	1,390
Movers without families (30%)	600
School age children*	980
Total population influx**	5,040

+Information provided in Appendix C (P.C-3) Amendment XIII
*Assuming .7 school age children per family.
**Assuming 3.2 people per family.

QUESTION (26)

Appendix-Introduction

In Section 8, Migration Condition A was indicated as 25 percent, while this level of migration is defined as 26 percent in the Appendix. The Applicant should explain this apparent discrepancy.

RESPONSE 26

In the introduction of Section 8, Migration Condition A is indicated as 26 percent, the same as the level of migration defined in the Appendix.

QUESTION (27)

Appendix-Table 2.2-8

Project enrollment for Knox County differs significantly from data in Table 8.3-2.

RESPONSE (27)

We assume there was a typographical error and Table 8.3-5 is the table in question rather than Table 8.3-2. Appendix Table 2.2-8 provides project enrollment for the 40 percent mover rate while Table 8.3-5 provides project enrollment for the 26 percent movers rate. The numbers for Knox County differ significantly because of the comparison of project enrollment from two different mover rates.

QUESTION (28)

Appendix-Section 2.4

What is the basis for the Applicant's conclusion that no expansion of fire protection services would be necessary during the construction period? Do current fire protection services meet or exceed guidelines established by the national insurance rating organization, the American Insurance Association?

RESPONSE (28)

The conclusion that no expansion of fire protection services would be necessary is based on the expectation of a relatively small peak population influx that should also be widely distributed among area communities. Maintenance of current levels of service, not national insurance rating guidelines, were used as the basis for the assessment. Thus, the relation of current fire protection services to those insurance guidelines was not considered.

QUESTION (29)

Appendix-Section 2.5

The Applicant's analysis of and conclusion on the adequacy of water supply facilities does not appear to take into account population growth between 1981 and 1985. Considering this increment of growth and the influx of project-related population, would these facilities be adequate?

RESPONSE (29)

Existing and proposed water supply facilities will be able to accommodate the demand for use of water from both the population growth between 1981 and 1985 and the projected CRBRP project-related demand.

QUESTION (30)

Appendix-Section 2.6

The comment and question in item (29) applies to this section.

RESPONSE (30)

Existing and proposed wastewater and solid waste disposal facilities will be able to accommodate the demand for use of these type of public services from both the population growth between 1981 and 1985 and the projected CRBRP project-related demand.

QUESTION (31)

Appendix-Section 2.6

The amount of solid waste generated by the inmoving population is overstated by a factor of 10 and the amount of total solid waste handled per day differs from the total figure in Section 8.1.3.3.3. The Applicant should check these data and correct as necessary.

RESPONSE (31)

The calculations presented in Appendix section 2.6 for the amount of solid waste generated by the inmoving population were rechecked and found to be correct. The number of tons of solid waste handled per day in the four counties listed on page C-42 as (about 1,025 tons) should be changed to read (about 525 tons). This change was included in Amendment XIII.

QUESTION (32)

Appendix-Section 3.2

In what instances would an "assessment lag" apply? Who would be responsible for an assessment lag if it did occur?

RESPONSE (32)

An assessment lag is simply the time required for a new addition to the property tax rolls to pay its full share of taxes. It would be expected to occur in most, if not all, instances and would not be considered an unusual occurrence.

QUESTION (33)

Appendix-Section 3.2

The Applicant mentions state funds--state foundation and equalization--in the analysis of local expenditures and revenues. Do the level of these funds or any other intergovernmental transfer funds to local jurisdictions change with changing local revenue levels?

RESPONSE (33)

State foundation funds are apportioned equally to all school systems in the state on a per ADA basis with additional funding related to vocational and special education needs. In contrast, equalization funds are apportioned on the basis of each jurisdiction's capacity to generate property tax revenue, i.e., local property assessment values. Depending on values statewide, an increase in those values could possibly result in a decrease in equalization funds. However, for purposes of the fiscal analyses, it was assumed that the current level of both educational revenues would remain constant.

QUESTION (34)

Appendix-Section 3.2

The Applicant states that no necessary education-related capital improvements were identified. However, Tables 2.2-5 and 2.2-6 indicate that 15 classrooms and 29 classrooms would be needed under Migration Conditions A and B, respectively. The Applicant should explain this apparent discrepancy and provide the bases for the conclusion.

RESPONSE (34)

Tables 2.2-5 and 2.2-6 indicate that 15 classrooms and 29 classrooms would be needed under Migration Conditions A and B, respectively. This does not mean that up to 29 classrooms would have to be built to accommodate project-related students. Under migration Condition B (the worst case scenario) 980 students would have to be housed for a period of no more than one year by the 8 school systems (see Appendix Table 2.2-8). Because of the low number of students added to each system (to be assigned to various schools grades K-12 located throughout each school system) and because of the short time period of maximum project-related demands, it is concluded that no school system would choose to construct a new school facility to accommodate project-related students. Instead, they would assign individual students to exisitng rooms with available space and in cases of demand exceeding capacity, assign students to school areas excluded in the capacity numbers used in Appendix Table 2.2-7.

QUESTION (35)

Appendix-Table 3.2

The table and text are unclear as to whether the sales and beverage tax data reflect local collections (with a smaller amount being dispersed to the municipalities by higher levels of government) or the actual dispersements to local government. The Applicant should clarify. Also, by assuming that the project-related (inmoving) population have the same per capita income as residents, the Applicant is conservatively estimating sales tax and beverage tax revenues. Does the Applicant agree that its estimates of sales and beverage tax revenues are conservative?

RESPONSE (35)

The sales and beverage tax data reflect actual disbursements to local governments. We agree that the estimates of sales and beverage taxes are conservative.

QUESTION (36)

Table 3.1

What are the specific values and assumptions underlying the data in the column titled, "Inmover-Related Taxable Assessed Value"? This information should be presented for each housing type and jurisdiction.

RESPONSE (36)

Refer to the table below. Those values are estimated from the range of values included in the various sources referenced in Table 3.1 of Appendix C.

AVERAGE HOUSING VALUES

Location	Single-Family Homes	Mobile Homes	Multi-Family*
Clinton	$37,000	$9,000	$13,000
Oak Ridge	55,000	9,000	15,000
Lenoir City	24,000	9,000	13,000
Kingston	44,000	9,000	13,000
Rockwood	30,000	9,000	13,000
Harriman	33,000	9.000	13,000
Anderson Co.	37,000	9,000	13,000
Knox Co.	55,000	9,000	15,000
Loudon Co.	33,000	9,000	13,000
Roane Co.	44,000	9,000	13,000

*Per unit

QUESTION (37)

Tables 3.3 and 3.12

The Applicant should specify the population figures used for each jurisdiction to derive the general fund and school fund revenues. How do these numbers differ from those contained in or underlying Table 8.2-1, 8.3-3, and 8.3-4? Also, in this series of tables, how are sales taxes apportioned between general fund and school fund revenues?

RESPONSE (37)

The population figures used to estimate the general fund and school fund revenues are either found in or derived from Tables 8.3-3 and 8.3-5. The employment figures in Table 8.2-1 were not used in estimating revenues but instead provide the basis for the analysis population and housing estimates. For the purposes of estimating per capita revenues, half of the population estimated for each municipality, except for Oak Ridge and Knoxville, was assumed to be located outside of the municipal limits but in the general area. For example, about 240 persons would be expected to locate within the city limits of Kingston (see Table 8.3-3). The housing distribution data in Table 8.3-4 were used in estimating property tax revenue for each jurisdiction. Table 8.3-5 contains the data, number of students by jurisdiction, used in estimating per pupil educational revenue. The per capita sales tax revenue figures contained in Table 2.2 of Appendix C are based on the amount of sales tax revenue historically received by either the general or school funds. Therefore, there was no apportionment between the two funds.

QUESTION (38)

Appendix-Table 3.13

In addition to salary, what are the components of the cost/teacher data?

RESPONSE (38)

The cost/teacher data are based on salary only.

QUESTION (39)

Appendix-References

The Applicant should provide a copy of citation 8.

RESPONSE (39)

This reference was provided to the NRC in a letter Longnecker to Check, "Response to NRC Questions 1-39," January 22, 1982.

Question (40)

Appendix Section 1.0 What is the basis for the percentage distribution of operating work force in the counties? Why wouldn't the percentage distribution in Table 8.1-7 be a more accurate estimate of where CRBRP employees will choose to live than the distribution in Section 1.0?

Answer (40)

The distribution of the operating movers is based on the same factors utilized in the distribution of construction movers, i.e., distance and direction to the site, area housing availability, and data on location patterns from TVA employee surveys. Table 8.1-7 indicates the existing location of DOE employees, many of whom have been area residents for a long period of time. Therefore, the data do not reflect recent housing trends, the most important of which is the tremendous growth in west Knox County in the past decade. In addition, the proportion of DOE employees residing outside Oak Ridge has been increasing in the past several years.

Question (41)

Tables 3.3 to 3.12 Please prepare a series of tables similar to those indicated which show the revenues generated by the operating work force. Explain all assumptions and calculations.

Answer (41)

The assumptions used to estimate the construction-related nonproperty tax revenue were based on resident per capita figures, instead of specific construction worker characteristics. This results in a conservative estimate of revenues. Therefore, it is reasonable to utilize those same assumptions and calculations for the operational influx. The attached revenue projections were prepared by applying operation to construction population ratios for each governmental jurisdiction to the projections contained in Tables 3.3 - 3.12 of the ER. For example, the size of the operational population influx for Oak Ridge (50) is about 7 percent of that projected for Migration Condition A (760). Thus, the amount of nonproperty tax revenue generated by the operational influx is estimated to be about 7 percent of that revenue estimated for Migration Condition A.

The property tax revenue estimates could not be ratioed because housing characteristics of operational and construction movers are expected to be different. Based on the relative permanence of the operational movers and data from surveys of operational movers at three TVA nuclear plants, it was assumed that, in general, a large percentage of them would occupy single family homes (70 percent). The housing choice of the remaining movers is assumed to be evenly split between mobile homes and apartments (15 percent each). These overall percentages were varied somewhat among jurisdictions based on local housing characteristics. For example, Oak Ridge is not expected to have any movers occupying mobile homes. The property tax estimates were calculated with the same average housing values and tax rates used for the construction period estimates.

Our estimated distribution of the location of immoving operational employees is attached. For the purposes of these revenue calculations, half of the projected movers expected to reside in the vicinity of each municipal area, except for Oak Ridge and Knoxville, are assumed to locate outside the city limits. An identical assumption was made for the construction period revenue calculations.

CRBRP

DISTRIBUTION OF OPERATIONAL MOVERS

	Movers	Total Population Influx	School Age Children
Anderson County			
Oak Ridge	19	50	10
Clinton Area	6	20	4
Knox County			
Knoxville	6	15	3
West Knox County Area	50	125	22
Loudon County			
Lenoir City Area	13	30	6
Roane County			
Kingston Area	19	50	14
Rockwood Area	6	15	3
Harriman Area	6	15	3

TABLE 1

SELECTED REVENUES FOR ANDERSON COUNTY
FROM CRBRP OPERATION-RELATED POPULATION INFLUX

General Fund Revenues

Property Tax	5,500
Sales Tax	NA
Beer and Alcoholic Beverage Tax	10
Fines, Fees, Charges	100
TOTAL	$5,600

School Fund Revenues

Property Tax	8,100
Sales Tax	NA
State Funds	700
TOTAL	$8,800

NA = Not Applicable

Note: Totals rounded off to nearest 100.
Estimates are for typical year of operation.

TABLE 2

SELECTED REVENUES FOR CLINTON
FROM CRBRP OPERATION-RELATED POPULATION INFLUX

General Fund Revenues	
Property Tax	600
Sales Tax	500
Beer and Alcoholic Beverage Tax	100
Fines, Fees, Charges	40
TOTAL	$1200
School Fund Revenues	
Property Tax	1300
Sales Tax	NA
State Funds	700
TOTAL	$2000

NA = Not Applicable

Note: Totals rounded off to nearest 100.
Estimates are for typical year of operation.

TABLE 3

SELECTED REVENUES FOR OAK RIDGE

FROM CRBRP OPERATION-RELATED POPULATION INFLUX

General Fund Revenues

Property Tax	7,500
Sales Tax	1,200
Beer and Alcoholic Beverage Tax	100
Fines, Fees, Charges	200
TOTAL	$9,000

School Fund Revenues

Property Tax	4,800
Sales Tax	100
State Funds	4,400
TOTAL	$9,300

Note: Estimates are for typical year of operation.

TABLE 4

SELECTED REVENUES FOR KNOX COUNTY
FROM CRBRP OPERATIONS-RELATED POPULATION INFLUX

General Fund Revenues	
Property Tax	6,600
Sales Tax	NA
Beer and Alcoholic Beverage Tax	100
Fines, Fees, Charges	400
TOTAL	$7,100
School Fund Revenues	
Property Tax	3,900
Sales Tax	2,200
State Funds	12,000
TOTAL	$18,100

NA = Not Applicable

Note: Estimates are for typical year of operation.

TABLE 5

SELECTED REVENUES FOR LOUDON COUNTY
FROM CRBRP OPERATION-RELATED POPULATION INFLUX

General Fund Revenues	
Property Tax	900
Sales Tax	NA
Beer and Alcoholic Beverage Tax	10
Fines, Fees, Charges	200
TOTAL	$1,100
School Fund Revenues	
Property Tax	2,300
Sales Tax	200
State Funds	1,500
TOTAL	$4,000

NA = Not Applicable

Note: Totals rounded off to nearest 100.
Estimates are for typical year of operation.

TABLE 6

SELECTED REVENUES FOR LENOIR CITY
FROM CRBRP OPERATION-RELATED POPULATION INFLUX

General Fund Revenues

Property Tax	900
Sales Tax	200
Beer and Alcoholic Beverage Tax	0
Fines, Fees, Charges	200
TOTAL	$1,300

School Fund Revenues

Property Tax	1,200
Sales Tax	100
State Funds	600
TOTAL	$1,900

Note: Estimates are for typical year of operation.

TABLE 7

SELECTED REVENUES FOR ROANE COUNTY
FROM CRBRP OPERATION-RELATED POPULATION INFLUX

General Fund Revenues	
Property Tax	3,200
Sales Tax	NA
Beer and Alcoholic Beverage Tax	30
Fines, Fees, Charges	300
TOTAL	$3,500
School Fund Revenues	
Property Tax	2,000
Sales Tax	700
State Funds	6,400
TOTAL	$9,100

NA = Not Applicable

Note: Totals rounded off to nearest 100.
Estimates are for typical year of operation.

TABLE 8

SELECTED REVENUES FOR KINGSTON
FROM CRBRP OPERATION-RELATED POPULATION INFLUX

General Fund Revenues	
Property Tax	1,600
Sales Tax	700
Beer and Alcoholic Beverage Tax	200
Fines, Fees, Charges	10
TOTAL	$2,500
School Fund Revenues	
Property Tax	NA
Sales Tax	NA
State Funds	NA
TOTAL	--

NA = Not Applicable

Note: Totals rounded off to nearest 100.
Estimates are for typical year of operation.

TABLE 9

SELECTED REVENUES FOR ROCKWOOD
FROM CRBRP OPERATION-RELATED POPULATION INFLUX

General Fund Revenues

Property Tax	500
Sales Tax	200
Beer and Alcoholic Beverage Tax	40
Fines, Fees, Charges	100
TOTAL	$800

School Fund Revenues

Property Tax	NA
Sales Tax	NA
State Funds	NA
TOTAL	--

NA = Not Applicable

Note: Totals rounded off to nearest 100.
Estimates are for typical year of operation.

TABLE 10

SELECTED REVENUES FOR HARRIMAN
FROM CRBRP OPERATION-RELATED POPULATION INFLUX

General Fund Revenues	
Property Tax	300
Sales Tax	200
Beer and Alcoholic Beverage Tax	20
Fines, Fees, Charges	10
TOTAL	$500
School Fund Revenues	
Property Tax	1,000
Sales Tax	300
State Funds	1,500
TOTAL	$2,800

Note: Totals rounded off to nearest 100.
Estimates are for typical year of operation.

Question 320.1R

Provide updated economic comparison of Clinch River and viable hook-on sites. Level of detail should be consistent with data presented in Table 9.4 of the CRBR FES. Original source of this data was letter to NRC from A. R. Buhl, CRBR Project Office, January 10, 1977, also, see ER Section 9.2.6.2.

RESPONSE

Economic analysis has shown that a stand alone plant at the Clinch River site is preferred. As noted in the question, this conclusion was based on data provided by th Project in a letter dated January 10, 1977. Subsequent to the suspension of licensing interaction with the NRC (April 1977), Congress continued funding of engineering design and procurement of CRBRP equipment. With the CRBRP in its present state of design and procurement maturity a hook-on arrangement is no longer considered viable. This conclusion is supported by the following factors:

(1) The CRBRP Project has firm orders for approximately 10% of the BOP equipment valued at $63 million, of this, equipment valued at $5 million has already been delivered.

(2) Hook-on sites have aged in the intervening years and become less attractive than in the original economic study.

(3) Site specific engineering is at an advanced stage of completion. The rework of these designs to be compatible with a hook-on site would result in substantial economic and schedular penalties.

In light of the above, a detailed update to the economic comparison of Clinch River Project and viable hook-on sites cannot credibly alter the conclusion that the CRBRP at the Clinch River site is preferred over viable hook-on sites.

Question 320.2R

Discuss capacity losses and age of turbines associated with each hook-on arrangement identified in response to Q.320.1.

RESPONSE

As discussed in the response to Question 320.1R, detailed review of the age and capacity of turbines at hook-on sites cannot credibly alter the conclusion that the CRBRP at the Clinch River site is preferred over viable hook-on sites.

QUESTION 320.3R

Update those sections of Appendix E (Amendment VII - February 1977) to the CRBRP ER dealing with costs of delay associated with relocating the proposed plant. Specifically, provide new cost data for Tables 1 and 2 of Appendix E for all alternatives previously considered plus the cost associated with a move to potential sites on the TVA system. Additional discussion should include new Clinch River schedule, estimated months of delay associated with move, and date corresponding to reference time 0. Also, if timing requirements of the Project are still important, identify new critical dates for commercial operation and decision on full-scale LMFBR commercialization.

RESPONSE

This question was responded to in a letter from J. Longnecker to P. Check, dated 2/05/82. Since that response, Appendices A through E have been re-evaluated and the information contained there in reconfirmed, revised or supplemented in Appendices F (DOE sites) and G (TVA sites). Appendices F and G are incorporated into the ER by Amendment XV.

The cost associated with relocation to a TVA site is presented in Table 3, Appendix G. The cost to relocate to a DOE site is presented in Table 8, Appendix F. The key CRBRP milestone dates are provided in Table 7, Appendix F.

Question 320.4R

Provide updated $ estimates of the program benefits associated with LMFBR commercialization (see Program FES (ERDA-1535), Table III F-10 of Volume 1, and Section 11.5.1 of the ER). Also, provide $ estimate of the loss of benefits associated with the delay assumed in response to Q3. (See Buhl, Dec. 29, 1976, p. 31 for estimate based on 52 month delay).

Response

The program benefits, and potential losses associated with delay are described in the cited passages of the ER and FES. Based on today's information, those values are a conservative representation of benefits and losses. In addition, however, the benefits of Clinch River are measured in terms of the information it will generate to satisfy the program and project objectives and analyses of the need for and benefits of the LMFBR program are outside the scope of the Commission's review of CRBRP. United States Energy Research and Development Administration et al.(Clinch River Breeder Reactor Plant). CLI-76-13, 4 NRC 67 (1976).

Question 320.5R

Provide current estimate of operating revenues expected during demonstration period from sale of energy to TVA system and revenues from potential 30 year operating life. Identify all underlying assumptions used in making these calculations.

RESPONSE

A. Current estimate of operating revenues+ (in constant 1981 dollars) expected during demonstration period from sale of energy to the TVA system is as follows:

Fiscal Year	Revenue 1981 \$ million
1990	22.8
1991	33.5
1992	45.4
1993	61.9
1994	63.3
1995	36.9
	263.8

Underlying assumptions for A. are as follows:

1. Initial Criticality 9/30/89
2. Revenue rate is based on value of replacement power to TVA of \$27.53 per megawatthour in 1981\$.
3. Capacity factor based on 350 MWe net is as follows:

Time Period*	Capacity Factor
7 months**	20.2
6 months	36.4
12 months	40.
12 months	55.
12 months	75.
12 months	75.
6 months	75.

B. Current estimate of operating revenues expected from potential 30 year operating life is $1954 million in constant 1981$.

Underlying assumptions for B. are as follows:

1. Revenue through the five year demonstration period is as shown in A.

2. Revenue rate for the remaining 25 years is based on the same value per megawatthour as in A. This assumes that the same, or similar, arrangements will be made for sale of power to TVA after the demonstration period; or the power will be worth this same amount to TVA if it chooses to purchase the plant after the demonstration period.

3. Capacity factor, based on 350 MWe nominal: (Note that the stretch rating is 402.5 MWe).

Year After Demonstration Period	Capacity Factor
1-4	75
5-15	92***
16	90
17	86
18	81
19	76
20	71
21	67
22	62
23	58
24	53
25	40

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† Represents gross revenue and has not been offset by costs of operation and fuel.

* From initial criticality.

** Seven month test period before start of demonstration period.

*** Represents achieving stretch and 80 percent capacity factor the same year.

Question 320.6R (NRC letter dated 10/26/81, response letter dated 2/5/82)

Review Section 8 -- Need for the Proposed Facility -- of the CRBRP FES (NUREG 0139) and based on post-1977 developments regarding the CRBR project identify all revisions and updates necessary to make this section factually consistent with the current status of the program.

Response

Conclusions made in Section 8 of the CRBRP FES (NUREG 0139), support the need for CRBRP as a key part of the LMFBR development program. Post 1977 developments do not alter these conclusions. Current actions and policy decisions by Congress and the Reagan administration are evidence that the conclusions drawn in the CRBRP FES are still valid. The President's October 8, 1981, nuclear energy policy statement established this Administration's definitive policy on the LMFBR program and CRBRP project, as follows:

> "I am directing that government agencies proceed with the demonstration of breeder reactor technology, including completion of the Clinch River Breeder Reactor. This is essential to ensure our preparedness for longer-term nuclear power needs."

Continuing Congressional support is evidenced by the enactment of the Omnibus Budget Reconciliation Act of 1981.[1] This continued the authorization for the CRBRP and set the stage for additional funding. The Conference Report accompanying this legislation[2] explicitly states the intent of Congress that the Project is a key step in the development of the LMFBR, and that the Project must be constructed in a timely and expeditious manner, so that a

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[1] Omnibus Budget Reconciliation Act of 1981 (Pub. L. No. 97-35).
[2] House Conference Report No. 97-208, 97th Cong., 1st Sess., 2 at 827 (1981).

a decision on the commercialization and deployment of breeder reactors can be made on the basis of information obtained in the operation of the plant.

On August 30, 1976 the Nuclear Regulatory Commission established the guidelines for the consideration of specific issues in the CRBRP construction permit proceeding. The Commission specified that any inquiry into the need for the CRBRP must be limited to consideration of the likelihood that the CRBRP will meet the objectives of the demonstration plant project.

The demonstration objectives of the CRBRP remain unchanged:

- o to demonstrate the technical performance, reliability, maintainability, safety, environmental acceptability, and economic feasibility of an LMFBR central station electric powerplant in a utility environment;
- o to confirm the value of this concept for conserving important nonrenewable natural resources.

The role of the CRBRP in the LMFBR development program is essentially unchanged since 1976. The schedule for CRBRP and the overall LMFBR development program has changed but the importance of the demonstration plants to the program is undiminished. NRC staff concluded in 1977 that the probability of CRBRP meeting its objectives was high. Progress in the development of the CRBRP design, since 1977, provides further assurance that the CRBRP will meet its objectives.

CRBRP Program Summary

Significant progress has been made to date in the design, development, and hardware procurement areas of the CRBRP. The project is in a position to begin site clearing and construction upon receipt of the necessary approvals from the NRC. The following list includes some of the significant accomplishments to date:

- Overall plant design about 90% completed and project-funded research and development about 95% completed;
- About 7,000 architect-engineering drawings of the required 9,400 prepared;
- Procurement contracts for over $500 million of hardware representing approximately 60% of the total required project hardware placed;
- Manufacture of approximately $251 million of hardware completed and about $120 million of effort accomplished on other hardware in process;
- Contributions made to advancement of the worldwide state-of-the-art on LMFBR plants, such as the heterogeneous core;
- Continuous evaluation and updating of the plant design to remain current with changing regulatory requirements;
- Issuance in 1977, by the NRC, of the Site Suitability Report and the Final Environmental Statement, which concluded that the site is suitable for the plant and that the action called for under the National Environmental Policy Act is the issuance of a construction permit;
- Licensing activities were resumed with the Nuclear Regulatory Commission staff in 1981; and
- Prototype steam generator and prototype primary pump delivered to Energy Technology Engineering Center for testing in sodium.

Base Technology Program Progress

The base technology program is structured to satisfy the goal of developing the technological data required to support LMFBR power plant design, construction, and safe operation. The elements of the base program include safety, components, materials and structures, fuels and other core materials and physics. For each of these program elements, significant accomplishments since the mid-1970's are reviewed below:

Safety

- The reliability of the reactor shutdown system and shutdown heat removal system has been established through extensive out-of-reactor laboratory testing.

- Experiments conducted with molten fuel have provided important data for validation of analytical methods to be applied to fuel movement from breached pins. As a result, self-termination of unprotected overpower accidents, unprotected loss of flow, it can be shown that extensive system damage is unlikely.

- The experimental data base, together with computer codes that extrapolate those data to prototypic accident conditions, indicates that the inherent nature of fuel motion under molten core conditions makes the core self-dispersive, and that recriticality is therefore unlikely.

- Earlier uncertainty over the limit which can be placed on the extent of the damage associated with a postulated whole core accident has been substantially reduced. For the CRBRP, the adequacy of the plant design to withstand such an accident has been established.

Components

- Tests were completed on the FFTF prototype pump in 1977. The test facilities at the Energy Technology Engineering Center (ETEC) were subsequently modified to accommodate CRBRP-size components.

- A CRBRP prototype pump and steam generator have been fabricated and are being installed for testing in 1982.

- Prototype components representative of large plant components are being fabricated for eventual testing in the ETEC.

Materials and Structures

- Developed design rules which have been adopted by the ASME Code and which are being applied worldwide in the design of LMFBR plants.

- Advanced the technology base for materials data, fabrication, nondestructive examination, advanced alloys, sodium technology, and high temperature design methods and criteria.

Physics

- Critical experiments in a CRBRP mockup core were completed in the Zero Power Plutonium Reactor. Analysis of these experiments will verify much of the CRBRP neutronic design and safety parameters.
- Studies of the FFTF physics measurements were initiated to confirm developmental LMFBR design methodology and to improve knowledge of the FFTF test irradiation environment.

Fuels

- Reference FFTF fuels and cladding were successfully tested to goal burnup and beyond clad breach in the EBR-II. The mechanical design of the FFTF fuel pin is identical to that of the CRBRP.
- Fabrication of pins for four FFTF cores was completed.
- Control assembly lifetimes were doubled.
- Improved alloys that promise significantly extended lifetimes for fuel pin cladding were developed. The list of candidate alloys has been narrowed to three.

Facilities

- Criticality of the Fast Flux Test Facility was achieved in February 1980. Full power was demonstrated in December 1980 and natural circulation was demonstrated in 1981.
- The Experimental Breeder Reactor II operated and supplied electrical power to the grid at 71-77% capacity while serving as a fuels and materials test facility from 1976-1980.

With respect to the specific CRBRP demonstration objectives reviewed by the staff in NUREG 0139, progress since 1977 is especially noteworthy in LMFBR technical performance and realiability.

Technical Performance and Reliability

Technical performance and reliability have been demonstrated in the foreign sector by the operation of Phenix at a 65% capacity factor, as well as operation of the BN-350 and Joyo reactors.

Confidence in U.S. capability is based on continuing EBR-II performance after 19 years of operation and recent FFTF startup and operation at full power. There is apparently no remaining question about technical feasibility, at least through intermediate plant size. Super Phenix, currently under construction, should remove technical feasibility questions.

An important remaining issue is the cost of commercial size LMFBR's. The cost will help determine when the LMFBR can be competitive with alternates. Continued development is the only satisfactory way to resolve that question.

Timing

The Prototype Large Breeder Reactor (PLBR) referred to in NUREG 0139 as the plant to follow the CRBRP, is no longer part of DOE planning. Design studies have been carried out on a 1000 MWe LMFBR developmental plant, during 1978-81 under the name Conceptual Design Study (CDS) and more recently as the Large Developmental Plant (LDP) project. A decision to proceed with construction of the LDP could come as early as FY 1984, with operation in the mid-1990's.

Should construction of the LDP begin in the mid-1980's, it would overlap CRBRP construction by 3-4 years. In NUREG 0139, LDP and the CRBRP construction were scheduled to overlap by about one year. The potential increased overlap now contemplated, does not significantly increase the technical risk associated with the LDP. To the contrary, it is DOE's belief that an overlap of 3-4 years is considered to be consistent with most efficient use of LMFBR program resources.

The current schedule with a potential construction overlap allows for assimilation of knowledge gained in design, construction, and licensing of the CRBRP. Overlap will allow for a more efficient use of the design team through continuity of effort as well as assimilation of all available project information. Such key information as base program R&D, construction and planning techniques, and equipment manufacturing experience is already being used in concept studies for the LDP. Results of CRBRP component tests will be available in 1982 for use in the preliminary engineering design of the LDP. CRBRP startup and testing data that will be particularly useful in the large plant effort include data associated with sodium systems and inert gas systems.

Experience gained from design of the CRBRP was factored into the conceptual design studies of the LDP and further benefits would be realized as the design continues. For example, CRBRP equipment design and fabrication experience will be directly applicable to the LDP as most of the CRBRP components will be fabricated before preliminary engineering design of the LEDP is initiated.

CRBRP construction planning and techniques are currently being incorporated into LDP construction planning evaluations. CRBRP construction experience will provide valuable input for the final planning and implementation of a cost-effective and schedule-oriented LDP construction plan.

Start-up testing of systems at the CRBRP will provide equipment confirmation data useful in design activities and subsequent test operations for LDP. This testing input can be particularly useful in the liquid metal and inert gas systems.

Operation of the CRBRP will provide additional on-line information useful for verification of designs and component concepts common to the LDP and the CRBRP and will provide additional input for testing procedures in such areas as remote fuel handling. CRBRP operating experience will also be factored into the procurement specifications of such LDP systems as the plant-wide computerized control system. In the event that early

CRBRP operation discloses an unexpected system problem, the phasing of the two projects provides time to implement corrections.

Additionally, operation of the CRBRP, in the course of demonstrating the technical performance, safety, and economics of an LMFBR plant in a utility environment, will develop information and expertise in plant start-up operation and maintenance. This experience will be valuable in the planning and implementation of these key functions for the LDP and in contributing to the broad base of experience and information that is important for commercial and industrial application of the LMFBR concept.

CRBRP experience is also applicable in large-plant confirmatory research and development work where much of the CRBRP work developed in the areas of safety, physics, fuels, materials, and component development is directly applicable. Nearly all this work will be completed before preliminary engineering design of the LDP. In addition, critical CRBRP components such as the steam generator and primary sodium pump will undergo thorough testing in 1982 and information developed during this testing program will be factored into the design process.

CRBRP operation and the follow-on operation of the LDP will serve to provide important experience and data regarding the LMFBR technology, environmental acceptability, economics, and value as a practical future option for generating electric power and conserving nonrenewable natural resources.

Technical Alternatives to the CRBRP

A key feature of the U.S. LMFBR development program remains avoiding premature foreclosure of technological alternatives. In any construction project, design choices must be made among feasible alternatives. To the extent possible during development, there is merit in keeping open options that might be exercised later. For some of the technological alternatives examined by NRC staff in NUREG 0139, additional information is now available.

The design of the primary heat transport system in LMFBRs falls into two categories: the pool (where the entire primary system is contained within a relatively large primary vessel) or the loop (where piping external to the reactor vessel transports sodium to pumps and heat exchangers). Experience indicates that either concept can be constructed and operated safely and reliably. Indeed the French, British, Soviet, and U.S. programs have all included at least one shift in the loop/pool choice.

The DOE Conceptual Design Study (CDS) concluded that there was no overwhelming advantage to either concept.[3] There would be no environmental differences and safety differences would be insignificant. Participants, drawn from the industry, recommended a loop concept for what is now the LDP, but recognized that there may be merit in the pool concept for commercial plants.[3] Regardless of the choice, the developments that are required in components and other key base technology areas are much the same. For example, the steam generators are equally applicable to either concept, and the pump technology required for a pool system is probably less complex than that now being developed for a loop system. In both instances, the design, manufacturing, and operating experienced gained are an effective base for future plants. The conclusion is that the U.S. program, now on the loop path for the CRBRP, is not precluded from a future switch to a pool system. Thus, the program retains more flexibility than does a specific project, in which changes in choice of technology can add considerable expense.

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[3] "LMFBR Conceptual Design Study; Phase I Summary Technical Report," CDS-500-1, U.S. Department of Energy, p. 4-29 (1980).

An updated Table 8.1 is provided to reflect events since NUREG 0139 was issued.

Fuels

Another example of the flexibility build into the U.S. program deals with fuel type. In the Conceptual Design Study for a large plant, flexibility was maintained with respect of choice of fuel type by making the design of the reactor internals capable of accepting either the reference oxide fuel design, or a carbide fuel. Similarly, it has been shown that the CRBRP could operate satisfactorily on a variety of fuel cycles, and the reference core design was switched from homogeneous to heterogeneous without other significant changes in cost, environmental or safety aspects.

In the recent large plant studies (CDS and LDP), oxide fuel was selected for at least the first several cycles. Super Phenix will use oxide fuel, Thus the use of oxide fuel in the CRBRP not only does not foreclose future U.S. emphasis on other fuels, but is presently consistent with the consensus choice for larger plants.

Foreign Purchase

It has been proposed that another alternative would be for the U.S. to purchase foreign technology rather than to pay for our own domestic LMFBR fuel cycle development program. Such proposals often neglect to account for the extensive domestic development work that would still be necessary to assure the foreign breeder designs would satisfy unique U.S. licensing requirements. This may involve, among other things, the need to make substantial plant modifications to key safety features such as the reactor containment building, reactor safety systems, and shutdown heat removal systems.

In addition, one of the central features U.S. energy policy of the past four Administrations has been to reduce U.S. reliance on foreign sources of energy supply. Regardless of current alliances, political or commercial barriers 20-40 years hence could prevent a foreign LMFBR supplier from selling to the U.S. Even if reactors were sold, without a complete domestic fuel cycle capability, the U.S. would have to rely on foreign sources of reactor fuel supply. This could have national security implications that are not unlike those associated with current U.S. dependence on foreign supplies of oil.

WORLDWIDE FAST BREEDER
REACTOR PLANT

Name	Country	Power Megawatts Thermal	Power Megawatts Electric	Pool or Loop	Initial Operation
DECOMMISSIONED					
Clementine	USA	0.025	---	Loop	1946
Experimental Breeder Reactor-1	USA	1	0.02	Loop	1951
BR-1/BR-2	USSR	0.1	___	Loop	1956
LAMPRE	USA	1	___	Loop	1961
Fermi	USA	200	60.9	Loop	1963
SEFOR	USA	20	___	Loop	1969
Dounreay Fast Reactor	UK	72	14	Loop	1959
Rapsodie	France	20/40[b]	---	Loop	1966[b]
OPERABLE					
BR-5/BR-10[a]	USSR	5/10[a]	---	Loop	1959[a]
Experimental Breeder Reactor-II	USA	62.5	18.5	Pool	1963
BOR-60	USSR	60	12	Loop	1969
BN-350	USSR	1000	150[c]	Loop	1972
Phenix	France	567	233	Pool	1973
Prototype Fast Reactor	UK	600	250	Pool	1974
Joyo	Japan	100[d]	---	Loop	1977
BN-600	USSR	1470	600	Pool	1980
Fast Flux Test Facil.	USA	400	---	Loop	1979
KNK-II[e]	W. Germany	58	20	Loop	1977
UNDER CONSTRUCTION					
Super-Phenix	France[g]	2900	1200	Pool	
SNR-300	W. Germany[f]	770	312	Loop	
Prova Elementi di Combustibile	Italy	140	---	Modified Pool	1987
PLANNED					
Monju	Japan	714	300	Loop	
Clinch River Breeder Reactor	USA	975	359	Loop	1989
Commercial Fast Reactor	UK	3230	1320	Pool	
SNR-2	W. Germany[g]	5000	1200-2000	Loop	1985-6
BN-1600	USSR	5000	1600	Pool	

[a] Initially operated at 5 megawatt thermal as BR-5; upgraded to BR-10 (10 megawatt thermal) in 1973.

[b] Initially operated at 20 megawatt thermal; power increased to 40 megawatt thermal in 1970 with "Fortissimo" core.

[c] Also produces the equivalent of 200 megawatt electric as process steam for desalination.

[d] To be operated initially at 50 megawatt thermal.

[e] Operated 1971 through 1974 as a thermal reactor, KNK-I.

[f] In cooperation with Belgium and the Netherlands.

[g] Tripartite effort of Franch, German and Italian electric utilities.

Question 320.7R (NRC letter dated 10/26/81, response letter dated 2/5/82)

Update the internal costs of the CR project. Maintain level of detail in Section 8.3.1 including Table 8.3-1 of the ER. Also, indicate portions of the internal cost to be borne by federal government, participating utilities, etc.

Response

The CRBRP Project cost estimate to the level of detail reflected in Section 8.3.1 including Table 8.3-1 of the Environmental Report has been updated (ER Amendment XIV) consistent with the current schedule baseline.

Question 320.8R

Provide updated justification for excluding other energy sources as viable alternatives to CRBRP. Currently, ER Section 9.1 dismisses depletable energy resources based on energy growth rates, nuclear expansion plans, costs, and estimates of energy resource stocks, all reflecting 1975 expectations. In addition, as a result of the passage of time and advances made in implementing the larger next state demonstration LMFBR, provide justification for not considering this as a viable alternative energy source.

Response

Other energy sources were excluded as viable alternatives to the CRBRP on the ground that the need for a demonstration plant facility, including its timing and objectives is to be taken as given in the Commission's review of CRBRP. United States Energy Research and Development Administration et al. (Clinch River Breeder Reactor Plant). CLI-76-13, 4 NRC 67 (1976). Further, the alternative of the next-larger-size demonstration plant can be excluded on the ground that the structure, pace, timing and objectives of the LMFBR Program are likewise to be taken as given. Id. DOE has prepared a Supplement to the LMFBR Program Environmental Statement DOE/EIS-0085-FS, May 1982, in which both technological (other energy sources instead of LMFBR's) and programmatic (LDP instead of CRBRP, and no action) alternatives were addressed. None of these alternatives were found to be acceptable.

Question 320.9R (NRC letter dated 10/26/81, response letter dated 12/22/81)

> Update economic cost analyses developed in support of your decisions regarding alternative plant designs. Specifically, Sections 10.1.5 (Tables 10.1-9 and 10.1-10), 10.2.5 (Tables 10.2-1 and 10.2-2), 10.3.5 (Table 10.3-2) and 10.6.5.

Response

Although the economic costs presented in the tables identified in the question are not up-to-date in current prices, the analyses remain valid. Since the time of the evaluation of these analyses by the NRC (NUREG-0319, February 1977) the major change has been the effect of inflation on the costs (both economic and environmental) included in the analyses. However, general price inflation has not affected the relative ranking of the alternatives nor the relative balance of environmental costs to economic costs. The only change that would invalidate the analyses would be the development of an advantage (either technological or economic) not previously available for one of the alternatives. For the facility systems referenced in the question, i.e., cooling system, sanitary waste system, and intake and discharge systems, significant changes such as new technologies with a lower cost that would require reanalysis of alternatives have not developed.

Furthermore, the design, testing, and procurement of these facility systems are at advanced stages of completion. If a reanalysis were to be undertaken at this time, any alternative would have to demonstrate economic and environmental cost advantages greater than the selected design's costs. These costs to be assessed against alternative systems would properly include the amounts expended to date on the selected systems to design, test and procure the equipment, the costs to terminate current contracts, and the environmental costs associated with scrapping fabricated components. In the case of the selected cooling system for the plant, i.e., a mechanical draft wet cooling tower, changes from this design could cause changes in plant performance parameters that might have costly cascading effects on the current design and procurement of the steam/water cycle equipment. All of these "sunk" costs would properly be included in any updated analyses because the applicant has proceeded on the basis of previously valid evaluations of alternatives.

QUESTION 451.1

In a letter dated 11/20/81 NRC requested,

"Pursuant to the information needs of the staff identified in Section 2.3.3 of Regulatory Guide 1.70.29, "Information for Safety Analysis Reports - Meteorology", we request transmittal via magnetic tape of onsite meteorological data for our evaluation of the radiological consequences of normal and accidental releases to the atmosphere. Please use the enclosed guidance on format and tape attributes (Enclosures 1 and 1A) and provide hour by hour data for the period of record (July 1, 1975-June 30, 1976) which you have used to construct the diffusion estimates reflected in the Tables in Section 2.3 of the PSAR. Also, please include documentation identifying the parameters measured, instrumentation, period of record and a dump of the first block of data on the tape as shown in Enclosure 2. We have assigned question number 451.1 to this request. Please provide this information by December 21, 1981."

NRC further requested in their letter dated 11/30/81,

"Please provide, in an amendment to the Environmental Report, the information identified in the Enclosure for our review of your application for a permit to construct the Clinch River Breeder Reactor Plant. This information is needed by December 15, 1981, in order to maintain our schedule for the review. Submittal of this information by letter on or before that date is sufficient if followed by an amendment.

In addition, please endeavor to furnish the magnetic tape with meteorological data by December 11, rather than December 21 as requested in our letter to you of November 20, 1981. These data should include the data gathered in 1977 and 1978."

RESPONSE

Transmittal of magnetic tapes of onsite meteorological data was provided to NRC in a letter dated 12/15/81 from G. W. Reynolds, TVA to Mr. I. Spickler and was supplemented to define the recording periods and locations in a letter dated 12/28/81 as follows:

Your letter of November 20, 1981, requested transmittal of onsite meteorological data (magnetic tape) in accordance with specified format and tape attributes. The requested period of record was from July 1, 1975, to June 30, 1976. This information was requested to be provided to NRC by December 21, 1981. Your letter of November 30, 1981, requested that the meteorological data be provided by December 11, 1981, rather than December 21, 1981 as previously requested, and that the data include onsite meteorological data gathered during 1977 and 1978.

There have been three onsite meteorological data sets used for the CRBRP construction permit application documents. In the ER, July 1975 - June 1976 temporary tower data were replaced by February 17, 1977 - February 16, 1978 permanent tower data in Amendment IX. For the PSAR, the July 1975 - June 1976 data were used in Section 2.3 and March 1976 - February 1977 temporary tower data were used in Appendix 2.3A. The PSAR was further amended (Amendment 65, February 1982) to replace the temporary tower data with permanent tower data for the recording period of February 19, 1977 through February 16, 1978. Section 2.3A was deleted at that time. Magnetic tapes of each of these three data sets have been provided to Mr. Irv Spickler, NRC, under separate cover directly from TVA in a letter dated December 15, 1981.

These data tapes correspond to three distinct one-year sets of onsite meteorological data, two from the temporary tower, and one from the 110-meter permanent tower. They are (1) July 1975 to June 1976 Pulse-O-Matic cassette system data from the temporary tower, (2) March 1976 to February 1977 Nova computer system data from the temporary tower, and (3) February 17, 1977 to February 16, 1978 Nova computer system data from the permanent tower.

Tape (1) data, Pulse-O-Matic, were used for Section 2.3 of the CRBRP PSAR and tape (2) data, Nova, were used for Appendix 2.3A of the PSAR. These data have been replaced by Tape (3) data in Amendment 65 of the PSAR.

Tape (1) data, Pulse-O-Matic, were used in Section 2.6 of the CRBRP ER, but were replaced by tape (3) data in Amendment IX of the ER.

Question 460.1R

Have any design changes been made in the radwaste treatment systems since the FES was published 2/77?

RESPONSE

Yes. These design changes are stated and included in the response to Question 290.1R.

QUESTION 460.2R

Have any changes been made that would cause the source term to be altered? This could include fuel and coolant specifications and behavior as well as operational aspects.

RESPONSE

- o There has been no change to the coolant specifications.

- o There have been changes to the fuel specifications due to the core design change from the homogeneous core to the heterogeneous core and these changes do result in some change to the source term. The following table provides a comparison of homogeneous core and heterogeneous core fuel specifications and the target average and peak burnups.

Specification	Heterogeneous Current Core	Homogeneous Previous Core
Total heavy metal inventory in fuel (metric tons)	5.2	6.5
Plutonium enrichment in fuel (weight %)	33.2	18.7 to 32.0
Target Burnup (MWD/T)		
Average	80,000	100,000
Peak	110,000	150,000

- o However, it should be noted that in determining the source terms, the isotopic composition of LWR discharge plutonium was used instead of the composition in the fuel specification for conservatism.

- o The source terms in the cover gas have remained relatively unchanged from the basis used in the 1977 amendments to the ER.

- o Changes in the inert gas processing system have had the following effects:

1)	Noble gases are now sent from RAPS Noble Gas Storage Vessel to CAPS, rather than being bottled for disposal	Increases discharge from RSB HVAC
2)	RAPS Cryogenic Charcoal Beds have been deleted	Increases activity to CAPS, but CAPS charcoal beds supply hold-up time - little effect on offsite releases
3)	Re-evaluation of CAPS charcoal bed efficiency	Decrease in offsite releases
4)	RAPS moved inside of RCB	No effect on normal operation, Favorable effect with regard to accidents

5) Effluents from other systems to CAPS added to the total effluent (effluents from refueling system, fail fuel monitoring system and maintenance system)	Slightly increases discharge from RSB HVAC

These changes are contained in response to Question 290.1R.

Question 750.1R (NRC letter dated 10/26/81, response letters dated 2/5/82, 5/3/82)

Since there are no known commercial plans for participating in the CRBR fuel cycle on a licensed basis, it appears that the fuel cycle related to CRBR will have to be carried out by DOE in its own unlicensed facilities. Accordingly, it will be necessary for DOE to project its plans for carrying out the fuel cycle functions related to processing, safeguarding and transportation of fuels and for managing the handling and disposal of wastes.

In this regard, please provide an amendment to the environmental report that describes DOE's planned program and facilities for such functions related to CRBR, including estimates of the resource uses and effluents and assessments of the potential effects, including radiological, resulting from such activities. This report will serve as the basis for NRC to perform its independent evaluations of these functions for CRBR licensing purposes.

Response

The information requested in question 750.1R is provided in the ER Amendment XIV.

Question 750.2R

Provide a list of currently feasible candidate sites with current information to support comparison of them. As a minimum, the following should be considered:

1. Using the applicable portions of 10 CFP Part 51, Regulatory Guide 4.2 and the Proposed Rule on Alternative Sites (45 FR 24168-24178, April 9, 1980) as guidelines, review the previous site selection process. This reassessment should identify the region of interest and consider the potential sites within the region, select candidate sites with environmental diversity of land and water resources within the region of interest, and compare the final candidate sites with the proposed site.

   Verify that the data provided previously are still applicable and provide current information as necessary.

   The region of interest and selected candidate sites within the TVA service area should be representative of the environmental diversity reflected by the types of water bodies and floral and faunal diversity available within the region (upper and lower reaches of large rivers, small rivers, lakes, reservoirs, etc.)

2. Provide the rationale and supporting information for exclusion of potential candidate TVA sites along the Mississippi, the Ohio (at or in the vicinity of the Shawnee Steam Electric Plant), the Tombigbee (Black Warrior), the Coosa, the Green (Barren), and Pearl Rivers.

3. Reconsider the possible use of planned or existing power plant sites, including Phipps Bend, Hartville, Yellow Creek, Watts Bar, Browns Ferry, Sequoyah and Bellefonte. If CRBR were located at a site where some initial site work has been done, indicate whether savings in construction time and/or cost could be realized. Also, state whether there is any reason why the CRBRP should not be located on a common site with a light-water-reactor plant.

4. Discuss the present status of hook-on concept; if this is no longer a practical approach for the CRBRP, consider whether a complete CRBRP could be built at the hook-on sites previously compared to the proposed site.

5. Consider whether another suitable candidate site exists on the Clinch River including the possibility of locating the complete (non-hook-on) CRBRP at the Bull Run Steam Plant or the Kingston Steam Plant. If such a site is identified, what environmental or other constraints, if any, would be involved in so locating the CRBRP?

RESPONSE

See Appendix G to the CRBRP Environmental Report (Amendment XV).

Question 750.3R

Verify that the ERDA (DOE) sites previously considered in the alternative site review are presently acceptable as candidate sites and describe any additional DOE property that would qualify as candidate sites including any reasons why they should not be considered further. Review the information previously provided on these candidate sites and assure that it is adequate for comparison to the proposed site.

RESPONSE

See Appendix F to the CRBRP Environmental Report (Amendment XV).

Question 750.4R

If the Applicant's reassessment of the alternative sites indicated that any of them is environmentally preferable to the proposed site, provide economic costs (costs of delay, etc.) that would be associated with changing the site to such location and discuss any constraints or other reasons for not doing so.

RESPONSE

See Appendices F and G to the CRBRP Environmental Report (Amendment XV).