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

Vol. I. Summary

C. C. Burwell
D. B. Reister
C. S. Rosemarin
O. Sisman
J. S. Suffern

MASTER

OAK RIDGE NATIONAL LABORATORY

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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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ENERGY DIVISION

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

VOL. I. SUMMARY

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

MAY 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 electrical 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

In analyzing the surrogate sites certain assumptions were made, one being that the technology used in the large NECs was the same as that in 4- and 10-unit plants. This caused certain effects, such as eutrophication and silting, to be much greater at a 40-unit plant than at a 4-unit plant. The reason for this sort of comparison is obvious: It was to compare all

plants on the same basis so that problems related to size would show up. It should be equally obvious that if such problems did exist the applicant would have to install a more elaborate treatment system or change his mode of operation to conform with EPA regulation 40 CFR 423 and their relation to enforcement of water quality standards under Sections 303 and 304 of the Federal Water Pollution Control Act of 1972 (P.L. 92-500).

In the social impact section of this report some assumptions were also made, which may be at some variance with assumptions made in other NECSS documents. In most cases these variances do not detract from the major purpose of the report, which is to make comparisons between NECs and dispersed sites and not to make exact predictions. For example, 8.5 man-hr/KWe was used in this report, and others have assumed values up to 10.5. The manpower estimates for nonsupervisory labor may also be somewhat lower than reported in some other reports, but it is consistent for the different size plants. An operating staff of 350 persons was assumed for each 4-unit station. This value varies among plants, but some estimates are as high as 600. Finally, the influx of people into the area caused by the construction of a 40-unit NEC was based on workers directly associated with the NEC and their families. There will be a lot of peripheral construction and businesses, which will swell the number of new residents by a factor of 2 to 3 over the number employed directly by the NEC.

ABSTRACT

A very brief summary is presented of the surrogate site concept and the material contained in the other three volumes of this report. Volumes II and III use surrogate sites in western Tennessee to compare the NEC concept with the present method of dispersed siting of nuclear power plants, and Vol. IV. outlines a site selection methodology.

VOL. I. SUMMARY

1. INTRODUCTION

In this series of reports an attempt has been made to illustrate by means of hypothetical surrogate sites the differences between generating electric power in nuclear energy centers and in dispersed sites as is currently done. Major differences may occur in land use, method of heat dissipation, and electrical transmission. Primary impacts are ecological and socioeconomic.

The surrogate sites are located in middle Tennessee and adjacent areas in western Tennessee, southern Indiana and Kentucky, and northern Alabama and Mississippi. Although the study is primarily concerned with a 40-reactor NEC, the large NEC was compared to four 10-reactor NECs and to ten 4-reactor dispersed sites for the power transmission analysis and the environmental assessment. Three cases are discussed:

1. A surrogate 40-reactor NEC has been located on Kentucky Lake about 60 miles west of Nashville, Tennessee, and about 20 miles south of the Kentucky border. The NEC consists of ten units, each being a group of four reactors, four natural-draft cooling towers, and associated buildings and substations. The 4-reactor groups are spaced approximately 2.5 miles apart. The total land area occupied by the NEC is 75 sq miles, about 1 acre/MW. The reactors are assumed to be 1200 MWe each.
2. Four 10-reactor NECs (that might substitute for the large NEC) have been located to serve the same load centers as the large NEC. They are near Cadiz, Kentucky; Hartsville, Tennessee; Penton, Mississippi; and Browns Ferry, Alabama. Each of the 10-unit plants has been assumed to have the same geometry as one-fourth of the 40-unit site and to be otherwise the same as the large energy center in all details.
3. Ten 4-reactor dispersed plants (that might substitute for the large NEC) have also been selected to serve the same load centers as the two NEC modes. They are near Cadiz, Kentucky;

Hartsville, Tennessee; Cumberland City, Tennessee; McKinnon, Tennessee; Perryville, Tennessee; Eastport, Tennessee; Penton, Mississippi; Sardis, Mississippi; Browns Ferry, Alabama; and Bellefonte, Alabama. Each dispersed site plant has been assumed to be the same in all details as one of the 4-unit groups of the energy center.

Each of the three cases described has been assumed to serve five load centers (in the year 2020), namely Evansville, Indiana; Paducah, Kentucky; Nashville, Tennessee; Memphis, Tennessee; and Huntsville, Alabama. Transmission line corridors have been selected to carry the power to the load centers for each of the postulated cases.

A brief review of the theory and design of power transmission systems is presented in Vol. II. Systems have been analyzed for the three cases sited above, and the power centers and logical locations for the power plants in the year 2020 were selected from this analysis. The buildup of the power network system from the years 1985 to 2020 is discussed, and the layout of a transmission network system has been postulated.

In Vol. III a comparison of the environmental impacts has been made for the three cases. Methods of heat dissipation are reviewed, and the possible increases in temperature and effluents to the atmosphere and water are estimated. Ecological impacts are reviewed for the terrestrial and aquatic environment during both construction and operation of the plants. Possible effects of the high-voltage primary transmission lines are discussed. Finally, the differences in socioeconomic impacts are compared for the dispersed siting and the energy centers.

A site selection methodology is presented in Vol. IV. The criteria for selecting a candidate region or site (e.g., availability of water, population density, land use, ecological considerations) are presented, and the process is illustrated for the Kentucky Lake NEC region. In the process of testing the site selection methodology, a data bank was accumulated for the Kentucky Lake surrogate area. These data include geology, meteorology, land use, existing infrastructure, economic and social structure, and other factors pertinent to the selection and analysis of the suitability of this area for an NEC.

2. TRANSMISSION OF POWER

Two sequential transmission analyses were completed. In the first analysis, a comparison was made among the three cases described in the Introduction. In all cases 48,000 MWe of generating capacity is added to meet a large fraction of the growth in power demand for the period 1985 to 2020 projected for the areas centered around the Kentucky Lake area (see Table 1). The site areas for the small NECs and dispersed stations were chosen, based on their proximity to the load centers being served, from 60 potential siting areas in the region, all of which satisfied general criteria of water availability, low population density, and acceptable seismic risk. In the initial analysis, transmission systems were designed which ignored the existence of the power transmission system already in place; electric reliability was provided by circuit redundancy in the transmission network and, additionally, at the large NEC by interties among the generating facilities.

Table 1. Power capacity projections (GWe) for major cities in the Kentucky Lake area

City	Capacity projection for year		
	1985	2000	2020
Huntsville, AL	3.7	8.0	16.5
Evansville, IN	2.8	5.4	9.6
Paducah, KY	2.0	3.6	6.3
Chattanooga, TN	4.0	8.0	15.1
Memphis, TN	8.5	16.7	30.9
Nashville, TN	7.7	16.0	31.6

The results of the initial transmission analysis are presented for the year 2020 in terms of total miles of 765-kV transmission line, the product of power transmitted times the transmission distance (gigawatt-miles) and capital cost (see Table 2). The finding is that, from a transmission perspective and for the power density for this area assumed for the year 2020, four 10-reactor NECs may be more nearly optimum than either a single 40-reactor NEC or the ten 4-reactor power stations. The difference in cost for the three siting modes is relatively small when compared to estimated differences in the cost of generating facilities for the various construction modes.

Table 2. Comparison of transmission systems for three modes of siting 48,000 MWe of new generating facilities for the period 1988 to 2020

Siting mode	Transmission line mileage	Energy times distance (gigawatt-miles)	Cost (millions of \$)
One 40-reactor NEC	2000	5493	526
Four 10-reactor NECs	1216	2647	320
Ten 4-reactor power stations	1903	3277	500

The second transmission study of the Kentucky Lake area sought to test the validity of the first study by incorporating in the design both the existing high-voltage network and additions to it being planned by the cognizant utilities. Thus, the second study compared a design that utilized 23 dispersed sites in the year 2020 (derived from a logical extension of the existing 500-kV utility system for which plans have been fairly well formulated to the year 1984) with a design that substitutes a 40-reactor NEC for 9 of the 23 dispersed sites. Independent transmission systems were designed by the Institute for Energy Analysis (IEA) and by General Electric Company's Center for Energy Systems (GE) based on generating sites and load center demands as defined by IEA in a manner consistent with their first study.

Summary results of the second study based on separate work by IEA and GE are shown in Table 3 for the years 2005 and 2020. They are consistent with the first study and with each other in that a small transmission penalty is incurred if a very large NEC is included in the design.

According to IEA, the additional mileage required in the second study to augment an existing system is 50 to 60% of that required in the absence of an existing network. According to GE, the additional transmission mileage required is more or less comparable to the IEA findings for the first study. Differences in the transmission designs produced by the two groups reflect primarily the different assumptions used by the two groups regarding system operation.

Table 3. Comparison of transmission systems in the years 2005 and 2020 for two modes of expanding generation capacity by about 80,000 MWe during the period 1985 to 2020 for the Kentucky Lake Area

Siting mode	Year	Transmission line mileage added		Energy times distance ^a (gigawatt-miles)
		IEA	GE	
One 40-reactor NEC and 13 dispersed sites	2005	562	1300 ^b	2753
	2020	1096	2781 ^b	4551
23 dispersed sites	2005	459	1238	2002
	2020	891	2690	3735

^a IEA result only.

^b Includes 1288 miles of 765-kV line; other figures are for 500-kV line.

The miles of circuits added by General Electric's program are substantially larger than the miles projected by IEA. There are two primary reasons for it. The GE program operates largest units first (nuclear plants are operating continuously) for reasons of economy; and the network design — in addition to single-line contingencies — includes also a generator-out contingency. These differences can be appreciated by sensitivity analysis for some outages: Outages of one generator in dispersed cases increase the dispatch gigawatt-miles by a larger percentage than outages of two generators in the center cases. For instance, for dispersed sites the outage of Penton increases gigawatt-miles by about 90% in 1985, by 22% in 2005, and by about 13% in 2020; whereas, for a center, removal of two generators increases gigawatt-miles by about 7% in 2005 and by about 18% in 2020.

In summary, transmission studies for the Kentucky Lake area indicate that small energy centers may be more nearly optimum, from a transmission standpoint, both in terms of cost and environmental impact, than either a very large NEC or relatively small dispersed power sections. This finding

applies to the period from 1985 to 2020 for the projected growth in power capacity used in the analysis. A secondary finding is that use of off-optimum transmission system design would not result in major cost or impact penalties, and further that these penalties could be offset by modest gains in the cost, impacts, or operations associated with different modes of siting the power generating facilities.

3. ENVIRONMENTAL CONSIDERATIONS

3.1 Thermal and Ecological Impacts

The available heat dissipation technologies are evaluated, and the reasons for choosing natural-draft wet towers for this surrogate site are given. Generic ecological impacts are reviewed, and some of these impacts are evaluated for the Kentucky Lake Surrogate Site.

Once-through cooling. If one assumes a withdrawal rate of no more than 5% of flow, there are few available sites for a 40-reactor nuclear energy center, which would have an intake rate of some 72,000 cfs. The lower Mississippi could support only three once-through reactors sited contiguously, assuming such a withdrawal standard. The only real options available for once-through cooling of energy centers are coastal and offshore sites. On the basis of temperature rise alone, the use of once-through cooling for inland nuclear energy centers can be ruled out.

Cooling ponds. The use of cooling ponds would double or quadruple land requirements for an NEC. Extrapolating from known cooling pond systems, 150 to 300 sq miles of cooling pond would be needed to support a 40-reactor complex. A cooling pond of this size would probably cause an increase in local fog and other effects on local weather such as land-sea breezes. The large land requirement would increase the cost of this option.

Spray ponds and canals. Increased fogging, icing, and drift are conditions typical of this cooling option, but at present, there are no models to predict the distribution. However, it has been observed that drift droplets are large and do not travel far. Often, the spray ponds and canals are provided with a 200-ft concrete apron, which collects the majority of this material. Land requirements are modest — about 0.1 acre/MWe. Intake would amount to some 1500 cfs for a 40-reactor NEC.

Evaporative cooling towers. There are two basic kinds of evaporative cooling towers, mechanical (fan driven) draft and natural draft.

The land requirement for both is small — about 0.03 acre/MWe. Mechanical-draft towers are lower and less visible and more noisy, and they cause more fog and icing than do natural-draft towers. Natural-draft towers are more visible from longer distances and have higher plumes, which give better dispersion of drift. Both types of towers will cause additional precipitation of undefined distribution.

Dry cooling towers. Dry cooling towers discharge only hot air. They require about four times as much land as evaporative towers (about the same as spray canals) and are much more expensive. They process about five times as much air. This increase in air use suggests that problems of vorticity (tornadoes, thunderstorms) would be more severe. There is no visible plume with dry towers, no drift, fog, nor ice, and no consumptive water use.

Wet-dry towers. This system has impacts similar to wet towers, only smaller in magnitude, depending upon the proportion of heat dissipated by evaporative means. Drift and water use will be reduced in proportion to the percentage of heat rejected through the dry sections.

Wet, dry, and wet-dry towers all appear viable for NEUS. Dry and wet-dry towers have generally smaller direct impacts than do wet towers, but they have the indirect effect of requiring larger reactors to achieve the same electrical output (because of reduced efficiency). The dry towers are much more expensive to build, as well as to operate, than are the wet towers. Hence, they will probably be used only in unusual circumstances in which their particular qualities are essential. Among the wet towers, rectangular mechanical- and natural-draft towers have been used most extensively. Natural-draft towers are more efficient and have generally smaller fog and drift impacts. Rectangular mechanical-draft towers are less visible, have lower capital costs, and are more flexible in operation. The present trend is toward natural-draft towers for large installations because their advantages, particularly efficiency, seem to be most important. Hence, natural-draft towers are the most likely choice for most NECs.

The surrogate analysis of cooling systems assumed the use of wet natural-draft towers, each rejecting 2374 MWt by evaporating 30 cfs and operating at 5.7 cycles of concentration. It was determined that 5.7 cycles of concentration could be used for the average condition without exceeding EPA or State water quality standards.

Each cooling tower emits 1870 lb (848.2 kg) of water vapor and 0.6 lb (0.27 kg) of water droplets (drift)/sec. These water droplets contain dissolved solids; hence, each tower emits about 12,680 lb/year (5751.6 kg/year) of "salt," mainly sulfates and bicarbonates of calcium and magnesium.

The analytical techniques available did not allow accurate portrayal of plume behavior because the atmospheric discharges from all the cooling towers were assumed to originate from a point source. This gross oversimplification will overestimate near-field (<10 miles) concentrations and underestimate far-field concentrations.

The analysis showed that even with the above values, near-field salt deposition was negligible for both NECs and dispersed sites. No increase in fog is expected, and no impacts are expected from icing. Although increases in precipitation are probable and concentration of vorticity is possible downwind of an NEC, no firm assessment of meteorological consequences can be made at this time.

The aquatic impacts of the heat dissipation system are modest; no significant thermal impacts are expected. The heat plumes of the NEC overlap and there will be some far-field elevations in temperature and nutrient concentration.

The ecological impacts of NECs and dispersed siting are evaluated in Sections 3 and 4 of Vol. III. Comparison of some terrestrial ecological impacts for the Kentucky Lake surrogate NEC and smaller NECs and dispersed sites show:

1. A much higher loss of soil would occur at the 40-reactor NEC site as compared with estimates from the 10-reactor NEC sites and the dispersed sites, primarily because of the extreme relief there.

2. Although the total area affected by station construction is about the same for all strategies, the acreages required for transmission line rights-of-way are not. About 55,000 acres are required for the 40-reactor NEC transmission system, as compared to 50,000 acres for the dispersed-site transmission system and 33,000 acres for the 10-reactor NEC system. The comparatively low value for the 10-reactor NEC is an artifact of the advantageous locations of the power stations to the load centers and may not be true for a real situation.
3. The effects on terrestrial biota are highly correlated with acreage because acreage disruption is an index of habitat disruption. In addition, terrestrial biota may be affected by the heat dissipation systems because potential changes in weather could cause changes in floral and faunal distributions.
4. Within the framework of the factors examined in the surrogate analysis, the greatest impact on terrestrial ecosystems is associated with the 40-reactor NEC, less impact is associated with the dispersed sites, and the least impact is associated with the 10-reactor NECs. Many of these impacts are site-specific; their magnitudes may change in different siting situations.

The surrogate analysis revealed the following comparisons with regard to aquatic ecology:

1. The eutrophication of receiving waters may be extensive with the 40-reactor NEC. Preliminary estimates indicate substantial changes in nutrient levels extending over as much as 20 river miles, with concomitant biological effects such as algal blooms quite probable. The effect due to a 10-reactor NEC may be obvious for as much as five miles. There should be no obvious eutrophication effect from dispersed sites.
2. Far-field warming associated with NEC discharges likely would interact with increased nutrient levels to increase productivity over substantial areas. No such effect is anticipated for dispersed sites.

3. The sedimentation associated with the construction of the 40-reactor NEC is much greater than that of the 10-reactor NECs or dispersed sites because of the topography of the chosen site. The sedimentation associated with the NEC probably would cause more persistent floral and faunal changes with accompanying greater secondary effects. A longer time would be required for reestablishment of "normal" community structure upon cessation of sedimentation than would be the case with dispersed siting.
4. Ecologically sound siting criteria for water use would minimize the impact of both NECs and dispersed sites. When such criteria are applied, the greatest difference between NECs and a dispersed site configuration would be the limited number of sites available for the NECs compared with the smaller units.

3.2 Social and Economic Impacts

In the absence of more site-specific data, only a few generalizations can be made relative to the magnitude and duration of the effects of possible impacts on the people living in the Kentucky Lake area. The acquisition of one 75-sq-mile tract would in all probability displace a larger number of people, result in a greater change in local land use patterns, and have a more significant effect on local tax rolls than would the acquisition of ten 3-sq-mile tracts at dispersed sites required for the construction of a comparable amount of generating capacity.

The influx of a large number of construction workers with their attendant demands for housing and services is seen as the single largest impact causing the greatest disruption of the activity patterns and lifestyle of local residents. Depending on the schedule followed for construction of individual generating units at the NEC, the number of workers required during the peak of construction activity could be about the same as that required for construction of a 4-unit station over an eight-year period. Although the magnitude of the initial impact made

by demands for housing and services for incoming NEC workers might be comparable to that made by workers for a 4-unit station, the duration of the effects of this impact would be much longer. Both the magnitude and duration of this impact and its effects on the local area would be alleviated by the development of a planned community to accommodate NEC workers and their families. The conclusion has been made that the magnitude of the impact resulting from the demands for housing and services made by transient workers constructing 4-unit power stations at ten dispersed sites would be much greater than that made by the semipermanent workers constructing comparable generating capacity at a 40-unit NEC.

Direct expenditure on materials for construction of either a 40-unit NEC or a 4-unit station is expected to benefit only local suppliers of construction materials. The magnitude of this benefit would be much greater to those suppliers in the area of an NEC than to those in the area of a single 4-unit station, but construction of comparable generating capacity at ten dispersed sites would distribute this benefit among suppliers in the ten areas.

The expenditure of wages by semipermanent NEC workers, together with the development of a new community, would sustain a large increase in local income along with secondary employment opportunities over a relatively long period. It is therefore concluded that the benefits of an increase in local area income resulting from construction of a 40-unit NEC would be much greater than those resulting from construction and operation of 4-unit stations at ten dispersed sites.

Current taxation arrangements in most states are such that counties and communities of the local taxing jurisdictions within which a privately owned power plant is located receive the bulk of the increased revenue resulting from construction and operation of the plant. It is assumed that possible ownership arrangements and legal actions would serve to lessen the magnitude of a local tax base increase that could result from the construction and operation of a 40-unit NEC and that the adverse social effects that could arise from a local tax base increase associated with a privately owned 4-unit station might not occur as a result of construction and operation of a 40-unit NEC. At the Kentucky Lake site, a solution to this problem would be easier because the NEC would be built and operated by TVA, who would make payments in lieu of taxes.

4. A SITE SELECTION METHODOLOGY

The purpose of the power plant siting method used in the NEC surrogate site was, in its broader scope, to find a reasonable hypothetical area for study and to devise a method of finding a suitable site on the basis of certain criteria. A 1500-sq-mile area in Tennessee was selected that met coarse screening criteria on seismic activity, remoteness from projected major population centers, and adequacy of cooling water and that would not encroach on reserved land (national parks, historic monuments, etc.). Within the surrogate area, a 75-sq-mile surrogate site was arbitrarily selected to accommodate a 40-reactor NEC.

The purpose of the analysis after location of the surrogate area was to determine the relative suitability of the 75-sq-mile blocks within it. The purpose of the methodology was not to compare the suitability of one surrogate area in one part of the country with a different area in a different part of the country. To facilitate the analysis, a cell size of 170 acres was used. This size was selected because it is approximately the size of the Hartsville quad unit. The four reactor clusters of the configuration of the power plant complex planned for Hartsville, Tennessee, served as the building block of the NEC.

The NEC surrogate site identification methodology used two sets of weighting factors. The first set identified the relative importance of one data variable to another in making a siting decision. The importance weights took values of one to five, where one was least important and five was most important. The second set of weights examined the compatibility of a specific data category (e.g., 2% slope) of a variable (e.g., slope) with the NEC technology. The compatibility scores took values of +2 to -2, where +2 was the most compatible and -2 was least compatible. A value of -3 indicated either an extreme incompatibility or exclusion (if a cell consisted of water). After the data category for each variable was determined for each cell in the surrogate area, suitability was determined by means of a suitability index, which synthesized the importance and compatibility values. It must be noted that the importance and compatibility values used in the Kentucky Lake

area were for demonstration purposes. They represent a consensus of one group of analysts. However, the method was designed to accept varying sets of weights to reflect different value judgments.

The variables used in the analysis are provided in Table 4. Each was displayed by a computer-mapping routine that used a line-printing-over-printing technique, which has the capability of outputting single-variable or multi-variable index values in twenty shades of grey.

Table 4. Variables included in Kentucky Lake surrogate area analysis

Elevation	Slope (primary)
Engineering geology	Slope (secondary)
Land use (primary)	Soils
Land use (secondary)	Transmission lines
Land use (tertiary)	Proximity to population
Ownership (public)	Proximity to railroads
Population density	Proximity to recreation
Proposed development	Proximity to light-duty roadways
Railroads	Proximity to medium-duty roadways
Roadways	Proximity to transmission lines
Seismicity	Proximity to water

The result of the process was a general description of the area based on the variables (or each separate variable) as well as an indication of the suitability of each cell to support an NEC. Although almost all the variables are physical, some are more susceptible to change than others. Those that are not easily alterable — elevation, slope, soils, and engineering geology — place the area in neither a highly positive nor negative situation. Over a third of the cells are within 100 ft of the water surface, and flooding does not appear to be a problem. Although a consideration of slope at the 170-acre-cell level must be treated cautiously, over 60% of the area has a slope of greater than 16%, making it less than desirable for normal construction. Also, over 60% of the area is composed of fairly shallow residual soils, which were given a compatibility value of 0. Below the soil is bedrock composed mostly of carbonate rock that is flat-lying or domed. Although this would

probably not present serious problems, the bedrock is not of an optimal composition for siting an NEC.

There are other variables that allow more freedom in the location of reactors. For example, with two large sources of water in the surrogate area, physical access to an available supply should not present a difficult problem. In the surrogate area, 67% of all cells are within about 6 miles of at least one of the water sources. Although the existing land use in the region permits a relatively high degree of latitude, the current status relates more to land cover than use. Ten percent of the area is occupied by water, with the remaining 90% in forest and agriculture. Access to the Kentucky Lake area is favorable for siting. A heavy-duty road extends across the area from east to west, and lower-grade roads are dispersed throughout. Also, a railroad travels the width of the area. These facilities serve minor population centers, but virtually no area contains a population density of greater than 100 people/sq mile. None of these centers is likely to attain populations of 10,000 or more by 1990 although some industrial development has been proposed for some sections of the study area.

Finally, one variable that was taken into account allows freedom in siting in the area, but is also constraining. Public ownership of land was a positive factor for the Fort Campbell Military Reservation; however, it was weighted negatively for areas such as wildlife reserves and recreation areas.

When the variables were fed into the cell suitability index, the base map in Fig. 1 resulted. The range of cell scores was divided into eight levels, allowing the appearance of clusters of high- and low-scoring areas. A manually drawn overlay was produced which showed water areas, high-scoring clusters, the approximate location of the quads analyzed in Vol. III (solid circles), and an example of how new quads might be sited (triangles). Actually, the irregularly shaped outlines are the result of a quick visual analysis. When all square blocks of 225 cells were ranked, an area overlapping the one outlined in the northeast corner of the surrogate area was shown to be best (on the basis of the criterion used).

This comparison must be treated cautiously. Many aspects must be taken into account before it is stated with certainty that one site is better than another. In fact, it is essential that the analyst remain cognizant of the scope and limitations of the results of the entire analysis. The method used is not a complete analysis. It operates on a limited set of variables and therefore serves as an "intermediate screening." Its purpose is to indicate which sites within the surrogate area may be worthy of further study. This, in turn, is dependent upon the changeable importance and compatibility values imposed on the data. The analyst should not be deceived by the groupings selected for the shades of grey in the plot. In Fig. 1, intervals of 0.2 for less suitable scores and intervals of 0.1 for more suitable scores were used. However, it is possible to visually emphasize any degree of suitability.

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