20 A NUCLEAR ENERGY CENTERS-A NATIONAL SURVEY

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It is a pleasure to be here again and to participate in the Waste Management '75 Symposium. Long term radioactive waste management is still a very "hot" issue in this country. (If I may be forgiven.) Not surprizingly, therefore, it is an important subject for consideration in new studies that are aimed at helping to define the future structure of the nuclear industry.

In this regard, I am privileged to be here today to talk with you about a very new study -- one being undertaken by the Nuclear Regulatory Commission at the mandate of Congress -- and in my new job as Director of the Office of Special Studies. It deals with the feasibility and practicality of nuclear energy centers. Staff responsibility for this study lies with the Office of Special Studies. I would like to discuss our approach in tackling this very difficult assignment -- one in which we are seeking input from a broad spectrum of government and the public.

I would also like to note that this effort is one of three studies, being carried out by our office, that are strongly tied together. The other two studies are safeguards oriented; i.e., protection of strategic SNM (plutonium and high enriched uranium) at fixed sites and in transit from diversion and protection of the plants and transport vehicles themselves from sabotage.

Section 207 of the new Energy Reorganization Act, Public Law 93-438, enacted October 11, 1974, is not very long; however, as you will note, much staff work is explicitly called for and a lot more implied. I would like to read Section 207 to you.

NUCLEAR ENERGY CENTER SITE SURVEY

42 USC 5847.

SEC. 207. (a)(1) The Commission is authorized and directed to make or cause to be made under its direction, a national survey, which shall include consideration of each of the existing or future electric reliability regions, or other appropriate regional areas, to locate and identify possible nuclear energy center sites. This survey shall be conducted in cooperation with other interested Federal, State, and local agencies, and the views of interested persons, including electric utilities, citizens' groups, and others, shall be solicited and considered.

Federal-State-local cooperation. Solicitation of views. Definition.

(2) For purposes of this section, the term "nuclear energy center site" means any site, including a site not restricted to land, large enough to support utility operations or other elements of the total nuclear fuel cycle, or both including, if appropriate, nuclear fuel reprocessing facilities, nuclear fuel fabrication plants, retrievable nuclear waste storage facilities, and unranium enrichment facilities.

(3) The survey shall include—

(a) a regional evaluation of natural resources, including land, air, and water resources, available for use in connection with nuclear energy center sites; estimates of future electric power requirements that can be served by each nuclear energy center site; an assessment of the economic impact of each nuclear energy site; and consideration of any other relevant factors, including but not limited to population distribution, proximity to electric load centers and to other elements of the fuel cycle, transmission line rights-of-way, and the availability of other fuel resources;

(b) an evaluation of the environmental impact likely to result from construction and operation of such nuclear energy centers, including an evaluation whether such nuclear energy centers will result in greater or lesser environmental impact than separate siting of the reactors and/or fuel cycle facilities; and

(c) consideration of the use of federally owned property and other property designated for public use, but excluding national parks, national forests, national wilderness areas, and national historic monuments.

Report to Congress and Council on Environmental Quality; public availability.

(4) A report of the results of the survey shall be published and transmitted to the Congress and the Council on Environmental Quality not later than one year from the date of the enactment of this Act and shall be made available to the public, and shall be updated from time to time thereafter as the Commission, in its discretion, deems advisable. The report shall include the Commission's evaluation of the results of the survey and any conclusions and recommendations, including recommendations for legislation, which the Commission may have concerning the feasibility and practicality of locating nuclear power reactors and/or other elements of the nuclear fuel cycle on nuclear energy center sites. The Commission is authorized to adopt policies which will encourage the location of nuclear power reactors and related fuel cycle facilities on nuclear energy center sites insofar as practicable.

Thus, we are required to accomplish much in a few short months with the due date for the report to Congress and the Council on Environmental Quality being October 11, 1975. It is also anticipated that, if nuclear energy centers prove feasible and practical, substantial follow on effort will be required in 1976 and perhaps beyond.

We are defining "feasible" as meaning technical feasibility -- referring to those technical aspects that are important to the siting and economic operation of the nuclear energy center, including the availability of resources. "Practicality" refers to the practical aspects of implementation -- addressing problems associated with our institutions, methods of financing and operating, social and political costs and benefits, national security, and with the safeguarding of strategic special nuclear material.

The important point to keep in mind in what has already been said and what is still to be said is that we are doing a comparative study -- comparing centers with the present strategy of dispersed locations for nuclear facilities. Thus, all of our analyses will be directed at the "delta" and not at the pros and cons of nuclear power or even the level of electric power in the United States when centers might exist. In this regard, I do think we have a responsibility to make *reasonable* projections for the growth rate of electric power during the period of interest to our study. This is not a very easy job if you have been following the wide range of results coming out presenting projections by

the government, industry, and private groups. Our tentative decision is to use Case A of WASH-1139 (1974) for nuclear power levels into the year 2000.

Other ground rules and criteria will have to be set and the reasoning behind these judgments must be understandable to the reading audience -- the Congress and the public. Some examples (in addition to the assumed growth rate of electric power) include: a) ALAP assumptions for boundary dose level and limits of radioactive releases, b) restrictions on water and land availability, c) specific site screening criteria, d) tax and rate bases, e) assumptions with regard to the continuance of certain laws and regulations, f) assumptions with regard to some public attitudes, and g) assumptions with regard to HTGR and breeder technology and growth.

NECSS-75 - WHAT IT WILL COVER

The October 11, 1975 report (NECSS-75) will really have three main objectives with regard to nuclear energy centers -- to evaluate the technical feasibility of such centers, to examine the practical aspects of implementation, and to perform the national site survey.

Feasibility of NEC's - Arriving at a judgment regarding the technical feasibility of NEC's will mainly require an evaluation of: transmission needs

and technology, heat dissipation, radiological releases, emergency response and accident recovery, ecological effects, and waste management. (Resource requirements (land and water) are also part of the judgment regarding feasibility, and these aspects are described under the site survey.

Of primary importance regarding the determination of feasibility will be efforts to develop siting criteria for NEC's as compared to dispersed sites and the methodology that will permit a weighting of the various technical factors that are significant regarding the comparison of dispersed sites vs. NEC's. It is anticipated that conclusions will be reached in most of the areas involving technical feasibility, although minor follow on effort may be required.

Practicality of NEC's - The issues, constraints, possible courses of action, with respect to the practical aspects of implementation will all be clearly identified and fully discussed in NECSS-75. Recommendations will be provided as appropriate; however, it is expected that on many subjects significant public debate will be encouraged by our analyses and final recommendations and decision will have to await the additional effort that will undoubtedly follow the debate.

Site Survey - A national site survey will be conducted to identify potential land areas for the location of NEC's. A coarse-screening effort will be performed to satisfy the Congressional mandate for NECSS-75 regarding a national site survey.

To perform this screening, information must be developed regarding power needs and water and land resources available for use. Expertise within NRC and other Government agencies will be used to project nuclear fuel cycle needs and electrical power needs and to identify other fuel resources. Extensive use will be made of the results of other site surveys, with the primary effort aimed at identifying and evaluating existing data through the year 2000 and preparing the data in a format suitable for NECSS-75. The site survey will basically consider land and water availability (already noted), population density and seismic criteria, and the general location of load centers and power transmission corridors. There will be some coarse screening - environmental and hydrological; furthermore, federal lands that are available for use and that meet the coarse screening criteria will be identified.

WHAT ARE NUCLEAR ENERGY CENTERS?

Our frame of reference for nuclear energy centers is a concentration of nuclear power plants or nuclear fuel cycle facilities or both on a single site where the number of facilities so located is substantially greater than for any present arrangement. The first reactor at such a

site could commence operation in about 1986 if it becomes national policy within the next year or so to encourage or require such colocation.

A thumbnail description of the nuclear energy center models to be evaluated in the Nuclear Energy Center Site Survey (NECSS-75) follows, together with a few notes about some of the physical factors; technical problems areas of transmission, heat dissipation, and water; investment costs; the construction and operating labor forces involved in nuclear energy centers, and waste management.

"Power Only" NEC's - A "Power Only" nuclear energy center consists of either 10 or 40 reactors generating 1200 MWe each (12,000 - 48,000 MWe). A 10 reactor model was chosen as the lower limit for power only centers because it represents a substantial size increase over the 4 reactor stations presently in the licensing process. An upper limit of 40 reactors or 48,000 MWe appeared to represent the largest feasible unit, considering electric demand, and other technical considerations. The 48,000 MWe represents a block of capacity that is about twice that available to the metropolitan New York area.

Although the basic comparative analyses will largely focus on the present generation of light water-cooled reactors (LWR's), the HTGR and LMFBR will also be considered. Here, emphasis will be on any gross differences brought about by the introduction of these other types of reactors into the nuclear energy center.

"Fuel Cycle Only" NEC - To promote the safeguarding of plutonium, co-location of fuel reprocessing and mixed oxide fuel fabrication facilities will be evaluated. Two levels of aggregation of facilities will be defined: a single fuel reprocessing plant capable of servicing 50 - 100 reactors with matching mixed oxide fuel fabrication facility, and a regional integrated fuel cycle facility (IFCF) capable of servicing up to 300 reactors, and consisting of perhaps three reprocessing plants and three to six mixed oxide fuel fabrication plants. The site would also accommodate temporary* retrievable radioactive waste storage facilities.

For a projected installed domestic nuclear power base of 850,000 MWe by 2000, three to four regional integrated fuel cycle facilities would be adequate to service the domestic requirements.

Mixed Power and Fuel Cycle Parks - An additional level of aggregation of nuclear facilities is represented by the case in which fuel cycle facilities are located on the same site as reactors. Two models will be evaluated, one in which the reactors can be fueled with either uranium or plutonium fuel, the other in which the reactors would be fueled normally only by plutonium fuel. These "mixed" models are designed to evaluate the effects of minimizing the shipment of plutonium by locating plutonium recovery and fabrication facilities on the reactor site at which the plutonium would be used.

* For a period of decades.

Physical Factors - The land area for centers will be large, on the order of 60 - 75 square miles for the largest combined site. This estimate is closely related to yet undetermined limits of heat dissipation intensity. The regional integrated fuel cycle facility might require from 8 - 25 square miles if it were constructed separately. The land requirements for electrical transmission will very with location. For a 40 reactor center located 75 - 100 miles from an array of electric demand centers, the transmission land requirements might be as large as 250 square miles using conventional transmission concepts, down to perhaps 150 square miles using advanced concepts.

Transmission - The aggregation of generating facilities into a limited number of centers will increase the investment and right-of-way requirements significantly over those required for dispersed sites. This comes about because of the need to ensure system reliability in addition to technical factors for energy delivery. Advanced transmission technology will have some benefits. Fundamentally, the use of centers, nuclear or fossil, can be expected to intensify transmission problems including stability, long-range planning, rates, right-of-way acquisitions, and environmental considerations.

Heat Dissipation - The amount and concentration of heat from nuclear energy centers can be expected to raise environmental problems including questions involving weather modification, e.g., increased rainfall and local cloudiness, even severe turbulence.

Water - The availability of water is critical to operation of economically feasible generating facilities using conventional technology. If water is not plentifully available, and dry cooling systems are needed, heavy economic penalties can be expected. Therefore, it appears that access to water of sufficient quantity is essential (a 40 unit center would consume water at about twice the consumptive rate of the city of Chicago). It is not clear that, with exception of limited areas near major water sources, quantities of this sort can be developed without extensive impoundments and institutional conflicts. This limits siting flexibility and may force siting locations of diminishing economic attractiveness, principally because of additional transmission. Dispersed reactor siting is much more attractive from a water availability standpoint, because of point demand requirements which are more readily related to local stream capacity.

Financial - Estimates drawn from current studies indicate that the following are approximate capital requirements for centers.

	Capital ($ in billions)
Reactors Only - 10 units	8 - 10
Reactors Only - 40 units	35 - 40
Regional IFCF	4 - 5
Largest Combined Reactor plus Fuel Cycle	38 - 43

It is too early to determine if substantive differences between centers and dispersed siting exist. At this writing, differences would not be expected to exceed 15%.

Construction and Operating Labor Force - Construction of large industrial projects in remote, low population areas can cause major impacts on the native population and social resources. To construct a power only NEC can require a peak construction labor force of 5000 - 10,000 people, depending on the construction rate. Since a 40 reactor site may take as long as 25 - 30 years to complete, this will result in developing a quasi-dedicated construction force. Hence, some of the problems of trailer camp living, impact on schools and hospitals may be reduced compared with conventional construction projects of short (3 - 5 years) duration.

Operating manpower for the 40 reactor site could reach 3000 people for the reactors alone when the site was filled.

The presence of a large, stable construction force and a several thousand person operating force could result in the development of a "new town" of 20 - 50,000 people. If one assumes that the nuclear energy center is dedicated to power production in perpetuity, with new units replacing ones taken off line, then the new town will have a long-term, stable employment. Work force and town size might also be increased by the location of other related operations on or off-site.

The regional integrated fuel cycle facility could require a peak construction force of about 4000 people, and an operating force of 4000 - 5000 people. The predicted growth of the nuclear power industry is such that a regional integrated fuel cycle facility could be completely constructed in about 10 - 15 years. Hence, a more transient construction population might result than would be the case for the large power park, although a fair degree of stability is still indicated.

The impact of a mixed power-fuel cycle facility park is much like that of a power only park, with construction labor peaking at about 5000 - 10,000 people, and operating personnel at 3000 - 5000 people.

It is important to note that, although one can theorize about the community disruptions that may be occasioned by nuclear energy centers, the concentrations of required personnel with their sophisticated capabilities may attract a substantial intellectual community.

WASTE MANAGEMENT

NECSS-75 will assume and evaluate waste treatment and retrievable waste storage facilities at energy centers. These facilities accommodate both high level and other wastes from reprocessing plants as well as transuranium wastes generated during fuel fabrication.

The base case against which all other energy center models will be evaluated is that of dispersed facilities. For this case, we are assuming a single, large retrievable surface storage facility for high level waste and for hulls, similar to what is described in WASH-1539, Management of Commercial High Level and Transuranium Contaminated Waste. We are also assuming a single site, but a different one for treatment and management of transuranic wastes from the rest of the fuel cycle.

For collocated fuel cycle facilities, we are assuming the option of keeping all waste treatment and waste management facilities on site. Here, on a single site, we would be handling the high level and transuranium wastes associated with from 50 to 300 reactors, depending upon the size of the fuel cycle facility center. With such an arrangement, the need to transship waste from both fuel reprocessing and fuel fabrication plants to the National Repository would be eliminated; however, the eventual requirement to transfer wastes to the ultimate disposal site would not be affected.

Another point you may be interested in is that we are assuming Federal ownership of waste for all cases -- even as retrievable storage. This position is consistent with 10 CFR 50 Appendix F.

Finally, I would just like to comment that although we are doing a comparative study and, theoretically at least, the lack of definition of a permanent disposal plan should not be on trial -- the fact of the matter is that until we get a satisfactory solution for permanent disposal -- acceptable by the public -- any study involving radioactive waste management leaves a gap in the public's view.

PRACTICAL ASPECTS OF IMPLEMENTATION

To assess the practicality of nuclear energy centers will require broad thinking and attention to the five broad areas of safeguards, societal questions, jurisdictional and other institutional constraints, economic options, and national security. Thus, we must bring together expertise in economics, law, political science, sociology, nuclear technology, electricity production, transportation and distribution, environmental sciences, State and Federal regulations and legislation, national security, and labor relations. Our purpose is, and therefore our program will need to: a) identify the crucial questions and issues that will constrain the development of NEC's should they be demonstrated to be technically feasible, and b) show alternative solutions which could alleviate these constraints and resolve these issues. Any proposed solution or resolution must, of course, consider both social and monetary costs and benefits.

Safeguards - A major influence in the need to study nuclear energy centers comes from the need to protect strategic special nuclear materials -- plutonium, highly enriched uranium, and U-233.

Much has been written and said on the subject in the past year and a half. Our job will be to determine safeguards requirements for a plutonium, high enriched uranium economy and indeed, to answer the question "Is it worth it?" -- considering both social and monetary costs and benefits.

Societal - The primary emphasis is envisioned to be on subjects such as a) the political ramifications which might be inherent in concentrating large blocks of economic and political power in small areas, b) the role of State and local governments in NEC's and c) how civil liberties might be affected.

Of course, there are other more conventional socioeconomic problems that will arise because of the magnitude of construction, the attraction of labor skills and community support functions (as already noted), and the changes expected in the local fabric of society at the NEC site.

Jurisdictional - Some of the key issues in the jurisdictional area will be the problem of having public, private, Federal, and/or municipal utility interests on a single NEC; rate setting; tax base; the degree of Federal/State participation; free trade; use of Federal lands; and other

regulatory powers of Federal/State/local governments. Considering the above, the major problem will be to determine if one can get from "here to there" assuming nuclear energy centers are shown to be technically feasible.

Typical regional legal requirements and State and local laws that can impact on the development of NEC's must be identified. It is our plan to develop a tabulation of Federal laws which may limit or otherwise constrain NEC's in cooperation with other Federal agencies.

Economic - Two of the key questions in the economic area will be the antitrust issue and the ability to finance NEC's. Lesser issues will be the questions of insurance and indemnity.

Information must be developed to determine construction timing and capital costs for the development of "reactor only" NEC's, to consider the problem of plutonium fungibility, and to determine construction timing models and capital costs for the development of fuel cycle NEC's. NRC and other Federal agency expertise will be used to develop information on antitrust and on insurance and indemnity.

National Security - The key issues in this area will be consideration of the various occurrences or actions that could threaten national security (natural disasters, enemy attack, and/or sabotage) and the consequences of such action (radiological releases and/or loss of electricity reliability or stability for long periods of time).

Information will be developed regarding the potential radiological effects and the potential impact on electric reliability and stability, assuming that NEC's may be a target for enemy attack or sabotage or may be operationally affected by natural disasters. This information will be required so that a realistic evaluation of national security may be performed, comparing an NEC to dispersed siting.

CONCLUSION

We have recently placed our detailed Scopes of Work for the Nuclear Energy Center Site Survey in the Public Document Room and there is a Federal Register notice addressed to this point. We are also sending several hundred copies of the Scopes to a long mailing list covering a broad spectrum of public opinion. Most of the technical support work for the project is being done at the National Laboratories. The problems associated with the practical aspects of implementation are being attacked through workshops, use of expert consultants, contracted studies on specific aspects, public meetings, and through solicitation of opinions and input from key groups and individuals by members of our staff. (As well as through Federal Register notices requesting such input.) We are working closely with other Federal organizations to obtain information through staff members from their agencies assigned to our Study.

We recognize the great responsibility associated with the task we are tackling and we see clearly and respectfully the need to do a good job. We realize also that we have an opportunity to perform an important service for our country at a time when performing such a service could be of critical importance.