



Department of Energy
Washington, D.C. 20545

Docket No. 50-537
HQ:E:82:019

MAY 28 1982

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

Dear Mr. Check:

ADDITIONAL RESPONSE TO REQUEST FOR ALTERNATIVE SITES INFORMATION

Enclosed is an update to the CRBRP alternative siting analysis, within the TVA power service area, that encompasses and expands upon the additional information provided in Attachment 1 of my letter to you dated February 12, 1982. Also included as part of this alternative siting analysis update is additional information further addressing NRC staff concerns on the possible presence of 11 species of endangered freshwater mussels in the vicinity of the Clinch River site and the possible impact on striped bass of CRBRP thermal discharges during a potential period of extended zero releases from Melton Hill Dam during the hot summer and fall months. This expanded update analysis does not change the previous conclusions on the environmental acceptability of the CRBRP site or the Project's selection of the Clinch River site as the preferred site for the LMFBR Demonstration Plant.

The enclosed update was informally provided to Mr. P. Leech on May 14, 1982, and will be included as part of Amendment XIV (May 1982) to the Environmental Report.

Sincerely,

John R. Longenecker, Manager
Licensing & Environmental
Coordination
Office of Nuclear Energy

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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

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 (FES) for CRBRP (NUREG-0139), 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 a totally 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, was provided in Attachment 2 of a letter J. R. Longenecker (DOE) to P. S. Check (NRC) dated February 12, 1982. Attachment 1 to this same letter provided additional information to update the Environmental Report alternative siting analysis presented in Environmental Report Section 9.2 and Appendix A. This present update encompasses, but expands upon, the additional information provided in Attachment 1 of the Project's February 12, 1982 letter in order to address all of NRC's questions that have been raised concerning the CRBRP alternative siting assessment 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

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 LMFER 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.

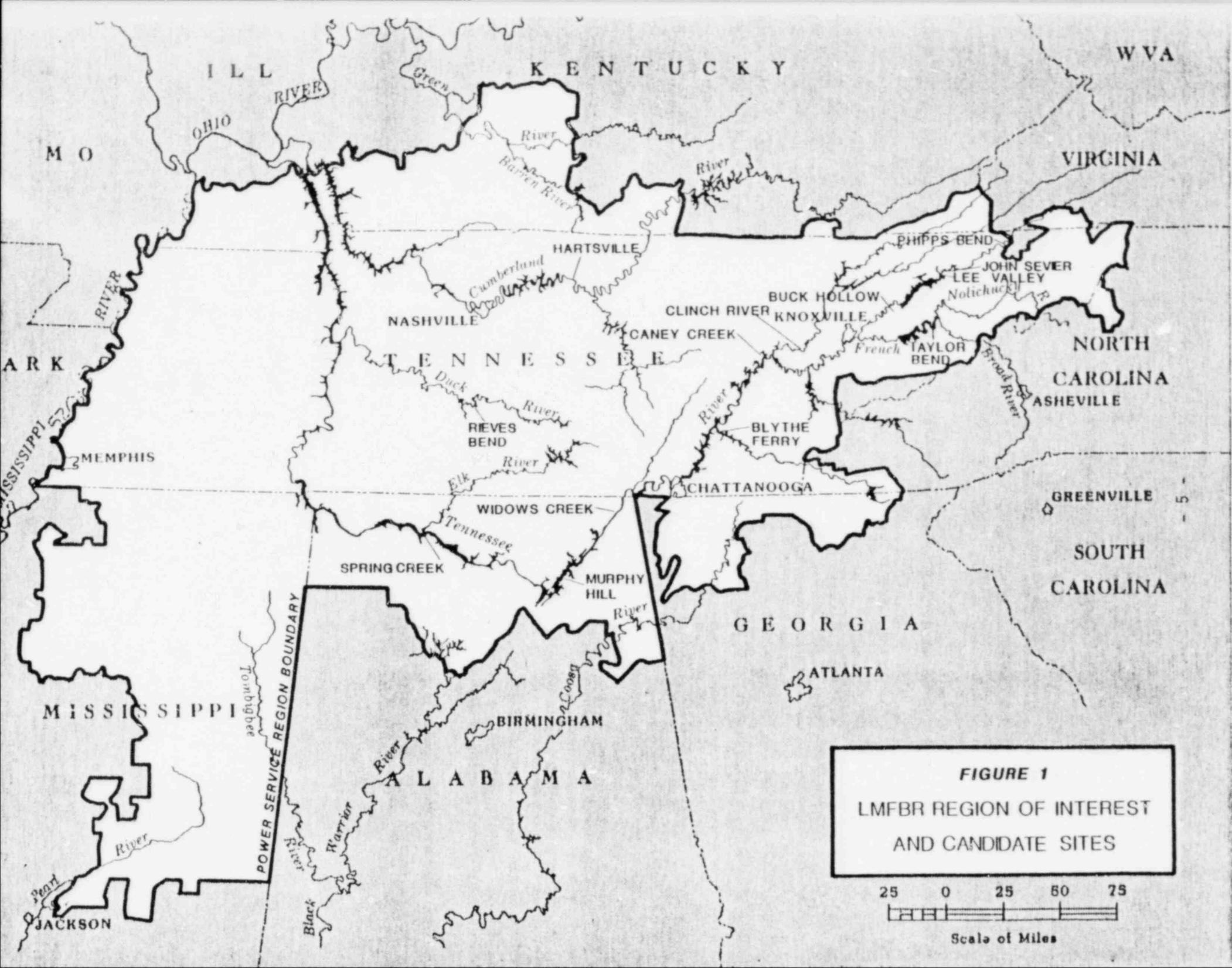
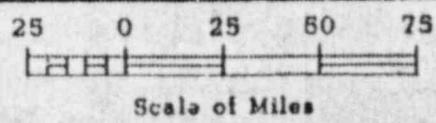


FIGURE 1
 LMFBR REGION OF INTEREST
 AND CANDIDATE SITES



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

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

<u>River</u>	<u>River Type</u>	<u>Associated Physiographic Units</u>
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
<u>Cumberland River Basin</u>		
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 related to water resources. 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 was also reviewed⁵ 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, and previous assessments have essentially been substantiated. In addition, the following information concerning the sites was not available at the time of the earlier assessment.

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.

⁵ The John Sevier and Widows Creek sites are not included as candidate sites since the Project is no longer considering a hook-on arrangement at these sites (see letter R. L. Copeland to P. S. Check, "Responses to NRC Questions," dated November 13, 1981, Question/Response 320.1R).

TABLE 2
CANDIDATE SITES

<u>Site</u>	<u>River</u>	<u>River Type</u>	<u>Physiographic Character</u>
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	Small, 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

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 site 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 also 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

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.

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). In the Project's February 12, 1982, response to NRC's request for additional information concerning the original siting analysis, the Project presented the results of a reexamination of the Environmental Report Section 9.2 and Appendix A siting analysis in light of the Proposed Rule. Based on this review, the Project 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, as a result, the review of the original siting assessment with the addition of applicable current information gave rise to no candidate site which could be considered environmentally preferable to the Clinch River site.

Subsequent to the February 12, 1982, submittal, the Project conducted a separate analysis comparing the environmental siting characteristics outlined in the Proposed Rule's selection requirements with 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 subsequent 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. The conclusion of this assessment substantiated 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 Questin 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). In letters, J.R. Longenecker (DOE) to P.S. Check (NRC) dated December 21, 1981, and January 28, 1982, the Project provided a response to this question. 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 confirm that no endangered freshwater mussels are located in the Clinch River near the CRBRP site. A description of the proposed survey is enclosed as Appendix I. 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 any of the suggested 11 species of endangered freshwater mussels are present in the vicinity of the Clinch River site. This should be confirmed by the proposed Clinch River survey. 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 (FES) 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. The following information is presented in response to this concern about a possible conflict between the CRBRP thermal discharge and use of the river near the CRBRP site as a cool-water refuge in summer and fall by striped bass.^{8,9}

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

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 Schalch, 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 m³/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 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

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 review of the Environmental Report analyses of the CRBRP thermal discharges and the Project's commitments to additional striped bass studies and adoption of restrictions upon thermal discharge during periods when the river water temperature is high and zero flow conditions exist, 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 a 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).

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 the footnotes 3, 10, and 12, minimal cost impact has been included for redesign, component or structural modifications, or reprourement 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

<u>Item</u>	<u>Incremental Cost</u> <u>— \$ (Million)</u>
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	10-88
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*

* This range of additional cost cannot be obtained by simply adding the minimum or maximum values respectively from the above line items. Each line item's range of incremental cost has been estimated to encompass the variety of potential TVA alternative sites and, where some TVA alternative sites may account for the maximum range for one item, they may represent the minimum range for another line item (e.g., alternative sites in northeastern Tennessee represent the maximum incremental cost for equipment procurement because of their lack of barge capabilities, but represent the minimum for difference in prevailing labor rates).

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	<u>\$1.3B</u>
-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	<u>\$ -9M</u>
	\$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.

10. Seismic

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 procurement 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 building 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 (600,000 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.

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 report 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 acceptably 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.

APPENDIX I

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.