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(Fourth Volume of ORNL/TM-5310)

**A Comparison Between Dispersed Nuclear
Power Plants and a Nuclear Energy Center
at a Hypothetical Site on
Kentucky Lake, Tennessee**

Vol. IV. A Site Selection Methodology

C. S. Rosemarin
S. L. Yaffee

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The complete report is composed of the following volumes:

- Vol. I. Summary (ORNL/TM-5310)
- Vol. II. Transmission of Power (ORNL/TM-5311)
- Vol. III. Environmental Considerations (ORNL/TM-5312)
- Vol. IV. A Site Selection Methodology (ORNL/TM-5313)

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A COMPARISON BETWEEN DISPERSED NUCLEAR POWER PLANTS
AND A NUCLEAR ENERGY CENTER AT A HYPOTHETICAL SITE
ON KENTUCKY LAKE, TENNESSEE

VOL. IV. A SITE SELECTION METHODOLOGY

C. S. Rosemarin
S. L. Yaffee

This study was performed for the Nuclear Regulatory Commission
in connection with the development of their Nuclear Energy
Center Site Survey report to Congress.

SEPTEMBER 1976

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FOREWORD

Section 207 of the Energy Reorganization Act of 1974 required the Nuclear Regulatory Commission to conduct a nuclear energy center site survey and report its findings to the Congress and the Council on Environmental Quality. The Survey included a general screening of the 48 contiguous States to identify large land areas that would be likely to contain sites potentially suitable for nuclear energy centers. It evaluated the technical and practical considerations involved in locating the production of electric power at a nuclear energy center and compared these considerations with those involved in producing an equivalent amount of power at dispersed sites.

One of the techniques utilized in the Survey was an analysis of several "surrogate" sites. These specimen sites were selected to permit study of certain concepts and analysis of alternatives as they applied to a real, rather than hypothetical, location. Selection of a particular area for a surrogate site did not mean that it was a preferred or even well-suited site, but only that it represented particular site problems which were deemed worthy of study.

One of the surrogate sites selected for study was at Kentucky Lake, Tennessee. The Nuclear Regulatory Commission contracted with the Oak Ridge National Laboratory to undertake analysis of this site and to prepare reports on the various tasks when completed. This is one of a series of reports in the fulfillment of this assignment.

The complete report is composed of the following volumes:

- Vol. I. Summary
- Vol. II. Transmission of Power
- Vol. III. Environmental Considerations
- Vol. IV. A Site Selection Methodology

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ABSTRACT

A methodology has been developed for selecting suitable sites for development as nuclear energy centers. First, the forty-eight contiguous states were screened on the basis of four variables: (1) seismic stability; (2) distance from projected population centers; (3) adequate water supply; and (4) noninterference with scenic and reserved lands. After location of a surrogate area in north central Tennessee, further screening was performed using 22 variables to find a suitable 75-sq-mile surrogate site within this 1500-sq-mile area. A computer method for screening the surrogate area is presented, and the use of the data for the 22 variables is illustrated.

A SITE SELECTION METHODOLOGY

1. INTRODUCTION

The purpose of this report is to discuss the method of assessing relative advantages and disadvantages of candidate sites within candidate regions and to illustrate an application of the procedure to a surrogate site in a surrogate region. The output is a comparison of relative benefits of various sites within a particular larger area. It is not a comparison of the larger areas themselves, that is, for example, an area in Tennessee vs an area in New Jersey.

Four variables were applied to the entire United States to arrive at a more realistic study area. "More realistic" refers both to the practicality of the study and to the potential of a site to support a nuclear energy center (NEC). The United States, then, was reduced as a study area to include only the areas that showed the most promise as eligible for NECs according to criteria of four variables -- seismicity, population, water, and Federal and state lands. This "screening" of areas that were and were not likely to be capable of supporting NECs was accomplished by means of map overlays. Of the areas that were shown to have potential, three were selected as surrogate areas.

The phrase "surrogate area" is used to describe hypothetical areas within which suitable future sites for NECs might be expected to be found. Surrogate areas represent tracts of land that are about twenty times larger than surrogate sites. The areas are hypothetical in that they were chosen solely to serve the purposes of the NEC surrogate site and without consultation with organizations responsible for planning future generating capacity, without site visits, and without discussion with respective state or county officials, either public or private. The surrogate areas are *not* under consideration for the actual installation of an NEC.

Three areas were selected for study from the results of the coarse screening: Kentucky Lake in Tennessee, northern New York on the St. Lawrence River, and the New Jersey coast southeast of the Fort Dix Military Reservation (see Fig. 1). The varying qualities of the areas,

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Fig. 1. Location of NEC surrogate site areas.

shown in Table 1, offer distinctly different challenges. Because the charge of the study was to include the entire United States, consideration of a wide range of potential sites was necessary.

Table 1. Characteristics of NEC surrogate site areas

Site	Cooling technology	Type of water source	Climate	Transmission configuration
Kentucky Lake, Tennessee	Evaporative towers	Lacustrine	Humid subtropical	Radial
New York	Evaporative towers	Lacustrine	Humid continental	Remote concentrated load
New Jersey	Evaporative towers	Marine	Humid continental	Concentrated loads in 90 to 150° segments

The remainder of this volume relates to (1) the eligibility of the Kentucky Lake surrogate area based on the four variables, (2) the method used to determine the relative suitability of cells within the surrogate areas, (3) a description of the display technique required for the analysis, and (4) a discussion of the variables used and their inclusion in the analysis.

2. KENTUCKY LAKE SURROGATE AREA

This section is concerned primarily with the Kentucky Lake surrogate area and the determination of its potential to support an NEC. It is helpful to understand why the area survived the coarse screening exercise. The regional location of the Kentucky Lake surrogate area is shown in Fig. 2. The cities (load centers) surrounding the area graphically display the radial distribution pattern referred to in Table 1. The area itself, however, is sparsely populated. Nashville is the nearest SMSA, and Clarksville is the nearest municipality with more than 25,000 residents. Clarksville is about 7 miles from the study area, and therefore the area is not affected by the 5-mile excluded zone around the city.

Seismically, the area does not present severe difficulty for finding a site, but it is not as well suited as, for example, some areas of eastern Tennessee and the entire state of Louisiana. The Kentucky Lake surrogate area is located in the level 2 area of the map of "Areas of Relative Seismic Suitability for Nuclear Energy Centers," which was produced by the Nuclear Regulatory Commission and used as a measure of seismic suitability. This indicates that site-specific studies would have to be conducted to determine suitability.

The area is served by two sources of water — Kentucky Lake and the Cumberland River. Kentucky Lake on the Tennessee River runs from the northern to the southern border of the study region. The annual 20-year low flow of the Tennessee River at its outflow is 48,600 cfs, and its monthly 20-year low flow is about 23,600 cfs. Kentucky Lake, with its large surface area, provides onsite storage capacity. The Cumberland River enters the surrogate area from the east and exits through the north. It is smaller than the Tennessee River, with an annual 20-year flow of 18,600 cfs at the outflow and a monthly 20-year low flow of 4000 cfs. If one assumes that 10% of the annual 20-year low flow would be available as cooling water, both water sources can support multiple reactors. A 1200-MWe reactor consumes about 30 cfs when generating at peak times (i.e., on a hot summer day, running 24 hr). However, 20 cfs is a more realistic figure for average water consumption assuming a load factor of 65 to 70%.

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Fig. 2. Regional location of the Kentucky Lake surrogate area.
Scale: 1:7,954,545.

Finally, no land within or in the immediate proximity of the surrogate area has been excluded by the Energy Reorganization Act of 1974.¹ The Land-Between-the-Lakes Recreation Area was not excluded because it is not a national park, forest, or monument. It was, however, weighted very negatively for its attractiveness as a potential NEC site in the analysis. The extension in the northeast corner of the surrogate area reflects the inclusion of Fort Campbell Military Reservation. This was done to comply with Section 207(a)(3)(c) of the Energy Reorganization Act, which stated that the survey shall include consideration of lands already in Federal ownership.

3. SURROGATE AREA ANALYSIS METHODOLOGY

The purpose of the siting method was to determine favorable *surrogate sites* within the larger Kentucky Lake *surrogate area* and to describe the area itself. It has been assumed that a 48,000-MWe NEC would occupy around 75 sq miles. This figure represents the land area actually used for the reactors, cooling towers, and exclusion area, but excludes the land used for transmission corridors. The Kentucky Lake surrogate area was about 1300 sq miles. The object of the method, then, was to find the "best" 75-sq-mile area (surrogate site) within the Kentucky Lake study area.

3.1 Suitability Analysis: Weighting Techniques

The problem at hand was the siting of an NEC technology package. Spatial information was broken down by data category and was stored within a two-dimensional cellular structure (see Sects. 4 and 5). A process was needed to relate cell data to the suitability of a cell to support an NEC quad unit. (An NEC quad unit is a group of four reactors, which served as the basic unit for building larger NECs.)

The NEC surrogate site identification methodology uses two sets of weighting factors. One set identified the relative importance of one data variable compared with another in making a siting decision. The importance values for the NEC technology package were arranged in a 1 x 22 matrix. The importance weights took values of one to five, where one was least important and five was most important. The importance matrix used in the analysis is reproduced in the first two columns of Table 2.* The other set of weights examined the compatibility of a specific data category (e.g., 2% slope) with the NEC technology sets. The compatibility values were arranged in a vector of data (1 x 65 matrix) as shown in

*The importance and compatibility values used in the Kentucky Lake area are for demonstration purposes only. They represent consensus of one panel of project participants.

Table 2. Suitability criteria for NECs

Variable	Importance values	Data categories	Compatibility values
Elevation, ft above sea level	2	350-449	+1
		450-549	0
		550-674	-1
		675+	-2
Engineering geology	5	See Table 3	
Land use (primary)	5	Urban	-3
		Water	-3
		Open	+2
		Forest	+1
Land use (secondary)	4	Urban	-3
		Water	0
		Open	+2
		Forest	+1
Land use (tertiary)	3	Urban	-3
		Water	+1
		Open	+2
		Forest	+1
Ownership (public)	4	Military	+2
		TVA-other	+2
		TVA-recreational	-2
		Land-Between-the-Lakes	-3
		Fort Donnelson	-3
		Wildlife refuges	-3
		Public recreation	-2
Population density, persons/sq mile	5	0-30	+2
		31-100	+1
		101-300	0
		301-640	-1
		640+	-2
Proposed development	1	Industrial site	+2
		Road corridor	0
Proximity to population	5	$0.022 \leq \text{SPF}(30) \leq 0.042$	+2
		$0.043 \leq \text{SPF}(30) \leq 0.133$	+1
Proximity to railroads, cells	3	0-2	+2
		3-6	+1
		7-10	0
		11+	-1

Table 2 (Continued)

Variable	Importance values	Data categories	Compatibility values
Proximity to recreation areas, cells	4	0-6 7+	-2 0
Proximity to light-duty roadways, cells	2	0-2 3-6 7-10 11+	+2 +1 0 -2
Proximity to medium-duty roadways, cells	3	0-2 3-6 7-10 11+	+2 +1 0 -2
Proximity to transmission lines, cells	1	0-2 3-10 10+	+2 +1 0
Proximity to water, cells	5	0-2 3-4 5-7 8-10 11+	+2 +1 0 -1 -2
Railroads	3	Presence in cell absence	+2 0
Roadways	3	Light-duty Medium-duty Light and medium	+2 +1 +1
Seismicity, % <i>g</i>	5	0-10 11-20 21-30 31-40 40+	+2 +1 0 -1 -2
Slope (primary), %	4	0-8 8-16 16+	+2 +1 -3
Slope (secondary), %	3	0-8 8-16 16+	+2 +1 -3

Table 2 (Continued)

Variable	Importance values	Data categories	Compatibility values
Soils	5	See Tables 4, 10, and 11	
Transmission lines	2	Presence in cell Absence in cell	+1 0

Table 2. The compatibility scores took values of +2 to -2 (as illustrated in Tables 3 and 4), where +2 was most compatible and -2 was least compatible. A -3 indicates either an extreme incompatibility or exclusion (e.g., if a cell consists of water).

Table 3. Compatibility values of engineering geology

Class lithology ^a	Class structural attitude ^b			
	Faulted (4)	Tightly folded (3)	Domed, arched (2)	Flat-lying (1)
Coastal plain sediments (7)	-2	-2	-1	0
Carbonate rocks (4)	-2	-2	-1	0
Shale, slate, phyllite, and schist (3)	-2	-1	0	+1
Interbedded rocks (2)	-1	-1	0	+1
Metamorphic rocks (5)	0	0	+1	+1
Igneous rocks (6)	0	0	+1	+2
Sandstone (1)	0	+1	+2	+2

^aNumbers in parentheses come from first number of bedrock coding.

^bNumbers in parentheses come from second number of bedrock coding.

Table 4. Compatibility values of soils

Class type ^a	Class thickness ^b (ft)				
	>100 (5)	50-100 (3)	0-100 (4)	0-50 (2)	>10 (1)
Swamps, marshes, etc. (5)	-2	-2	-2	-1	0
Glaciolacustrine, glaciomarine (8)	-2	-2	-2	-1	0
Recent alluvium (4)	-2	-2	-1	0	+1
Continental deposits (1)	-2	-2	-1	0	+1
Marine silt and clay (3)	-2	-1	-1	0	0
Residual soil (9)	-2	-1	-1	0	0
Glaciofluvial (6)	-1	-1	0	0	+1
Marine sand and gravel (2)	-1	0	0	+1	+1
Glacial till (7)	0	0	+1	+1	0

^aNumbers in parentheses come from first number of soil coding.

^bNumbers in parentheses come from second number of soil coding.

The compatibility and importance matrices were combined to yield an index of suitability that related cell characteristics to suitability for an NEC. This cell suitability index (CSI) was determined by the equation,

$$CSI_c = \frac{\sum_{v=1}^x S_{cv} I_v}{2 \sum_{v=1}^s I_v},$$

where

S_{cv} = the compatibility score for the cth cell for the vth variable,

I_v = the importance weight for the vth variable,

s = the number of variables being considered in the analysis,
 x_v = the maximum number of values the v th variable takes ($x_v \leq s$).

The summation of the importance factors is multiplied by +2 because the denominator represents the maximum possible score a cell could receive under the most favorable conditions. This procedure facilitates comparison. Tables 5 and 6 are examples of cell suitability index calculations. The cell under consideration in Table 5 is hypothetically located in the Land-Between-the-Lakes Recreation Area, as is indicated by the ownership variable. Public ownership has an importance variable of 4, indicating relatively high importance as compared with the other variables. However, as stated earlier, the Land-Between-the-Lakes Recreation Area was considered to be highly incompatible with the construction of an NEC. Therefore, the product of the importance and compatibility evaluations is a -12. This factor and some other poor qualities of the cell (such as seismicity and primary slope) yield a rather low score for the cell suitability index. The cell for which the index is calculated in Table 6, however, is more advantageously situated, as is indicated by the higher cell suitability index (0.28). Although this cell does contain some negative characteristics such as relatively steep primary slope, they are outweighed by positive qualities such as low population density, distance from a population center, and nearness to water.

Because the suitability score is unitless, it is susceptible to misinterpretation. The CSI is a quantification of an intangible but should not lure the user into a false sense of security. Site suitability is largely determined by social values (e.g., desire to protect endangered species). Because perceptions of these values vary, the method was set up to accept quick changes in weights. Therefore, while examining a set of resultant scores one should remain cognizant of the positions of those who designated the weights as well as the conditions under which they operated.

Likewise, the form and makeup of the data should also be known. Resolution of the data and its relation to the location of the candidate region bear on the meaning of the CSI. Also, the number of variables included and their relative importance influence the comparative suitability of candidate sites.

Table 5. Cell suitability index calculation: example 1^a

Variable	Importance values	Data category	Compatibility value	Importance x compatibility
Elevation, ft above sea level	2	350-449	-1	- 2
Engineering geology	5	42	-1	- 5
Land use (primary)	5	Forest	+1	+ 5
Land use (secondary)	4	Urban	-3	-12
Land use (tertiary)	3	Water	+1	+ 3
Ownership (public)	4	Land-Between-the-Lakes	-3	-12
Population density	5	0-30	+2	+10
Proposed development	1	None	0	0
Proximity to population, cells	5	0.022 ≤ SPF(30) ≤ 0.043	+2	+10
Proximity to railroads, cells	3	11+	-1	- 3
Proximity to recreation areas, cells	4	0-6	-2	- 8
Proximity to light-duty roadways, cells	2	0-2	+2	+ 4
Proximity to medium-duty roadways, cells	3	0-2	+2	+ 6
Proximity to transmission lines, cells	1	10+	0	0
Proximity to water, cells	5	5-7	0	0
Railroads	3	Absence	0	0
Roadways	3	Absence in cell	0	0
Seismicity, % g	5	40+	-2	-10
Slope (primary), %	4	16+	-3	-12
Slope (secondary), %	3	8-16	+1	+ 3
Soils	5	91	0	0
Transmission lines	2	Absence in cell	0	0
	77			-23

$$a_{CSI_c} = \frac{\sum_{v=1}^x S_{cv} I_v}{2 \left(\begin{matrix} s \\ \sum_{v=1} I_v \end{matrix} \right)} = \frac{-23}{2 (77)} = -0.15 .$$

Table 6. Cell suitability index calculation: example 2^a

Variable	Importance values	Data category	Compatibility value	Importance x compatibility
Elevation, ft above sea level	2	350-449	+1	+ 2
Engineering geology	5	42	-1	- 5
Land use (primary)	5	Forest	+1	+ 5
Land use (secondary)	4	Water	0	0
Land use (tertiary)	3	Open	+2	+ 6
Ownership (public)	4	None	0	0
Population density	5	0-30	+2	+10
Proposed development	1	None	0	0
Proximity to population, cells	5	$0.022 \leq \text{SPF}(30) \leq 0.133$	+2	+10
Proximity to railroads, cells	3	0-2	+2	+ 6
Proximity to recreation areas, cells	4	7+	0	0
Proximity to light-duty roadways, cells	2	0-2	+2	+ 4
Proximity to medium-duty roadways, cells	3	11+	-2	- 6
Proximity to transmission lines, cells	1	10+	0	0
Proximity to water, cells	5	0-2	+2	+10
Railroads	3	Presence in cell	+2	+ 6
Roadways	3	Light-duty	+2	+ 6
Seismicity, % g	5	31-40	-1	- 5
Slope (primary), %	4	16+	-3	-12
Slope (secondary), %	3	0-8	+2	+ 6
Soils	5	91	0	0
Transmission lines	2	Absence in cell	0	0
	<u>77</u>			<u>+43</u>

$${}^a\text{CSI}_c = \frac{\sum_{v=1}^x S_{cv} I_v}{2 \left(\sum_{v=1}^x I_v \right)} = \frac{43}{2 (77)} = 0.28 .$$

4. REQUISITE DATA, INFORMATION, AND DISPLAY CAPABILITIES

The worth of any data base lies in its ability to provide needed input into problem-solving algorithms and analysis techniques. Thus, goal and problem definition generally must precede data acquisition. This becomes evident in light of cost considerations in addition to making certain that the data system will facilitate the resolution of the problems at hand. For the NEC surrogate site, the problem was fairly well defined: to identify areas in which nuclear energy centers could be accommodated in terms of resource requirements and systemic impacts. With the specific problem in mind, a list of data items needed to make NEC siting decisions was generated. In the interests of time and past experience, the list used in the NRC-Maryland Regional Siting Factors Study² was modified for this purpose.

The mechanism used for displaying the data is also of critical importance, especially in a process designed to aid planners and decision-makers. Two sets of display techniques were used: extant cartographic display capabilities generated by the ORNL/NSF-RESA Program³ and capabilities developed for the NRC-Maryland Regional Siting Factors Study.² The principal display mechanism, discussed later in the report, was a computer-mapping routine that used a line printer over-printing technique. This routine has the capability of outputting single-variable or multi-variable index values in 20 shades of grey. Legends are given at the bottom of each map and relate grey-tone symbols to data categories. Frequency of occurrence (i.e., number of cells in a category) and percentage of total cells in each category are also given in the legend.

Tables 7 and 8 are presented as overviews of the single variable evaluations of the entire Kentucky Lake area. Table 7 is a tabulation of the percentages of the Kentucky Lake area that are in various data categories of each variable. Table 8 provides a key to the data categories. Table 7 is presented to give the reader a quick profile of the entire area without examining the computer graphics that follow. The manner by which this profiling capability can be useful in determining the overall suitability of blocks of cells will be shown later.

Table 7. Profile for site containing 4725 cells with rows 46 through 105 and columns 31 through 120

SOILS		TRANSPORTATION	
CATEGORY 12 =	0.95% (45 CELLS)	CATEGORY 1 =	6.62% (313 CELLS)
CATEGORY 14 =	6.73% (318 CELLS)	CATEGORY 2 =	2.20% (104 CELLS)
CATEGORY 22 =	0.34% (16 CELLS)	PORTION OF AREA UNCATEGORIZED = 91.17%	
CATEGORY 24 =	5.90% (279 CELLS)	POPULATION DENSITY	
CATEGORY 25 =	7.89% (373 CELLS)	CATEGORY 1 =	90.56% (4279 CELLS)
CATEGORY 42 =	3.60% (170 CELLS)	CATEGORY 2 =	9.25% (437 CELLS)
CATEGORY 44 =	2.71% (128 CELLS)	CATEGORY 3 =	0.19% (9 CELLS)
CATEGORY 52 =	2.07% (98 CELLS)	PORTION OF AREA UNCATEGORIZED = 0.0%	
CATEGORY 54 =	0.72% (34 CELLS)	OWNERSHIP	
CATEGORY 91 =	65.23% (3082 CELLS)	CATEGORY 1 =	6.05% (286 CELLS)
PORTION OF AREA UNCATEGORIZED = 3.85%		CATEGORY 2 =	1.33% (63 CELLS)
GEOLOGY		CATEGORY 3 =	0.57% (27 CELLS)
CATEGORY 21 =	0.60% (28 CELLS)	CATEGORY 4 =	3.62% (171 CELLS)
CATEGORY 22 =	13.71% (648 CELLS)	CATEGORY 5 =	0.04% (2 CELLS)
CATEGORY 24 =	1.35% (64 CELLS)	CATEGORY 6 =	4.02% (190 CELLS)
CATEGORY 41 =	27.68% (1308 CELLS)	PORTION OF AREA UNCATEGORIZED = 84.36%	
CATEGORY 42 =	20.59% (973 CELLS)	PROPOSED DEVELOPEMENT	
CATEGORY 44 =	3.87% (183 CELLS)	CATEGORY 1 =	0.66% (3 CELLS)
CATEGORY 72 =	28.15% (1330 CELLS)	CATEGORY 2 =	1.90% (90 CELLS)
PORTION OF AREA UNCATEGORIZED = 3.96%		PORTION OF AREA UNCATEGORIZED = 98.03%	
SEISMICITY		PROXIMITY TO POPULATION	
CATEGORY 2 =	5.80% (274 CELLS)	CATEGORY 1 =	86.10% (4068 CELLS)
CATEGORY 3 =	32.21% (1522 CELLS)	CATEGORY 2 =	13.90% (657 CELLS)
CATEGORY 4 =	14.62% (691 CELLS)	PORTION OF AREA UNCATEGORIZED = 0.0%	
CATEGORY 5 =	47.37% (2238 CELLS)	PROXIMITY TO ROAD (LIGHT & LT/HEAVY)	
PORTION OF AREA UNCATEGORIZED = 0.0%		CATEGORY 1 =	17.63% (833 CELLS)
ELEVATION		CATEGORY 2 =	39.70% (1876 CELLS)
CATEGORY 1 =	33.57% (1586 CELLS)	CATEGORY 3 =	36.87% (1742 CELLS)
CATEGORY 2 =	32.38% (1530 CELLS)	CATEGORY 4 =	5.76% (272 CELLS)
CATEGORY 3 =	28.97% (1369 CELLS)	CATEGORY 5 =	0.04% (2 CELLS)
CATEGORY 4 =	4.93% (233 CELLS)	PORTION OF AREA UNCATEGORIZED = 0.0%	
PORTION OF AREA UNCATEGORIZED = 0.15%		PROXIMITY TO ROAD (HEAVY & LT/HEAVY)	
TOPOGRAPHIC SLOPE (PRIMARY)		CATEGORY 1 =	3.77% (178 CELLS)
CATEGORY 1 =	29.63% (1400 CELLS)	CATEGORY 2 =	10.75% (508 CELLS)
CATEGORY 2 =	8.08% (382 CELLS)	CATEGORY 3 =	22.35% (1056 CELLS)
CATEGORY 3 =	62.29% (2943 CELLS)	CATEGORY 4 =	21.16% (1000 CELLS)
PORTION OF AREA UNCATEGORIZED = 0.0%		CATEGORY 5 =	41.97% (1983 CELLS)
TOPOGRAPHIC SLOPE (SECONDARY)		PORTION OF AREA UNCATEGORIZED = 0.0%	
CATEGORY 1 =	22.20% (1049 CELLS)	PROXIMITY TO RAILROADS	
CATEGORY 2 =	64.68% (3056 CELLS)	CATEGORY 1 =	2.20% (104 CELLS)
CATEGORY 3 =	13.12% (620 CELLS)	CATEGORY 2 =	6.75% (319 CELLS)
PORTION OF AREA UNCATEGORIZED = 0.0%		CATEGORY 3 =	14.35% (678 CELLS)
LAND USE (PRIMARY)		CATEGORY 4 =	18.16% (858 CELLS)
CATEGORY 1 =	0.32% (15 CELLS)	CATEGORY 5 =	58.54% (2766 CELLS)
CATEGORY 2 =	5.88% (279 CELLS)	PORTION OF AREA UNCATEGORIZED = 0.0%	
CATEGORY 3 =	28.99% (1370 CELLS)	PROXIMITY TO TRANSMISSION LINES	
CATEGORY 4 =	60.80% (2873 CELLS)	CATEGORY 1 =	6.62% (313 CELLS)
PORTION OF AREA UNCATEGORIZED = 0.0%		CATEGORY 2 =	18.94% (895 CELLS)
LAND USE (SECONDARY)		CATEGORY 3 =	56.38% (2664 CELLS)
CATEGORY 1 =	0.40% (19 CELLS)	CATEGORY 4 =	18.05% (853 CELLS)
CATEGORY 2 =	2.46% (116 CELLS)	PORTION OF AREA UNCATEGORIZED = 0.0%	
CATEGORY 3 =	23.28% (1100 CELLS)	PROXIMITY TO RECREATION AREAS	
CATEGORY 4 =	17.57% (830 CELLS)	CATEGORY 1 =	4.23% (200 CELLS)
PORTION OF AREA UNCATEGORIZED = 56.30%		CATEGORY 2 =	23.64% (1117 CELLS)
LAND USE (TERTIARY)		CATEGORY 3 =	72.13% (3408 CELLS)
CATEGORY 1 =	3.03% (143 CELLS)	PORTION OF AREA UNCATEGORIZED = 0.0%	
CATEGORY 2 =	1.82% (86 CELLS)	PROXIMITY TO WATER AREAS	
CATEGORY 3 =	16.38% (774 CELLS)	CATEGORY 1 =	5.88% (279 CELLS)
CATEGORY 4 =	10.92% (516 CELLS)	CATEGORY 2 =	15.05% (711 CELLS)
PORTION OF AREA UNCATEGORIZED = 67.85%		CATEGORY 3 =	13.99% (661 CELLS)
ROADS		CATEGORY 4 =	23.45% (1108 CELLS)
CATEGORY 1 =	16.89% (798 CELLS)	CATEGORY 5 =	14.69% (694 CELLS)
CATEGORY 2 =	3.03% (143 CELLS)	CATEGORY 6 =	22.94% (1084 CELLS)
CATEGORY 3 =	0.74% (35 CELLS)	PORTION OF AREA UNCATEGORIZED = 0.0%	
PORTION OF AREA UNCATEGORIZED = 79.34%			

Table 8. Category definitions

Soils: class type	Class thickness (ft)				
	<10 (1)	0-50 (2)	0-100 (3)	50-100 (4)	>100 (5)
1. Continental deposits	11	12	13	14	15
2. Marine sand and gravel	21	22	23	24	25
3. Marine silt and clay	31	32	33	34	35
4. Recent alluvium	41	42	43	44	45
5. Swamps, marsh, etc.	51	52	53	54	55
6. Glaciofluvial	61	62	63	64	65
7. Glacial till	71	72	73	74	76
8. Glaciolacustrine, glaciomarine	81	82	83	84	85
9. Residual soil	91	92	93	94	95

Geology: class lithology	Class structural attitude			
	Flat-lying (1)	Domed, arched (2)	Tightly folded (3)	Faulted (4)
1. Sandstone	11	12	13	14
2. Interbedded rocks	21	22	23	24
3. Shale, slate, phyllite, schist	31	32	33	34
4. Carbonate rocks	41	42	43	44
5. Metamorphic rocks	51	52	53	54
6. Igneous rocks	61	62	63	64
7. Coastal plain sediments	71	72	73	74

Seismicity, % g

1. 0-10
2. 11-20
3. 21-30
4. 31-40
5. >40

Topographic slope (primary), %

1. 0-8
2. 9-16
3. >16

Elevation, ft

1. 350-449
2. 450-549
3. 550-674
4. >674

Topographic slope (secondary), %

1. 0-8
2. 9-16
3. >16

Table 8 (Continued)

<u>Land use (primary)</u>	<u>Proposed development</u>
1. Urban	1. Industrial sites
2. Water	2. Proposed highways
3. Open	
4. Forest	<u>Proximity to population</u>
	1. $0.222 \leq \text{SPF}(30) \leq 0.042$
<u>Land use (secondary)</u>	2. $0.043 \leq \text{SPF}(30) \leq 0.133$
1. Urban	<u>Proximity to roads</u>
2. Water	<u>(light and light/heavy), cells</u>
3. Open	1. 0 (Cell contains road)
4. Forest	2. >0-2
	3. >3-6
<u>Land use (tertiary)</u>	4. >7-12
1. Urban	5. >12
2. Water	
3. Open	<u>Proximity to roads</u>
4. Forest	<u>(heavy and light/heavy), cells</u>
	1. 0 (Cell contains road)
<u>Roadways</u>	2. >0-2
1. Light	3. >3-6
2. Heavy	4. >7-12
3. Light/heavy	5. >12
<u>Transportation</u>	<u>Proximity to railroads, cells</u>
1. Transmission lines	1. 0 (Cell contains railroad)
2. Railroads	2. >0-2
	3. >2-6
<u>Population density, people</u>	4. >6-12
1. 0-30	5. >12
2. 31-100	
3. 101-300	<u>Proximity to transmission lines, cells</u>
4. 301-640	1. 0 (Cell contains transmission line)
5. >640	2. >0-2
	3. >3-12
<u>Ownership</u>	4. >12
1. Military	
2. TVA and other	<u>Proximity to recreation, cells</u>
3. Public recreation (TVA included)	1. 0 (Cell contains recreation)
4. Land-Between-the-Lakes	2. >0-7
5. Fort Donelson	3. >7
6. Wildlife refuge	

Table 8 (Continued)

<u>Proximity to water, cells</u>	
1.	0 (Cell contains water)
2.	>0-2
3.	>3-4
4.	>5-8
5.	>9-12
6.	>12

5. DATA VARIABLES AND SUITABILITY

Information was converted from map to digital form by manual digitization, semi-automated digitization, and calculation. The U.S. Geological Survey (USGS) 7.5-min topographic series maps used are shown in Fig. 3. Information was coded on the basis of 170-acre cells. The 170-acre cell unit was used to correspond to the size of one quad unit (including reactors and cooling towers). Because an analysis with a 170-acre resolution may not consider necessary information in sufficient detail (especially for particular variables such as slope), primary, secondary, and tertiary categories were used for some variables. As will be seen in the discussion of the individual variables, this classification expanded the initial data categories on the basis of the characteristic of the cell. Although this level of analysis is intended to be used as a finer indicator than the coarse screening, it still remains rather gross. The land area required for exclusion and limited use zones is not included in the 170-acre cells. Each cell corresponds to an area of approximately 30" latitude x 30" longitude. The information that is stored on magnetic tape for every 170-acre cell is described in the following sections.

5.1 Elevation

Elevation was digitized from the USGS 7.5-min topographic map series. Centroid elevations (heights above sea level) for the 170-acre cells are displayed in Fig. 4. Local relief (here defined as the difference between the maximum and minimum centroid elevation within the surrogate area) can provide useful information, for example, pumping requirements for water. The Kentucky Lake surrogate area contains a local relief of about 325 ft, with the lake surface at its lowest elevation. The western half of the area and the areas adjacent to the river are low-lying. TVA sources indicate that the lake rarely fluctuates greater than 3 ft in height (not above 353 ft above sea level). The map does not indicate the areas falling strictly in this range, but very little of the shoreland appears to be subject to flooding because of the rapid increase in elevation in the land adjacent to the lake.

Fig. 3. USGS topographic quadrangles in Kentucky Lake surrogate area. Scale: 1:552,000.

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2 = NO INFORMATION
4 = 350 - 449 FEET
5 = 450 - 549 FEET
9 = 550 - 674 FEET
GREATER THAN 674 FEET

FREQUENCY		PERCENTAGE	
.....	1586	0000000	0000000
.....	1530	0000000	0000000
.....	1369	0005000	0007000
.....	233	0000000	0000000
.....	34	0000000	0000000
.....	32	0000000	0000000
.....	29	0000000	0000000
.....	5	0000000	0000000

Fig. 4. Kentucky Lake NEC surrogate area: elevation.
Scale: 1:560,000

5.2 Engineering Geology

Bedrock geology was classified by two numbers, the first giving the bedrock lithology and the second giving the structural attitude (see Tables 9 and 10). Primary and secondary bedrock were distinguished and classified separately. The lithology classifications take into account all the major types of sedimentary rocks and interbedded sedimentary deposits of various types, as well as igneous and metamorphic rocks. Two additional categories include all other possible bedrock conditions. Unconsolidated Coastal Plain sediments, which are the only available founding materials over large areas of the Atlantic and Gulf Coastal Plains are included in a separate category and are considered to be a type of bedrock. In general, the classes are formed to denote the mechanical character of the rock, such as bedding, fissility, or the properties it is likely to assume in relation to its structural attitude. Thus, shale, slate, phyllite, and schist are grouped together as rocks with a pervasive, closely spaced fissility, and marbles and limestones are grouped as rocks that may develop subterranean caverns.

The structural attitude of the bedrock is divided into four classes. The first class includes areas that are flat-lying or without apparent structure. The second class includes areas that are domed, arched, warped, or flexed. Tightly folded and megascopically faulted rocks make up the two remaining classes. Because of the complexity of structure introduced, tightly folded rocks can be considered a negative cost factor. At the very least, an evaluative program would be required to satisfy regulatory requirements. If negative, the findings could result in increased design costs or possibly abandonment of the site.

A map of lithology for the Kentucky Lake study area is contained in Fig. 5. The eastern half of the surrogate area is characterized by carbonate rocks, and the western third by Coastal Plain sediments. A map of structural attitude is contained in Fig. 6. The eastern third of the region is flat-lying, whereas the western two-thirds is domed, arched, flexed, warped, or openly folded. A small area (about 5%) in the east central portion of the region is megascopically faulted. Both figures show right-angle boundaries, which resulted from an error in collection of data from the field. The error was not correctable during this study.

Table 9. Classification of lithology

Class number ^a	Class name	Description
1	Sandstone	Siliceous and calcareous orthoquartzite and protoquartzite.
2	Interbedded rocks	Interbedded sandstone, limestones, cherts, and shales.
3	Fissile rocks	Shale, slate, phyllite, and schist.
4	Carbonate rocks	Limestone, dolomite, and calcitic and dolomitic marbles.
5	Metamorphic rocks	Undifferentiated gneiss, paragneiss, and metagabbro.
6	Igneous rocks	All igneous rocks.
7	Coastal Plain sediments	Uncemented or partially cemented marine clay, silt, sand, and gravel.

^aRefers to first number of primary and secondary bedrock coding.

Table 10. Classification of structural attitude

Class number ^a	Description
1	Flat-lying or no apparent structure.
2	Domed, arched, flexed, warped, or openly folded.
3	Tightly folded.
4	Megascopically faulted.

^aRefers to second number of primary and secondary bedrock coding.

Fig. 5. Kentucky Lake NEC surrogate area: classification of lithology (bedrock). Scale: 1:590,000.

[illegible]

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Fig. 6. Kentucky Lake NEC surrogate area: classification of structural attitude (bedrock). Scale: 1:590,000.

5.3 Land Use

Three variables were constructed on the basis of existing land use information — primary, secondary, and tertiary land use. The primary, secondary, and tertiary designations deal with dominance in a cell. For example, if the primary land use is residential, then over 50% of the land area of the cell is in residential use. The land use variables are categorized into four classes of uses: (1) urban (residential, commercial, and industrial), (2) water (surface), (3) open (nonforested, unused, including agriculture), and (4) forest (vegetated). The material was coded from the USGS topographic maps.

Maps of primary, secondary, and tertiary land use are contained in Figs. 7, 8, and 9 respectively. Because all three categories will exist in each cell, three separate displays are required. Existing land use is related to conflicting uses of the potential NEC site as well as site clearing and preparation costs. As illustrated in the maps, the dominant land cover of the area is forest (61% of the study area's primary use). Very little of the region is classified as dominantly urban; urban cells are indicated for Big Sandy, Cumberland City, Dover, Erin, McKinnon, and Tennessee Ridge, Tennessee. Approximately 30% of the region is unforested open land. Although this may appear to present siting opportunities because of reduced clearing, it is necessary to remain cognizant of active farm communities that are susceptible to disruption.

5.4 Public Ownership

Public ownership was taken from USGS and TVA maps. Six areas, or types of areas, in public ownership were identified: (1) Fort Campbell military, (2) TVA recreation, (3) Land-Between-the-Lakes Recreation Area, (4) Fort Donnelson National Battlefield, (5) national wildlife refuges, and (6) other public recreation lands (Nathaniel Bedford Forrest Memorial State Park, Paris Landing State Park, and Stewart State Forest). Public ownership can serve as a restrictive factor (e.g., of recreation land) or an attractive factor (e.g., unused military bases and TVA nonrecreational land). Figure 10 contains a map of ownership for the study area.

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2 = NO INFORMATION
4 = URBAN
5 = WATER
7 = OPEN
9 = FOREST

FREQUENCY	0	15	467	1370	2873
0	0000000	0000000	0000000	0000000	0000000
1	0000000	0000000	0000000	0000000	0000000
2	0000000	0000000	0000000	0000000	0000000
3	0000000	0000000	0000000	0000000	0000000
4	0000000	0000000	0000000	0000000	0000000
5	0000000	0000000	0000000	0000000	0000000
6	0000000	0000000	0000000	0000000	0000000
7	0000000	0000000	0000000	0000000	0000000
8	0000000	0000000	0000000	0000000	0000000
9	0000000	0000000	0000000	0000000	0000000
PERCENTAGE	0	10	29	61	

Fig. 7. Kentucky Lake NEC surrogate area: primary land use.
Scale: 1:590,000

Fig. 8. Kentucky Lake NEC surrogate area: secondary land use.
Scale: 1:570,000.

Fig. 9. Kentucky Lake NEC surrogate area: tertiary land use.
 Scale: 1:570,000.

Fig. 10. Kentucky Lake NEC surrogate area: ownership.
Scale: 1:630,000.

Sixteen percent of the region is in public ownership. This is significant for both restrictive and attractive reasons. The Fort Campbell area (military) constitutes 6% of the region. The three recreation-oriented segments of public land comprise 5% of the area while the wildlife refuges add another 4% to the likely-to-be-reserved segment of land. The Land-Between-the-Lakes area, Fort Campbell, and the wildlife refuges, consisting of large contiguous tracts of land, are the most dominant of the publicly owned lands.

5.5 Population Density

United States Atomic Energy Commission guidelines⁴ and research into the effects of toxic materials on populations have indicated that power generation sites should be in sparsely settled areas if other criteria do not mitigate against use of such areas. To examine the distribution of population across and around the study region, the facilities of the ORNL Regional and Urban Studies Technical Information Center were used.

This process involved the calculation of population densities across a 170-acre cell grid. The total procedure consisted of the following four steps:

- (1) Identify population centroids for a large area surrounding the Kentucky Lake area (from Census tapes).
- (2) Assign these centroids to the appropriate cells in a geodetic grid.
- (3) Calculate the population densities for those cells containing centroids.
- (4) Calculate population densities for all cells in the grid by using an interpolation procedure on the cells containing centroids.*

* For a more detailed description of the interpolation technique, the reader is referred to Ref. 5.

The gridded population density contains discrete values of persons per square mile. A map of density for the Kentucky Lake area is reproduced in Fig. 11. The map illustrates the sparsely settled nature of the Kentucky Lake area. Most of the cells (91%) contain densities of less than 31 persons/sq mile. The small clusters of increased density (mostly 31 to 100 persons/sq mile) represent the influence of Dover, Erin, Fort Campbell-Clarksville, Paris, and Puryear. Population density does not appear to be a limiting factor for NEC siting in the region.

5.6 Proposed Development

Industrial development sites and proposed major road corridors were coded into the cellular data base under the heading of "Proposed Development." These areas were identified on the basis of maps provided by the Tennessee State Planning Office. The data was coded in a binary manner indicating presence or absence in a cell. A map of these areas is provided in Fig. 12. Industrial development sites may indicate land suitable for NEC use that has been identified by other sources (such as local chambers of commerce). It may also indicate potential conflict with other industrial developments if industrial sites are limited in the area.

5.7 Proximity to Population

The site population factor (SPF) was used to indicate the nearness of a site to a densely populated area. An SPF(30) value was calculated for every cell of the study area. The values that were calculated were very low, indicating sparse regional settlement. These values were categorized into two classes — SPF(30) values of 0.022 to 0.043 and SPF(30) values of 0.043 to 0.133. Neither of these categories is limiting in terms of NRC regulations. Figure 13 contains a map of SPF values for the Kentucky Lake surrogate area. The SPF mapping indicates very low values across the entire region. The Fort Campbell-Clarksville, Paris, and Puryear areas show up in the northeast and western portions of the region. However, communities such as Big Sandy, Dover, and Erin were not outlined by the SPF measure at all.

Fig. 13. Kentucky Lake NEC surrogate area: proximity to population.
Scale: 1:590,000.

5.8 Proximity Variables

In addition to the primary data items outlined in this section, a set of variables was created to reflect the proximity or nearness of a cell to a data feature. The proximity to a variable is often as critical as whether a cell contains the item. For example, whereas a cell that was identified as water under the land use variable would be excluded for site location, the nearness of adjacent cells to water is important for cooling system considerations. The resultant data, described as proximity values, were written onto the data tape on the cellular records. Proximity values are generated by scanning out from a cell containing a data item (e.g., a railroad) and assigning cells on the scan line a code as a function of distance from the source cell. Proximity values were created for proximity to (1) railroads, (2) recreation areas, (3) roads, (4) transmission lines, and (5) water. Line printer plots for these five variables for the Kentucky Lake area are contained in Figs. 14 through 19.

The plots indicate that about 40% of the cells in the center of the region running east to west are within 6 miles of a rail line. However, all the cells are within 6 miles of a light-duty roadway; hence, access might be provided by road where rail is not feasible. Proximity to medium-duty roads is more limited; some 58% of the region is within 6 miles of a medium-duty road. A majority of the area lies close to an existing transmission network for power during the construction phase. Water is equally available. Fifteen percent of the study region is within 1 mile of a significant water body, and 77% is within 6 miles of water. The northeast and southeast corners of the region are the most significant of the areas located farthest away from water.

5.9 Railroads

Railroads and proximity to railroads indicate a partial measure of accessibility for materials for construction and fuel and waste shipments. Railroads were digitized from the USGS topographic series maps (1:24,000 scale). Values indicating presence or absence of a railroad in the cell

Fig. 14. Kentucky Lake NEC surrogate area: proximity to railroads.
Scale: 1:590,000.

ORNL-DWG-75-11997

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2 = CELL CONTAINS RECREATION
5 = > 0 THRU 7 CELLS
9 = GREATER THAN 7 CELLS

FREQUENCY	
200	1117 3408
.....	0000000
.....	0000000
.....	0005000
.....	0000000
.....	0000000
.....	0000000
PERCENTAGE	24 72

Fig. 15. Kentucky Lake NEC surrogate area: proximity to recreation area. Scale: 1:630,000.

ORNL-LWG-75-11756

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2 = CELL CONTAINS TRANSMISSION LINE
4 = GREATER THAN 12 CELLS
6 = > 2 THRU 12 CELLS
9 = > 0 THRU 2 CELLS

FREQUENCY	313	853	2664	895
.....	+++++	000000	000000	000000
.....	+++++	000000	000000	000000
.....	+++++	000000	000000	000000
.....	+++++	000000	000000	000000
.....	+++++	000000	000000	000000
PERCENTAGE	7	18	56	19

Fig. 18. Kentucky Lake NEC surrogate area: proximity to transmission lines (>69kV). Scale: 1:590,000.

Fig. 19. Kentucky Lake NEC surrogate area: proximity to water.
Scale: 1:560,000.

were assigned to each cell. The map of railroads for the Kentucky Lake area has been combined with the map of transmission lines and is contained in Fig. 20. The Kentucky Lake area contains one rail line running across the center of the region from east to west.

5.10 Roadways

Roadways also give a partial measure of accessibility for materials, fuels, and waste shipment as well as for commuting of the labor force. Roadways were digitized from the USGS maps. Values were assigned to cells indicating presence or absence of three categories of roads: (1) medium-duty (four lane); (2) light-duty (two-lane); and (3) both medium- and light-duty. A map of the road network in the Kentucky Lake region is displayed in Fig. 21. The figure identifies the presence of a major roadway (U.S. Route 79) extending across the study area from Paris to Puryear to the Fort Campbell-Clarksville areas. A connector system tying most of the study area to Route 79 exists. Indeed, some 21% of the cells contain a road of some type.

5.11 Seismicity

Seismicity of the cells is classified by a single number representing the expected range of acceleration at the bedrock surface beneath the site during the Safe Shutdown Earthquake (SSE). The acceleration (see Table 11) was derived by taking into consideration the distance to the epicenter of the SSE, the intensity (modified merca1i) of the SSE, and the relation of the SSE or significant event to a fault of the tectonic province.

Seismicity was developed by means of the deterministic approach prescribed in 10 CFR 100, Appendix A. This approach establishes a maximum expected earthquake and locates its closest approach to a specific site by considering all possible relationships between historical earthquake activities and the prevailing tectonic regime and local structure. Once the SSE is located at the closest logical proximity to the site, attenuation characteristics of the specific region are employed to determine the

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2 = NO INFORMATION
5 = POWERLINES
5 = RAILROADS

FREQUENCY	PERCENTAGE
4308	91
313	7
104	2

Fig. 20. Kentucky Lake NEC surrogate area: transportation.
Scale: 1:590,000.

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2 = NO INFORMATION
4 = LIGHT ROAD
5 = HEAVY ROAD
7 = LIGHT/HEAVY ROADS

FREQUENCY		PERCENTAGE	
3749	78	143	35
.....	+++++	00000000	00000000
.....	+++++	00000000	00000000
.....	+++++	00050000	00000000
.....	+++++	00000000	00000000
.....	+++++	00000000	00000000
79	7	3	1

Fig. 21. Kentucky Lake NEC surrogate area: roadways.
Scale: 1:590,000

level of acceleration expected in bedrock at various distances from the design event. Appropriate levels of conservatism are applied at each stage of development.

Table 11. Classification of acceleration

Class number ^a	Description (% <i>g</i>)
1	0-10
2	11-20
3	21-30
4	31-40
5	>40

^aRefers to the single number of seismicity coding.

Figure 22 maps seismicity for the Kentucky Lake region. Forty-seven percent of the study area was classified as having an expected range of acceleration greater than 40% *g*. This area covers the northwest half of the region. The remaining area is largely identified in the 21 to 40% *g* classes. A gradation of acceleration values is prevalent with higher values to the northwest. Using the compatibility information in Table 2, it can be seen that cost increases toward the northwest corner of the region. The southeast corner appears to be the best siting area in terms of seismicity alone.

5.12 Slope

A description of the slope of a cell is an indicator of factors such as construction preparation costs, ease of access, and water pumping costs. Slope was converted into digital form through use of the USGS topographic series maps. The approximate percentage of a cell in three slope classes was indicated. The three slope classes used indicate a gradation of suitability for construction operations. Construction in areas with a slope of 16% was thought to be difficult. The classes are 0 to 7%, 8 to 15%, and 16% and greater. Thus, a cell may be coded as 80% in the 0 to 7% category, 15% in the 8 to 15% category, and 5% in

Fig. 22. Kentucky Lake NEC surrogate area: seismicity.
Scale: 1:590,000.

the 16%+ category. These approximate cellular portions were estimated by use of a 10 x 10 linear unit grid which fits over each cell (thus, one unit equals 1% of the cell area). This method avoids the "average slope" measure and yields a more meaningful determination of land surface.

These data were converted into measures of primary and secondary slope. If a cell's primary slope is 8 to 15%, then at least 50% of the cell was in that class. Maps of primary and secondary slope are contained in Figs. 23 and 24, respectively. The slope maps indicate the roughness of terrain prevalent over a majority of the study area (62% of the cells having a primary slope greater than 16%). The dominant exceptions are in the Fort Campbell area and in the western quarter of the region. Although the Fort Campbell area is relatively flat, the land between it and the Cumberland River has slopes that are generally too steep for construction. Hence, increased cost of water pumping, for example, may offset the lower site preparation costs incurred due to the more level surface. The land below the embayment is relatively flat and near water.

5.13 Soils

Soils were classified by two numbers, the first giving the soil type and mode of deposition and the second giving the soil's predominant thickness (see Tables 12 and 13). Primary, secondary, and tertiary soils were distinguished and classified separately.

The soil types are distinguished mainly on the basis of grain size and mode of deposition. Deposits that normally consist of (1) sand and/or gravel; (2) silt and/or clay; (3) mixtures of sand, gravel, silt, and clay; and (4) residual soils whose composition is dependent on the parent rock are grouped together. Mode of deposition was also included because this parameter conveys important information to experienced geotechnical personnel. Thus, some idea can be gained regarding ranges of thickness, geometry of sedimentary body, degree of sorting, compaction or consolidation, and presence or absence of stratification. The user may also be alerted to the possible presence of soils with certain engineering characteristics (either favorable or unfavorable) that may be common to

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2 = 0 - 8 PERCENT SLOPE
9 = 9 - 16 PERCENT SLOPE
5 = GREATER THAN 16 PERCENT SLOPE

FREQUENCY
1400 382 2943
..... ++++++ 0000000
..... ++++++ 0000000
...2... ++++++ 0005000
..... ++++++ 0000000
..... ++++++ 0000000
30 8 62
PERCENTAGE

Fig. 23. Kentucky Lake NEC surrogate area: primary slope.
Scale: 1:590,000.

2 = 0 - 8 PERCENT SLOPE
4 = 9 - 16 PERCENT SLOPE
5 = GREATER THAN 16 PERCENT SLOPE

FREQUENCY		
1049	3056	620
.....	+++++	0000000
.....	+++++	0000000
...2...	+++4++	0005000
.....	+++++	0000000
.....	+++++	0000000
...22...	65	13
PERCENTAGE		

Fig. 24. Kentucky Lake NEC surrogate area: secondary slope.
Scale: 1:590,000.

Table 12. Classification of soil type

Class number ^a	Class name	Description
1	Continental deposits	Sand and gravel with silt and clay; old terrace remnants, colluvial material; often appears as a capping unit or as an upland erosional remnant of a previously blanket-like deposit.
2	Marine sand and gravel	Sand and/or gravel with some silt and minor clay; possibly subject to liquefaction.
3	Marine silt and clay	With occasional minor sand or gravel; possibly subject to settlement.
4	Recent alluvium	Stream deposits of sand and gravel with some silt and clay; found in modern streams and floodplains; possibly subject to flooding and environmental constraints.
5	Swamp and marsh deposits, recent beach sand, dune sand and loess	Soils generally displaying negative engineering characteristics or occurring in areas subject to environmental constraints.
6	Glaciofluvial	Outwash, kame deposits, eskers, etc.; stratified materials, mostly sand and gravel, deposited by glacial meltwater.
7	Glacial till	Unsorted and unstratified material deposited by glacial ice; includes ground moraines, drumlins, and terminal and recessional moraines.
8	Glaciomarine and glaciolacustrine	Silt and clay; fine-grained, stratified deposits laid down in ice-marginal lakes or seas; subject to settlement.
9	Residual soils	Varied soils, ranging from thick saprolites to thin mantling soils; may necessitate excavation to sound rock or relatively easy stripping.

^aRefers to first number of primary, secondary, and tertiary soil coding.

Table 13. Classification of soil thickness

Class number ^a	Description (ft)
1	<10
2	0-50
3	50-100
4	0-100
5	>100

^aRefers to second number of primary, secondary, and tertiary soil coding.

a particular depositional environment (e.g., soft clays in glaciolacustrine deposits). A single class (class 5) includes soils of various types and modes of deposition, all of which generally display negative engineering characteristics. Figure 25 contains a map of soil types for the Kentucky Lake area. The eastern two-thirds of the area consists of residual soils, whereas the western portion contains continental deposits, marine sand and gravel, recent alluvium, swamp and marsh deposits, and sand and loess.

The limits of the soil thickness classes were selected to take into account available data, ranges of variability in regional soil thickness, and critical thicknesses that might affect nuclear power plant siting. Soils less than 10 ft in thickness would be insignificant and could be easily excavated. Soils ranging from 0 to 50 ft in thickness are also excavatable, but would be considered negative factors if sites with thinner soil cover are available. Overburden ranging from 50 to 100 ft in thickness would be still less desirable because of increased excavation costs and stability problems and the possible necessity of founding in soil. Such sites would not be desirable unless dense stable soils were present. Areas classed as having soils ranging from 0 to 100 ft in thickness either display extreme variation in thickness or indicate a lack of specific data. Figure 26 contains a map of soil thickness for the Kentucky Lake area. The map illustrates that the area to the east of the Tennessee River is characterized by thin soils (less than 10 ft thick). The western region contains fluctuating soils (0 to 100 ft thick) and very deep soils (greater than 100 ft thick).

Fig. 25. Kentucky Lake NEC surrogate area: classification of soil type. Scale: 1:700,000.

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Fig. 26. Kentucky Lake NEC surrogate area: classification of soil thickness. Scale: 1:590,000.

The compatibility information in Table 13 indicates the interdependence of soil thickness and type in defining compatibility with an NEC. Generally, in comparison with the eastern area of thin soils, the western third of the region appears less suitable for NEC siting based on soil information. Marshy, swampy soils are prevalent in the northwest corner of the region.

5.14 Transmission Lines

The presence of existing transmission lines may be beneficial to NEC site location because power for construction would already be available. In addition, the existing corridor may be able to support additional transmission lines carrying a portion of the power from the NEC. Transmission lines were digitized on the basis of the presence or absence of a line of greater than 69 kV in a cell. The corridors were identified from USGS and TVA maps. A map of the transmission network in the Kentucky Lake area is reproduced in Fig. 26. A number of lines exist in the eastern half of the region, and one line extends across to the northwestern segment of the study area.

5.15 Suitability

Figure 27 is a display of suitability scores. This plot is similar to those just reviewed for the single variables. In this case, however, the data categories within the variables are replaced by ranges of cell suitability index scores. These were calculated in the manner described in Sect. 4.2. Therefore, for example, the cell for which the index (-0.15) was calculated in Table 5 would be represented in the plot by a zero, and the cell for which the index (0.28) was calculated in Table 6 would be represented by a zero with an overprinted X. The latter, being a higher score and therefore more suitable, would be represented by a darker shade. The frequency distribution indicates a rather normal distribution of cells in various shades. However, the spatial distribution of the categories is less random than this numeric pattern. Rather, there is a distinct clustering of unsuitable (light) and suitable (dark) cells. For example, a rather unsuitable area exists about midway between the

Fig. 27. Suitability scores for Kentucky Lake surrogate area.
Scale: 1:570,000.

Cumberland River and Kentucky Lake. The reasons for this may be varied, and examination of the single variable plots to determine why this pattern occurred is possible. As will be shown in the following paragraphs, however, this cumbersome procedure of reviewing plots is not necessary.

Figure 28 shows the approximate location of the ten quad units used for analysis in Vols. II and III and outlines clusters of cells that appear to be advantageous for supporting quad units. The figure represents a cursory visual analysis. The outlines were produced by finding dark clusters of cells. The boundaries were then drawn by using cells with scores between 0.2 and 0.3 (level 8) as outer extremities. Theoretically, the area within the boundary should have a higher average score per cell than other blocks of cells in the study area.

The plot suggests that the cells that were used for analysis (in the south central part of the study area) were not as suitable as groups of cells in other parts of the study area. As shown in Fig. 28, a more likely area appears to be the cluster of high-scoring cells in the westernmost area outlined. The triangles represent hypothetical quad units. To comply with meteorological requirements, a space of about 2.5 miles was maintained between quad units.

As was implied, this visual analysis is qualitative and is most useful for a "quick look." If, however, the analyst wishes to quantitatively determine the composition of a given block of cells, he can do so with the aid of the profiling program mentioned earlier. Table 7 displayed the percentages of the entire Kentucky Lake area which are in various data categories. Table 14 is the profile of the blocked area in the western part of the study area. As is shown in the table, the area contains 320 cells. To adhere strictly to the 1 acre/MW guide, a potential NEC should contain about 282 cells of 170 acres each.

To interpret the profile, reference to the key (Table 8) and the table of suitability criteria (Table 2) for NECs is necessary. For example, almost 23% of the cells in the subarea are in category 2 in the proximity to water areas variable. Table 8 shows that category 2 includes cells within two cell spaces of water. Table 2 shows that proximity to water was given an importance of 5 and that the 0- to 2-cell compatibility value was +2. Therefore, the product of these two values is +10 for

2 = EXCLUSION
 3 = SCORE -1.0 - -0.3 LEAST SUITABLE
 4 = SCORE -0.3 - -0.1
 5 = SCORE -0.1 - 0.0
 6 = SCORE 0.0 - 0.1
 7 = SCORE 0.1 - 0.2
 8 = SCORE 0.2 - 0.3
 9 = SCORE 0.3 - 1.0 MOST SUITABLE

FREQUENCY								
467	0	163	1132	1695	983	270	15	
.....		+++++	000000	000000	000000	000000	000000	000000
.. 2 ..	.. 3 ..	++ 4 ++	00 5 100	00 6 100	00 7 00	00 8 100	00 9 100	00 10 100
.....		+++++	00 10 100	00 11 100	00 12 100	00 13 100	00 14 100	00 15 100
10	0	3	24	36	21	6	0	
PERCENTAGE								

Fig. 28. Aggregations of cells based on suitability scores.
 Scale: 1:620,000.

Table 14. Profile for site containing 320 cells with rows 81 through 100 and columns 40 through 55

SOILS

CATEGORY 12 = 3.44% (11 CELLS)
 CATEGORY 14 = 6.56% (21 CELLS)
 CATEGORY 22 = 2.19% (7 CELLS)
 CATEGORY 24 = 27.19% (87 CELLS)
 CATEGORY 25 = 19.65% (63 CELLS)
 CATEGORY 42 = 14.06% (45 CELLS)
 CATEGORY 52 = 0.31% (1 CELLS)
 CATEGORY 54 = 2.81% (9 CELLS)
 CATEGORY 51 = 20.00% (64 CELLS)
 PORTION OF AREA UNCATEGORIZED = 2.75%

GEOLOGY

CATEGORY 22 = 21.88% (70 CELLS)
 CATEGORY 72 = 74.37% (238 CELLS)
 PORTION OF AREA UNCATEGORIZED = 3.75%

SEISMICITY

CATEGORY 3 = 5.69% (31 CELLS)
 CATEGORY 4 = 39.37% (126 CELLS)
 CATEGORY 5 = 50.94% (163 CELLS)
 PORTION OF AREA UNCATEGORIZED = 0.0%

ELEVATION

CATEGORY 1 = 66.56% (213 CELLS)
 CATEGORY 2 = 28.13% (90 CELLS)
 CATEGORY 3 = 4.37% (14 CELLS)
 PORTION OF AREA UNCATEGORIZED = 0.94%

TOPOGRAPHIC SLOPE (PRIMARY)

CATEGORY 1 = 45.06% (157 CELLS)
 CATEGORY 2 = 24.06% (77 CELLS)
 CATEGORY 3 = 26.81% (86 CELLS)
 PORTION OF AREA UNCATEGORIZED = 0.0%

TOPOGRAPHIC SLOPE (SECONDARY)

CATEGORY 1 = 25.94% (83 CELLS)
 CATEGORY 2 = 55.94% (179 CELLS)
 CATEGORY 3 = 18.12% (58 CELLS)
 PORTION OF AREA UNCATEGORIZED = 0.0%

LAND USE (PRIMARY)

CATEGORY 1 = 0.54% (3 CELLS)
 CATEGORY 2 = 13.44% (43 CELLS)
 CATEGORY 3 = 40.31% (129 CELLS)
 CATEGORY 4 = 45.31% (145 CELLS)
 PORTION OF AREA UNCATEGORIZED = 0.0%

LAND USE (SECONDARY)

CATEGORY 2 = 3.13% (10 CELLS)
 CATEGORY 3 = 22.15% (71 CELLS)
 CATEGORY 4 = 23.12% (74 CELLS)
 PORTION OF AREA UNCATEGORIZED = 51.56%

LAND USE (TERTIARY)

CATEGORY 1 = 5.94% (19 CELLS)
 CATEGORY 2 = 1.25% (4 CELLS)
 CATEGORY 3 = 15.63% (50 CELLS)
 CATEGORY 4 = 13.12% (42 CELLS)
 PORTION OF AREA UNCATEGORIZED = 64.06%

ROADS

CATEGORY 1 = 26.25% (84 CELLS)
 PORTION OF AREA UNCATEGORIZED = 73.75%

TRANSPORTATION

CATEGORY 2 = 6.56% (21 CELLS)
 PORTION OF AREA UNCATEGORIZED = 53.44%

POPULATION DENSITY

CATEGORY 1 = 59.37% (191 CELLS)
 CATEGORY 2 = 0.62% (2 CELLS)
 PORTION OF AREA UNCATEGORIZED = 0.0%

OWNERSHIP

PORTION OF AREA UNCATEGORIZED = 100.00%

PROPOSED DEVELOPEMENT

CATEGORY 2 = 5.00% (16 CELLS)
 PORTION OF AREA UNCATEGORIZED = 55.00%

PROXIMITY TO POPULATION

CATEGORY 1 = 100.00% (320 CELLS)
 PORTION OF AREA UNCATEGORIZED = 0.0%

PROXIMITY TO ROAD (LIGHT & LT/HEAVY)

CATEGORY 1 = 26.25% (84 CELLS)
 CATEGORY 2 = 49.65% (159 CELLS)
 CATEGORY 3 = 24.06% (77 CELLS)
 PORTION OF AREA UNCATEGORIZED = 0.0%

PROXIMITY TO ROAD (HEAVY & LT/HEAVY)

CATEGORY 2 = 1.87% (6 CELLS)
 CATEGORY 3 = 13.44% (43 CELLS)
 CATEGORY 4 = 41.56% (133 CELLS)
 CATEGORY 5 = 43.12% (138 CELLS)
 PORTION OF AREA UNCATEGORIZED = 0.0%

PROXIMITY TO RAILROADS

CATEGORY 1 = 6.56% (21 CELLS)
 CATEGORY 2 = 20.00% (64 CELLS)
 CATEGORY 3 = 41.87% (134 CELLS)
 CATEGORY 4 = 31.56% (101 CELLS)
 PORTION OF AREA UNCATEGORIZED = 0.0%

PROXIMITY TO TRANSMISSION LINES

CATEGORY 3 = 43.75% (140 CELLS)
 CATEGORY 4 = 56.25% (180 CELLS)
 PORTION OF AREA UNCATEGORIZED = 0.0%

PROXIMITY TO RECREATION AREAS

CATEGORY 3 = 100.00% (320 CELLS)
 PORTION OF AREA UNCATEGORIZED = 0.0%

PROXIMITY TO WATER AREAS

CATEGORY 1 = 13.44% (43 CELLS)
 CATEGORY 2 = 22.81% (73 CELLS)
 CATEGORY 3 = 23.12% (74 CELLS)
 CATEGORY 4 = 29.37% (94 CELLS)
 CATEGORY 5 = 10.54% (35 CELLS)
 CATEGORY 6 = 0.31% (1 CELLS)
 PORTION OF AREA UNCATEGORIZED = 0.0%

about 23% of the cells in the subarea. Because category 3 includes cells that are three or four cell spaces from water areas, it follows that about 46% of the cells in the subarea are within four spaces of a water supply. Table 15 is the profile that corresponds to the area of cells in the eastern portion of the study area, as shown in Fig. 28.

To make a value judgment as to whether the eastern area is better than the western, or vice versa, is difficult at this point. An algorithm to produce a single measure for comparative purposes has been produced, but several points must be kept in mind about this type of calculation. First, a single measure often tends to hide its components; that is, a score may tend to disguise the meaning of the variables that comprise it. Second, the algorithm that produces the score can emphasize the values of those who devise it. As has been noted previously, application of the method necessarily contains considerable subjectivity. A final score may magnify this shortcoming. Third, as a corollary to the second reason, not only may different interests emphasize different criteria, but the reasoning behind the algorithm may also vary. With a suitability score for each cell already determined, there are several ways of determining a single measure for a predetermined cluster. The following are possible measures: (1) highest total score; (2) highest median score; (3) highest average of the scores; (4) highest average with lowest standard deviation; and (5) combination of 1 through 4.

As a first attempt to use a means of comparison, the highest average with the lowest standard deviation was used. A program was written that calculates this measure for all cell blocks of a predetermined size within the surrogate area. The program operates on the northwest corner in a block of cells and deletes cell blocks that cannot meet the size criterion. For example, a cell that is two spaces north and two spaces east of the southeastern-most cell in the surrogate area cannot serve as the northwest corner of a sixteen by sixteen block of cells. To include the northeast extension of the surrogate area in the analysis, a fifteen by fifteen cell square was predetermined. Virtually any size block of cells can be used. Moving from the upper left-hand corner across the columns and then down each row, each cell represents the northwesternmost

Table 15. Profile for site containing 322 cells with rows 65 through 87 and columns 92 through 105

SOILS CATEGORY 42 = 0.62% (2 CELLS) CATEGORY 44 = 3.11% (10 CELLS) CATEGORY 52 = 10.25% (33 CELLS) CATEGORY 54 = 0.93% (3 CELLS) CATEGORY 91 = 65.09% (274 CELLS) PORTION OF AREA UNCATEGORIZED = 0.0 %	TRANSPORTATION CATEGORY 1 = 14.60% (47 CELLS) CATEGORY 2 = 7.14% (23 CELLS) PORTION OF AREA UNCATEGORIZED = 78.26%
GEOLOGY CATEGORY 21 = 3.11% (10 CELLS) CATEGORY 22 = 1.24% (4 CELLS) CATEGORY 24 = 8.70% (28 CELLS) CATEGORY 41 = 37.27% (120 CELLS) CATEGORY 42 = 8.07% (26 CELLS) CATEGORY 44 = 41.61% (134 CELLS) PORTION OF AREA UNCATEGORIZED = 0.0 %	POPULATION DENSITY CATEGORY 1 = 76.40% (246 CELLS) CATEGORY 2 = 21.74% (70 CELLS) CATEGORY 3 = 1.86% (6 CELLS) PORTION OF AREA UNCATEGORIZED = 0.0 %
SEISMICITY CATEGORY 2 = 1.86% (6 CELLS) CATEGORY 3 = 56.27% (310 CELLS) CATEGORY 4 = 1.86% (6 CELLS) PORTION OF AREA UNCATEGORIZED = 0.0 %	OWNERSHIP PORTION OF AREA UNCATEGORIZED = 100.00%
ELEVATION CATEGORY 1 = 25.47% (82 CELLS) CATEGORY 2 = 34.78% (112 CELLS) CATEGORY 3 = 34.78% (112 CELLS) CATEGORY 4 = 4.97% (16 CELLS) PORTION OF AREA UNCATEGORIZED = 0.0 %	PROPOSED DEVELOPEMENT CATEGORY 1 = 0.31% (1 CELLS) CATEGORY 2 = 5.54% (18 CELLS) PORTION OF AREA UNCATEGORIZED = 94.10%
TOPOGRAPHIC SLOPE (PRIMARY) CATEGORY 1 = 11.49% (37 CELLS) CATEGORY 2 = 0.31% (1 CELLS) CATEGORY 3 = 88.20% (284 CELLS) PORTION OF AREA UNCATEGORIZED = 0.0 %	PROXIMITY TO POPULATION CATEGORY 1 = 53.17% (300 CELLS) CATEGORY 2 = 6.83% (22 CELLS) PORTION OF AREA UNCATEGORIZED = 0.0 %
TOPOGRAPHIC SLOPE (SECONDARY) CATEGORY 1 = 16.77% (54 CELLS) CATEGORY 2 = 76.71% (247 CELLS) CATEGORY 3 = 6.52% (21 CELLS) PORTION OF AREA UNCATEGORIZED = 0.0 %	PROXIMITY TO ROAD (LIGHT & LT/HEAVY) CATEGORY 1 = 36.34% (117 CELLS) CATEGORY 2 = 56.52% (182 CELLS) CATEGORY 3 = 7.14% (23 CELLS) PORTION OF AREA UNCATEGORIZED = 0.0 %
LAND USE (PRIMARY) CATEGORY 1 = 0.93% (3 CELLS) CATEGORY 2 = 12.11% (39 CELLS) CATEGORY 3 = 16.46% (53 CELLS) CATEGORY 4 = 70.50% (227 CELLS) PORTION OF AREA UNCATEGORIZED = 0.0 %	PROXIMITY TO ROAD (HEAVY & LT/HEAVY) CATEGORY 4 = 5.59% (18 CELLS) CATEGORY 5 = 94.41% (304 CELLS) PORTION OF AREA UNCATEGORIZED = 0.0 %
LAND USE (SECONDARY) CATEGORY 1 = 0.62% (2 CELLS) CATEGORY 2 = 3.11% (10 CELLS) CATEGORY 3 = 39.75% (128 CELLS) CATEGORY 4 = 15.22% (49 CELLS) PORTION OF AREA UNCATEGORIZED = 41.30%	PROXIMITY TO RAILROADS CATEGORY 1 = 7.14% (23 CELLS) CATEGORY 2 = 22.36% (72 CELLS) CATEGORY 3 = 41.30% (133 CELLS) CATEGORY 4 = 26.71% (86 CELLS) CATEGORY 5 = 2.48% (8 CELLS) PORTION OF AREA UNCATEGORIZED = 0.0 %
LAND USE (TERTIARY) CATEGORY 1 = 1.24% (4 CELLS) CATEGORY 2 = 2.80% (9 CELLS) CATEGORY 3 = 21.74% (70 CELLS) CATEGORY 4 = 6.52% (21 CELLS) PORTION OF AREA UNCATEGORIZED = 67.70%	PROXIMITY TO TRANSMISSION LINES CATEGORY 1 = 14.60% (47 CELLS) CATEGORY 2 = 40.06% (129 CELLS) CATEGORY 3 = 45.34% (146 CELLS) PORTION OF AREA UNCATEGORIZED = 0.0 %
ROADS CATEGORY 1 = 36.34% (117 CELLS) PORTION OF AREA UNCATEGORIZED = 63.66%	PROXIMITY TO RECREATION AREAS CATEGORY 1 = 0.93% (3 CELLS) CATEGORY 2 = 34.78% (112 CELLS) CATEGORY 3 = 64.29% (207 CELLS) PORTION OF AREA UNCATEGORIZED = 0.0 %
	PROXIMITY TO WATER AREAS CATEGORY 1 = 12.11% (39 CELLS) CATEGORY 2 = 21.43% (69 CELLS) CATEGORY 3 = 19.25% (62 CELLS) CATEGORY 4 = 27.33% (88 CELLS) CATEGORY 5 = 18.01% (58 CELLS) CATEGORY 6 = 1.86% (6 CELLS) PORTION OF AREA UNCATEGORIZED = 0.0 %

cell in a square block of 225 cells. For each block, the average cell score and standard deviation are calculated. All blocks of cells are then ranked.

The results of this analysis indicated that a block of cells whose northwest cell had coordinates of 46 and 94 was the "best" of the 2821 possible blocks of 225 cells. Parts of this area, and others with high ranks, were included in the area outlined in the northeast extension of the surrogate area. The analysis also showed that the westernmost area outlined in Fig. 28 had a rank of 113 (of the 2821 possible blocks) when coordinates 76 and 31 are used. This suggests that that area is a highly acceptable site. The outlined area adjacent to it, ranked 418, was also shown to be a fairly good site. Similarly, the area outlined to the south of the Cumberland River was ranked 377. The area on the northern border of the Cumberland River did not lend itself to analysis in this run of the program because of the fifteen by fifteen dimensions. Finally, the surrogate site, analyzed in Vols. II and III, ranked 446, reinforcing the findings of the visual analysis that the site was less than optimal.

Several points should be kept in mind while analyzing the output of the ranking procedure. Depending on the dimension of the block of cells, particular clusters of cells may appear in blocks with high scores and in blocks with low scores. For example, assume that an area larger than 225 cells is comprised of cells with high scores. The block of cells for which an average is being calculated is theoretically moving, cell by cell, across the surrogate area, row by row. Therefore, part of the block may include high-scoring cells, and part may cover low-scoring cells. Consequently, a mediocre average score and rank may result. Relatively few coordinates will then show up as a cluster. It must also be recalled that when such clusters do show up, they are still in the same area. That is, even though a "site" has been defined by the block size, different sites may represent largely the same area.

This problem might be overcome by the use of a small block size, but this may defeat the analytical advantages offered by the profiling program. Another remedy might be a display that illustrates the output of the list of ranked coordinates. This may take the form of a contour

plot. As yet, none of these methods has been tested. However, one method that may alleviate part of the problem is the production of a suitability plot that can be overlaid on a base map. Figure 29 is such a display. It presents the identical information that was shown on the printer suitability map (Fig. 27). ORNL has acquired the capability of converting from one scale to another and from one projection to another. In this case a map was drawn at the same scale and projection as the USGS 1:125,000 topographic map (which covers the Kentucky Lake area). The mechanical plotter is used for this purpose. With the overlay, the analyst can essentially peer into a particular cell and determine the reasons for its suitability score. Also, since a shading routine is employed, the capability to identify clusters of cells is not lost. This method allows discovery of the shortcomings of a particular cell as well as the implications of its deficiencies.

As a final note, it should be emphasized that the output of the method used in this study is analogous to the output of the more gross coarse screening; it is limited by the considerations (variables) made in the input. Some considerations, such as whether water will be legally or politically (as opposed to technologically and economically) available, have not entered this process. Further, social and socioeconomic issues, for the most part, have not entered the procedure. They must not be neglected, however, in actual siting of an NEC. Therefore, the output displays which, if any, surrogate sites are favorably disposed toward supporting an NEC on the basis of some initial considerations. This, in turn, can give rise to the decision of whether to analyze the area or particular site in more detail or to abandon consideration of an NEC in the particular area. The method is flexible enough to easily accept changes in technology, criteria, or variables.

36°37'30.00"

ORNL-DWG-75-15451

Fig. 29. Cell suitability scores in the Kentucky Lake area.
Scale: 1:448,052.

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