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FINAL DRAFT REPORT

ON

ORGANIZING FOR NUCLEAR
POWER FACILITY DEVELOPMENT

REPORT PREPARED

BY

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ORGANIZING FOR NUCLEAR POWER FACILITY DEVELOPMENT

I. INTRODUCTION

It should be noted, at the outset, that centralized power development concepts have been of interest for some years and have been given considerable study in the past, e.g., the Congressionally-directed 1975 NRC studies. In general, while all such studies have concluded that such Centers did offer potential benefits and were feasible, in the mid-1970's, when most of these studies were done, the advantages did not appear to make use of Energy Centers on balance, preferable to continued conventional or dispersed siting.

The DOE recognized that more recent circumstances, particularly the TMI accident, and the new imperatives which have been defined since that event for the proper conduct of the nuclear power "enterprise" may well have changed that balance. Centralized siting may today offer important benefits, but clearly those benefits can only be realized if the Center is effectively organized and if the institutional problems of organization (i.e., financial, political and jurisdictional) can be dealt with. Thus, by DOE Contract #31-109-38-5593, dated March 18, 1980, the Department of Energy asked The S.M. Stoller Corporation (SMSC) to outline the institutional factors and the organizational considerations to be taken into account in the establishment of nuclear power energy centers in the United States.

The key component of any such Center was considered to be the capability of housing a substantial (perhaps 10-20 units) nuclear power capability, with supporting services, and satellite nuclear power and other energy-related activities, as appropriate. The assignment was not focused on any particular site. However, in order to carry it out, particularly to provide some basis for considering benefits in dollar terms, clearly some conceptual model had to be constructed. For this purpose, it was elected to select a model which,

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in many important respects, resembles the spectrum of activities now present and being contemplated for the Hanford site, albeit the same considerations could be applied to any other sites of suitable characteristics. Hanford as a model has much to commend it. It meets all of the physical characteristics that appear desirable; many of the services and facilities useful for emergency planning now exist at a reasonably substantial level as a result of its historic and important defense role, and it is already being developed to accommodate major nuclear power generating facilities.

There are a number of fundamental issues which must be dealt with in implementing any such Center. The organizational concepts treated in this report are keyed to these, some of which are outlined below by way of introduction.

First, and apart from those activities clearly supportive and organically tied to the Center and its mission (i.e., power production), any existing reservation generally has a number of diverse activities, some of which are clearly only peripheral to an energy center function, but must be considered in the planning. These could include certain defense-related projects, general research laboratories and caretaker activities associated with decommissioned or idle facilities. The sites devoted to such activities are often dispersed throughout the reservation, so that they cannot be separated from an area control standpoint; further, they will require support facilities and services which are also needed by the energy center.

Further, there are other facilities or activities which could be envisioned that would play a supportive role in the operation of an energy center, but which would have other missions independent of it. These could include such things as high and low level waste handling/storage facilities, analytical laboratories, medical research facilities and fuel fabrication or storage facilities.

The planning and control of an energy center embracing such activities must account for the special needs they represent, and the additional demands they place on coordinated action. These demands can range from resource allocations, such as construction labor planning/scheduling to waste discharge

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regulation. As a result, the coordination of existing and new diverse activities into the overall operation of an energy center will cover a spectrum of legal and institutional issues, which must be successfully dealt with.

One such major issue is the role(s) which the Federal Government (DOE) can and should play. Clearly, the development of a major energy center represents the potential for a large concentration of economic and political power, and it could well be perceived that only through the continued oversight of the Federal Government will both regional and local interests be conserved, as well as maximum public protection and benefit be achieved. It is also clear, however, that achieving the fullest benefits which can accrue requires an organization which, beyond having central responsibility and authority for the Center, must be a facilitator and advocate in the Center development. It is not clear that the Government can, without special enabling legislation, assume either of these necessary roles, or would choose to. However, since DOE does own and operate many of the existing facilities on the reservation, including defense related facilities, it will necessarily play a significant role in the operation of an Energy Center.

The Federal reservation may already contain nuclear generating stations owned and operated by private or public utilities under specific leasing and operating agreements as is, in fact, the case at Hanford. These agreements, and possibly even the provisions of the operating license, would require careful review to assure that the eventual covenants, etc. necessary for successful implementation of an Energy Center are not incompatible with the existing agreements or licenses.

In a similar vein, there may, likewise, be existing lease arrangements with the state in which the Center is located, to accommodate state-sponsored activities. The implementation plan would, therefore, require that the State become a direct party to the development of joint commitments necessary for operation of the Center.

There are a number of issues involving the implementation of an Energy Center, which have to do with existing or new institutional arrangements and interests which, while not directly involved in the internal structuring of the Center, will nonetheless have significant impact. These include existing

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union agreements for both construction and maintenance, existing tax agreements with the state and local government, the interaction with utility-planning groups, including intertie arrangements, intrastate coordination with numerous state agencies and, finally, the many questions related to the implications regarding equitable balance of risk and benefit on an interstate or regional basis. These latter factors are highly dependent on the location of the reservation, the historical success of joint undertakings in that area, and the degree to which the concept of an Energy Center is accepted, particularly at the state level.

II. BASIC RATIONALE

The Kemeny Commission's report to the President on TMI identified several areas of needed improvement in the management of civilian nuclear power development, to which development of a Center appears to be especially pertinent:

- Increased safety related control over design and construction by the operating organization;
- Better operating management and operating forces training, with the training to be performed by the organization having operational responsibility;
- The need for more effective emergency planning.

Clearly, a large, stable workforce, including a large pool of well-qualified personnel in all areas of design and construction management, should translate into safe plants of high quality. Further, and perhaps more important, if the design and construction were carried out by the same organization, or at least in close cooperation with the plant operators, that plant design should reflect concern with reliability, which would have positive economic value, as well as operational safety values (i.e., better control of radiation exposure to permanent and transient workers.

Similarly, if training is to be upgraded, perhaps more along the lines of that practiced in commercial aviation (i.e., intensive initial training, proficiency training, qualification and requalification testing and performance

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evaluation), the substantial scale of operations at the Center would permit consideration of a complete onsite training capability. The proximity of training facilities with sophisticated simulation capabilities to the operating plants could help assure coherence and relevance, could expand the opportunities for training, and permit it to be formulated and managed by the organization having operational responsibility.

As regards emergency planning, a large site, assumed to be one with relatively low population density, and the presence of a pool of sophisticated nuclear manpower, should assure the most favorable environment for effective emergency planning.

Finally, one of the strongest incentives for implementation of Centers would be to simplify and reduce the unpredictability of the licensing process. There are important potential licensing benefits in fostering integrated development at particularly suitable locations and, in fact, regulatory reform proposals which were being considered in the Congress several years ago were moving in the direction of "generic" site approval, implying endorsement by both Federal and State authorities. There was also contemplation, relating to the interest in "standardization"; of going another step; "generic" approval of some number of plants of "standard" designs at such approved sites, so that if the proposed plant fits within some technical criteria envelope, the CP could be routinely issued for the site with a minimum of procedural processing. Such generic approval would likely be limited to some finite period, obviously, with provision for adjustment if new data became available. Such a procedure could remove much of the uncertainty as to cost and schedule, which now inhibits utility commitments to nuclear power.

In sum, the last few years have emphasized the uncertainties associated with the undertaking of a nuclear project by a utility. These are already seen so great that only the largest have the resources to make the related financial risks individually tolerable. Many of the committed (and operating) nuclear plants thus represent "Participant" ownership; integrated Center development extends that general approach to financial risk spreading by considering organizational structures which may help to stabilize the nuclear investment picture.

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In fact, as post-Three Mile Island pressures for more extensive utility technical capabilities and support activities grow, it will become more difficult for individual utilities to put powerful site organizations in place to manage only one or two units. (Of the utilities operating nuclear power plants today, about half have only one plant.) Thus, integrated site development may offer the most practical route (perhaps the only practical one in some regions) for siting new nuclear plants.

Beyond the operational and management advantages, there appears to be substantial potential for cost savings in integrated development. The previously mentioned studies indicated that onsite construction cost savings, of on the order of 12%, might be realized in an Energy Center of ten to twenty units. We should hasten to point out that a substantial portion of these savings reflect the use of a single service organization to accomplish design construction, and a single owner operation, and clearly such an organizational approach can result in significant savings, even at dispersed sites. However, there are also other potential savings in nuclear projects unique to integrated siting; i.e., well planned development can buffer nuclear power plant operations against changes in Federal policy with respect to site security, safeguards and emergency planning; can permit optimized decommissioning arrangements; can provide centralized spent fuel storage, and can reduce the cost of transportation of irradiated fuel and radioactive waste.

If a suitable site is found, then the extent to which the conceptual benefits are in fact realized, depends primarily upon the institutional factors, i.e., the organizational structure and the degree of integration intended. Any such organizational development has to be carefully planned and controlled in light of its importance to regional energy supply and the substantial investment of the participating parties. Their investments and operations are linked in critical ways, and their common interests must be carefully managed if cost savings and efficiencies are to be achieved. All participants, public institutions, regulatory bodies, as well as private interests, must be prepared to give up some, and perhaps a substantial, measure of the managerial prerogatives they traditionally exercise, recognizing that the site and its environment are shared resources, as is the good will

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of the State and local community. For example, the positive support of the labor force is critical, and the development of a stable and cooperative labor force requires overall construction scheduling and labor relations activities which maximize the Center's long-range development, rather than the particular short-range interests of a single participant or project. In short, to achieve some of the more important benefits of co-location, it is necessary that the participants think of themselves as partners seeking to share and to maximize the collective benefits, even if these impinge on their separate onsite interests.

It is recognized that the organizational development process can, and likely would be, evolutionary, beginning with simple coordinative and planning steps. Thus, in this study, several levels of integration are described, intended to embrace the spectrum of structures possible in concept and which would have to be tailored to the players and the circumstances which apply in any location.

VII. THE CONCEPTUAL FRAMEWORK

One of the fundamental requirements of a Nuclear Center, as herein conceived, is a large area not committed to other, more highly valued uses and away from areas of high population. Other needed attributes include high geologic stability, substantial available water supply for cooling, consistent with environmental concerns and long-term competitive needs for water resources, and reasonable proximity (from a power transmission standpoint) to a region with base load power growth needs, at least 500 Mw per year, which could be met practicably at the Center.

Clearly, at this scale, the Center could meet a significant portion of the power needs of the Northwest, for example if located at Hanford. Other regions, such as the Southeast, with a possible location being at Savannah River or the Northeast, could benefit from such an approach, although suitable locations are less obvious for the latter.

In order to raise the full range of institutional and other issues, a model has been postulated and is outlined below. It should be noted that, at any single Center it is not likely, nor is it necessary, that all the activities would be undertaken.

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The study Center is assumed to be located at a Federal site, which is generally acceptable for siting of nuclear power plants, fuel facilities, waste storage/handling facilities and related energy-development projects. There is assumed to be an existing municipality in near proximity to the site. The site contains a mix of existing facilities:

- a) One or more nuclear power plants;
- b) Waste/storage/handling facilities for both low and High level waste;
- c) Research or development reactor facilities;
- d) Research or development fuel facilities;
- e) Research laboratories;
- f) Central site support services.

The key constituent is a network of nuclear generating units which builds up with time. The most favorable result - most benefits from the unified operational concept - derive from a Center in the range of 20 generating units installed at full development. This is not a rigid criteria; in general, the question of whether the Energy Center is continuing to provide commensurate benefits is one which can be reexamined from time to time, presumably as facilities are added. In any event, it would appear that a Center's "front end investment" is not large in the context of power reactor investment and, thus, would likely be justified even if development were to be stopped with considerably fewer, e.g., perhaps five or six units installed. However, the benefits of a unified structure (discussed later) do become increasingly important, as the development can be conceived as continuous and proceeding well beyond that kind of "break even" point.

Thus, it has been assumed that the site has sufficient area and water resources available for the eventual siting of ten to twenty additional electric generating plants, as well as for reactor demonstration or prototype facilities. The site development assumes that additional electric generating plants will be constructed on the site, with a new unit in the 1000 to 1200 MW(e)

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class starting construction every two years. Construction time is assumed to be six years; this may be optimistic in today's nuclear climate, but is taken to be feasible within the Center concept. (Indeed, the reduction of the construction schedules with the important cost savings that would produce is one of the principal conceptual benefits of the Center.)

If favorable fuel delivery logistics can be achieved, there is no reason the site could not also house coal-fired generating units, or other energy related (co-generation) projects, which could be attracted to the site in light of the powerful technical manpower base and existing support functions. However, it is not now clear that any such site (including Hanford) is economically the optimum solution for coal, and no fossil fuel development has therefore been assumed.

The Center concept will not, in itself, nor should it, bring an end to dispersed siting. First, there already exists a regime of nuclear generating station sites around the U.S., which represents a substantial dispersion. Second, there are many areas where it would simply not be enough load growth to support a Center of the scale and degree of integration considered here. In other areas, issues of electric system reliability, as well as limitations on financial risk, suggest limits as to the portion of a region's electric generating capacity, which should be located at any one place. In this context, earlier studies generally have considered limiting Center development to 15 to 20 percent of the generating capacity of the electric system into which it is integrated, in light of such considerations. This seems to be a reasonable target value; illustratively, if at a Center in a region having a current installed capacity of 25 GE, and a long-term capacity growth rate of 4%/year, a 1,000 Mw unit were placed in operation in 1985 and additional units were placed in operation every two years, for 30 years, the Center would represent, at any point in time, no more than 17% of the region's capacity. Obviously, the bulk of power system growth over such a period is elsewhere; in this example, over the 30-year period wherein the system would grow by over 52,000 MW, only 13,000 MW of which would be at the Center.

The groups assumed present at the site include DOE personnel, DOE contractors, private and public utilities, other private companies and State

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agencies and their contractors. The site is assumed to be under the jurisdiction and management of DOE, and certain site services are provided by DOE contractors. The present tenants, excluding DOE or its contractors, are on the site under leasing arrangements and, as a part of the lease provisions or under separate arrangements, are utilizing and paying for certain common site services.

Common Site Services

- a) Central receiving/warehousing/storage;
- b) Central medical facilities and services;
- c) Overall site security;
- d) Dosimetry and personnel exposure history;
- e) Site monitoring - meteorological and environmental;
- f) Overall site emergency planning and control;
- g) General services, including road and rail spur maintenance, water/sewerage treatment, central shops, site civil work, etc.

Construction Support Activities

The fact that extensive construction of power plants will be underway for upwards of 30 years makes it practical, in an integrated development approach, to consider substantial investment in permanent facilities, to cut construction field costs and enhance quality control. Such facilities are assumed to include:

- Pipe shop and central fabricating facilities;
- Cement plant;
- Construction warehousing and parts management, and
- Field office and field engineering facilities.

Operational Support Activities

In an integrated development approach there is a potential for group action to importantly strengthen conventional support functions

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and develop additional support activities which would not be practical at the scale of dispersed sites. Clearly one candidate activity is a modern operator training complex. Other candidate centralized support service opportunities include:

- Security;
- Maintenance planning, including control of personnel radiation exposure;
- Environmental management, and
- Medical support.

Research and Development

A major development activity is also assumed, including a large prototype advanced power plant in the 900 to 1000 MW(e) class, and corollary fuel fabrication, reprocessing and recycle development facilities. To lend some focus to the analysis of the financial circumstances, the model assumes this to be an LMFBR.

The people employed for the construction and operations would be under the direct operational control of the Center in an emergency. Earlier studies (NRC, NSF) indicate a peak construction labor force of about 5,000 people, and a power generation related labor force which could grow to about 2,000 people as the complex grows. The undertaking of fuel cycle services and developmental projects could create construction and operating labor forces of several thousand and additional people.

This labor force would, of course, generate a "secondary population", and accommodations may be required for another 30,000 people. It is important that this accommodation be planned so as not unduly to stimulate close-in residential development and thus diminish the emergency response capability. There are a number of tools for assuring continuing relative isolation. The Center can be connected by good rapid transit (rail or monorail) to larger, more distant communities, thereby stimulating the development of accommodations at these locations. In the immediate vicinity of the Center, easements

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can be acquired prohibiting intensive residential or commercial development, but permitting all activities of the type now taking place.

IV. ENERGY CENTER ACTIVITIES

As already identified, the Center has been postulated as a host to a series of individually diverse facilities, with the common thread being that of relevance to the development of U.S. nuclear power capability. Some further identification of the major components is given below.

1. Power Generation Support

The nuclear generation has been taken to be light water reactors.

(a) Spent Fuel Storage

Centralized spent fuel storage facilities, if these continue to be an operational necessity, could serve all the plants at the Center, and perhaps others in the region, beyond the capability it is prudent and economic to provide with each unit. This could minimize individual plant storage facility investment and avoid offsite shipment, and provide a reasonably substantial revenue source, although such revenues are not likely to be manifested until the 1990's.

(b) Low-Level Waste Handling

Centralized low-level waste treatment and onsite disposal facilities could be provided. Because a specific disposal situation could be focused on, and since the facility would serve a multiplicity of plants, a high integrity, integrated treatment and disposal system could be tailored, including use of processes which might not be practical at the scale of individual generating plants. Because no offsite transportation would be involved, one can consider such postulated approaches as making the low-level shipping container the actual disposal capsule.

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Land disposal of activated components could be accommodated on site, thereby avoiding the costs of packaging and shipping such materials and related transportation risks. This could also be particularly useful when one considers the waste disposal implications in plant de-commissioning.

(c) Training and Qualification

A variety of training facilities can be contemplated. Certainly, a reactor training facility could be located on the site for the training of plant operating personnel. The availability of a major computer stimulation capability at the site makes practical sophisticated training programs, including frequent refresher training and systematic evaluation of operational personnel response to unusual and stressful circumstances.

There are other possibilities, such as the qualification of key construction personnel.

(d) Stable Labor Force

To the extent that construction can be scheduled to provide reasonable continuity of employment for critical construction trades, an essentially stable labor force with strong qualifications in nuclear related specialties can be developed. Similarly, if one organization is responsible for engineering and construction management for all units at the Center, it can develop a strong knowledge of the site and benefit from experience developed in the construction and operation of earlier units. This is particularly true if the Center's expansion is achieved by acquiring groups of essentially identical standardized plants.

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(e) Security

Most Federal reservations already have strong security awareness, and in-place security capability. However, the site characteristics and scope of operations could justify a more comprehensive (i.e., real-time on line) computerized security system network as are now available.

(f) Environmental Management

An environmental characterization and qualification group on site can be put in place, and expertise as to the site environment build up substantially with time. The performance of such services with personnel and data continuity among projects, are likely to improve the quality of environmental analysis with benefits in regulatory processes and plant design decision making.

(g) Medical Support

Apart from the kinds of permanent capabilities for the performance of routine industrial medical services which exist at all Federal reservations, substantial capability for emergency treatment of radiation related medical emergencies can be provided.

(h) Centralized Maintenance Planning

The ability to shift maintenance personnel as needed, e.g., refueling, and the concomitant ability to support extensive machine shop, spare parts management, etc. could provide substantial availability factor improvement as well as direct cost savings. Control of and access to a stable, large maintenance force should enable radiation exposure control systems, consistent with ALARA intent.

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2. Construction Support Operations

The fact that extensive construction is anticipated for upwards of thirty years makes it practical to consider essentially permanent investment in what would otherwise be considered temporary construction facilities. These would include:

- (a) Pipe shop and other central fabricating facilities, cement plant, etc.;
- (b) Construction warehousing and parts management;
- (c) Field office and field engineering facilities.

The prospects of enhancing shop-type assembly and fabrication, particularly for some standardized units, can produce significant capital savings, as has long been sought in other vehicles (i.e., off-shore power systems).

3. Other Major Developmental Facilities

The Center could particularly benefit from the development and implementation of power generation related R&D projects, including demonstration reactors. The immediate advantages would include:

- (a) Major construction forces and facilities already in place, and a large pool of technical nuclear specialists already in place;
- (b) Co-location of the prototype plant with a major group of conventional nuclear plants such that operation of the former plant for its developmental purposes can be assimilated into the electrical system without unduly disrupting energy dispatch;
- (c) Permit demo plant operation by an organization engaged in day-to-day utility operations and, thereby, assist the prototype project's development along lines which are highly compatible with the realities of utility service;

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- (d) The presumed prior involvement at the Center of a number of public and private utilities could provide a ready mechanism for their shared involvement in the financing of a portion of the costs of the prototype project. Also, there are possibilities for some revenues from the power production, i.e., R&D funds, to be allocated to help defray some of the costs of the prototype project (see later discussion).
- (e) For an LMFBF type of plant, the availability onsite of a major source of irradiated fuel and the potential for the co-location of reprocessing and refabrication facilities at the Center, so that a complete plutonium fuel cycle can be established within the Center, could provide programmatic as well as substantial proliferation resistance benefits.

4. Integrated Nuclear Fuel Cycle Activities

Although the National Waste Terminal Storage Program has not advanced to the point where the geology under a candidate Center could today be determined to be suitable for the permanent disposal of solidified wastes or fuel elements, there is reason to believe that a variety of geologic formations will be found suitable. Where site conditions seem to be appropriate, Center planning could go forward on a basis which will preserve the option of permanent disposal at the Center, with or without reprocessing.

One of the most significant aspects of the Center may well be this ability to "buffer" the electric generating investment against uncertainties in the "back end" of the nuclear fuel cycle. As already suggested, it is recognized that delays in the placing of a National permanent waste repository in operation may well exhaust the capability of power plant fuel storage pools. The existence of a substantial, and readily expandable, AFR at the Center, to which fuel can be delivered without offsite shipment, may well be an important advantage.

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After a substantial amount of fuel has been stored at the Center, there will be a significant incentive to deal with this material on site, if practicable. Thus, when and if the current national policy is changed and plutonium recovered from irradiated fuel, the Center, with its large inventory of fuel, could strongly contend as the site for reprocessing and refabrication facilities. Depending upon the Center's location (e.g., Hanford), such an operation might quite readily, from a shipping logistics point of view, lend itself to such recycle activities being "internationalized".

5. Cost Considerations

Although cost savings are an important aspect of the Center concept, many are not readily quantified and, in any event, such estimating was beyond the scope of this study. The NRC's 1975 Energy Center Site Survey estimated that onsite construction cost savings, on the order of 12%, might be realized by an energy center of ten to twenty units. It seems almost beyond question that the 1975 estimate is an understatement, in view of events in the years since that study was completed; much depends again on how the Center is structured and managed.

In a strongly integrated Center, there appear to be numerous managerial benefits available, and related savings. There are obvious construction management and quality control benefits, generally in the clear and evident benefits of coherent engineering and construction management, quality assurance, maintenance and operation of all the power generation projects. A recent study of utilities having a scale approximating that of the Center, and using a captive organization for design, engineering and operation, for example, indicated that such arrangements produced improvements in the availability of generating units of approximately 5%, improvements in fuel efficiency of 4% (through better heat rates) and reductions in production and maintenance expense (excluding fuel) of about 30%. These savings were achieved at what would be considered dispersed sites. Although many factors are involved, the results are indicative of the impact of continuity of management. Such benefits should be maximized when the organization is functioning at a single location.

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Perhaps more important to the national interest, participation in Centers may be the only way some utilities can practicably proceed if they are to continue to add nuclear capacity. The obvious cost-related incentive is the relative cost savings over alternative fuels, particularly in oil-burning regions, as nuclear can be substituted and oil consumption backed out. An important contribution, both as a direct savings and as to limiting the risk, could come from the streamlining of the regulatory process a Center may achieve, if some of the formerly proposed "reforms" could be legislatively enacted. For example, the site could be approved in a single initial proceeding as the location for up to ten nuclear plants of standardized design, with such site approval to remain effective for some period (15 years), and subsequent site review in connection with the licensing of individual plants could be limited only to matters not considered in the original proceeding, and to new information becoming available after the original proceeding.

The example of regulatory treatment described is derived from nuclear regulatory reform proposals developed prior to the Three Mile Island accident. Clearly that accident raised a whole set of new safety-related concerns not yet promulgated into criteria, and which clearly have (and deserve) priority attention. Thus, any quick general implementation of regulatory changes along these lines in the foreseeable future is unlikely; it is still possible that such an approach can be applied to Centers, recognizing their special character.

6. Factors Aimed at Maximizing Attainment of Center Benefits

As already noted, the attainment of the identified benefits is not inherent in the Center concept. The Center approach is, for the most part, simply strong facilitating. Center development has to be carefully planned and controlled, in light of the importance of the Center to regional energy supply and the substantial investment of the participating parties. Their investments and operations are linked in critical ways, and their common interests must be carefully managed. Continuity of design and construction teams and some degree of plant standardization is needed if cost savings and efficiencies are to be achieved.

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Many of the benefits of co-location require that day-to-day management operations at the site be performed as though all the plants were under one ownership. Training, power dispatch and scheduling of maintenance and refueling are examples of activities which must be undertaken in a coordinated fashion.

Real "one company" type management of the Center's power generation activities can only be attained when there is an underlying economic relationship which causes the participants to think of themselves as mutual owners of the Center, and seek to maximize its value rather than their separate utility interests.

Cooperative or joint action arrangements are also possible, but strongly rely on integrative bargaining among the parties to obtain needed cooperation. This can be an uncertain process.

Finally, one can let individual companies work out individual or joint financing arrangements among themselves. This process makes it unlikely that there will be continuity of management, engineering, construction and operations. The Center would, for most purposes, simply function as though a group of dispersed sites adjacent to each other.

Approaches involving all three levels of integration are outlined in the pages which follow.

V. ORGANIZATIONAL FORMS

There are obviously a large number of specific organizational arrangements which are possible. For purposes of discussion, and to provide some perspective, four "generic" possibilities, in order of increasing organizational integration are outlined below. There are, necessarily, overlaps among them.

1. Industrial Park
2. Joint Action Agency
3. Energy Center Management Corp.
4. Federally chartered Regional Energy Center Corp.

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1. The Industrial Park Concept

The minimum Center organization would involve the establishment of a private corporation, or a public authority, which could either be municipal or state, which would function much like an industrial park developer.* Such an organization could hold title to the Center's land, or hold a long-term lease. Its function could include:

- Site development planning;
- Financing, construction and management of general site improvements, such as roads, water supply, sanitary waste treatment facilities, etc.;
- Lease or sale of land for the construction of power plants by public and private utilities;
- Attraction of industry to the Center, to provide support services activities. Lease or sale of land for these purposes.

(a) Management and Coordination

The "Industrial Park" Corporation would be managed by a Board, which would include representatives of the utilities and industrial organizations using the site. Representatives of the host state, and the Federal Government, might be non-voting directors. Alternatively, if a Public Authority were created, its directors would be appointed by state or municipal government, and may well have to reside within the state or municipality.

* DOE is a candidate for that role, and the Area office may, in fact, see itself in that role (see later discussion), but a state or other local organization is probably preferable to derive the Center benefits for the reasons cited in the material that follows.

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The Corporation would develop land use plans and regulations, to assure the continued compatibility of the various Center activities. It would enforce such controls through covenants in deeds and restrictive provisions in leases. Such restrictions would include limits on the normal radioactivity and pollutant releases of individual tenants, and the allocation of available water resources.

The Corporation would not be strongly involved in power generation facility planning. The utility or utility group interested in constructing a power plant would have the basic responsibility for planning, financing, constructing and operating their project, and coordinating it with regional power planning bodies and other onsite groups.

(b) Financing

The Corporation would require initial funding from some source, to commence operations, make its initial investments and sustain it until revenues are sufficient to meet its expenses. The utilities of the region might well have to initially advance monies for this purpose, or the Corporation might issue initial securities for these purposes, backed by a guarantee from the utilities. A Public Authority could have such initial funds appropriated to it; e.g., "first instance" appropriations made by New York State to ASDA.

As soon as the Corporation's leases and sales develop, it would become financially self-sufficient. The charges levied by the Corporation could be calculated to provide income over and above that needed to cover its expenses and amortize its debts. The directors could allocate these funds to further site improvements, or to participation in joint ventures with industry in support services, or to support of research, or other purposes.

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Utilities at the Center would finance their power generation facilities independent of the Energy Center Corporation or Authority. Illustratively, a public utility could independently finance an entire plant, issuing its own tax-exempt* securities for that purpose.

Alternatively, it could issue such tax-exempt securities in sufficient amount to finance a portion of a generating plant proportional to its capacity addition needs, using a tenancy-in-common arrangement with other public and private utilities. Under this arrangement, the utility would bear its share of the operating expenses, and management of the plant would be overseen by a committee of the owners.

* Tax-exempt financing, as the term is used throughout this discussion, means debt obligations of a state or political subdivision thereof, the interest on which is exempt under Section 103 of the Internal Revenue Code from Federal income tax imposed on the holder of the bonds. Under state or local law, such securities may additionally be exempt of state and local income taxes on the interest income of holders. Such financing is fully available to public agencies in the financing of their projects.

A potential problem arises, however, when the funds or properties acquired with the funds are used directly or indirectly in the trade or business of a private person. Such bonds are in general not tax-exempt. Specific regulations limit the issuance of tax-exempt bonds for industrial development or power generation ventures which involve private companies. (Pollution control facility financing is an exception.) An important objective of the institutional studies is, therefore, the protection of the tax-exempt status of the bonds issued by the public utilities, and full use of the special tax-exempt financing opportunities available to the private utilities and industrial companies participating in center development.

The financial benefits can be substantial. For the ability to avoid Federal income tax on interest income, bond purchasers in high marginal tax brackets are willing to accept a substantially lower interest rate. Illustratively, under current market conditions, and for equivalently rated securities, there is a difference of about 3% between taxable and tax-exempt interest rates.

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Finally, the public utility could participate in a "joint action agency" financed plant. In this approach the participants agree to:

- Purchase the output of the plant to the full extent of their needs;
- Pay for such power and energy at a rate which will meet project debt service and operating expenses on a take-or-pay basis (rate to be paid even if no power is actually provided);
- Assume the obligations of any defaulting participants;
- Charge rates to customers as necessary to meet the foregoing obligations.

In light of such commitments, the joint action agency would issue its own tax-exempt bonds to fund the project. Although participants in "joint action agency" projects are generally exempt persons, non-exempt participation to the extent of 25% of the project's output is permitted under the IRS Code. This approach, which has been used by WPPSS, is detailed in a later discussion.

The private utilities would similarly have a variety of financing mechanisms. A utility could independently finance a plant using internally generated capital, and the proceeds of new stock and bond issues. These securities would be "general obligations" of the Corporation and the new facilities would be added to the property under the bond indenture which secures the private utilities bonds. Certain bond indentures require that the Company hold title to the lands underlying its plant. This may inhibit Center development by certain private utilities if the Center cannot convey title to the land. This might be the case if Federal land were involved.

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The private generating company thus has financing features similar to a Joint Action Agency. The generating company approach has a number of potential advantages to the consumer, principally the reduction in capital carrying costs if high debt financing can be used. It also raises a number of important issues which block its adoption.

- The generating company would be a bulk power producer and, as such, would be subject to the regulation of the Federal Energy Regulatory Agency, rather than State Public Service Commissions. States of the region may well resist this transfer of regulatory jurisdiction over a major portion of the activities of the utilities they now regulate to the Federal Government.
- The creation of a generating company would subject the sponsoring companies to the risk of regulation under the Public Utility Holding Company Act of 1935. The companies holding the stock would either have to register as holding companies, or seek an exemption from the SEC. Registration as a holding company brings with it some risk of divestiture in the case of integrated utilities having both gas and electric operations.

The generating company could secure tax-exempt financing for the portions of its utility plant qualifying as pollution control facilities through revenue bond issuances by a qualified agency of the host state. The issuer might, in fact, be the Energy Center Corporation if it were an agency of the state or municipal subdivision authorized to do so. Pollution control facilities in connection with support and nuclear fuel cycle facilities developed by private organizations could similarly be financed on a tax-exempt basis in this way.

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As indicated above, the private utility could alternatively enter into a tenancy-in-common arrangement, under which it would own a portion of a plant. The other participants in the project could be either public or private utilities. The Company's bond indenture would reach its property interest and there may again be problems if title to underlying lands cannot be conveyed. Up to 25% of the power generated by the publicly-owned portion of the plant could also be sold to private utilities. Management would be by a committee of the owners.

Finally, private utilities seeking to develop a project at the Center could form a "generating company". In such a concept, each participant in a particular plant would make an equity investment in the generating company equivalent to 20 to 30% of the capital cost of the portion of the plant's capacity it sought to acquire. The degree of participation could be varied from project to project. The generating company would raise the remainder of the funds required for construction by issuing its own bonds. These bonds could be sold in light of the sponsor's commitment to:

- Purchase the output of the plant;
- Pay for such power and energy at a rate which will meet project debt service and expenses;
- Make payment on a take or pay basis (rate is to be paid even if no power is actually provided).

NOTE: The latter two provisions require regulatory arrangements which permit the private utilities to pass such costs along to consumers, much as fuel adjustments are handled.

- Should a participant default on its obligations, the other participants are jointly and severally obligated to assume those obligations.

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(c) Assessment

The Industrial Park approach would put a Center into operation in relatively simple fashion, and provide some planning and coordination of activities at the Center. It is doubtful, however, whether it could effectuate the degree of coordination, cooperation and joint action necessary to realize significant benefits. Among other things, since it is not involved in engineering, construction and operation, it cannot serve as a useful force for continuity of technical management or do much to sustain a skilled construction labor force. Each plant may well be undertaken by a different project team - a team which would have no continuing responsibilities after the plant is completed. The operation of the plants would be completely separate, except as their owners might otherwise provide.

There would be only limited ability to foster and develop support facilities, or to attract fuel cycle facilities or other industrial activities to the site since the Corporation, particularly at the outset, would have limited financial resources. Unless its contracts and agreements with utilities provided significant funds for that purpose, research and developmental projects could not be initiated by the Corporation.

2. The Joint Action Agency

The benefits of Centers can be substantial if there is strong motivation to unified long-term planning and action. Such action requires a "one-company" philosophy, which can only realistically be achieved if there is something approaching a unified financial and operating structure.

A Joint Action Agency, as noted earlier, is a group of power retailing participants which join together to create an Agency which will finance, construct and operate power generation facilities for them, in light of firm power purchase contracts which commit the participants to pay on a take-or-pay basis for their shares of the facilities output. As noted earlier,

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the participants are jointly and severally obligated to make payments under the power purchase contracts, as necessary, to pay the debt service and operating expenses of the project, and to adjust their charges to customers, as necessary, to meet their obligations.

Only to the extent that the needs of non-exempt participants could be met within the 25%* allowance would this be a practical mechanism for financing a Center to meet regional utility needs - both public and private. It would offer substantial economic benefit, since all the generating facilities, and arguably everything else on the site directly supportive of the power generation function, could be financed on a tax-exempt basis.

(a) Functions

- Site planning and development;
- Overall responsibility for coordinating Center development with regional power planning bodies;
- Develops, finances and operates projects predominantly to meet the energy needs of public utilities;
- Finances and operates support facilities, or induces private industry to make such investment through the development of joint venture arrangements or long-term service contracts;
- Limited research and development (due to limited ability to garner firm revenues above power generation costs).

* The 25% test would, in general, be based on projected power sales over the life of the plant. In any one year the sales to non-exempt persons could exceed this figure.

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(b) Management

The Joint Action Agency would be managed by a Board of Directors made up of representatives of each of its participating utilities. It would be structured like an operating utility under the day-to-day management of a Chief Executive Officer. Major functional groups within the Agency would include:

- Project finance;
- Project planning and power system coordination;
- Environmental analysis;
- Engineering;
- Construction management;
- Power plant operations;
- Support services;
- Fuel and related services procurement.

(c) Financing

Tax-exempt Agency bonds would be used to fund Center development and power projects. The cost savings of tax-exempt financing would be reflected in lower energy prices to both public and private agencies. There would be no need for pollution control revenue bond financing mechanisms.

(d) Assessment

The Joint Action Agency approach appears to be potentially strongly unifying in ways which are important to Center development. The Agency role envisioned in engineering, construction management and operations is not, however, typical of the Joint Action Agency arrangements which have developed to date. Most look to one of the participants, or a private utility, to develop and manage projects. No Joint Action Agency other

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than the Washington Public Power Supply System is currently developing staff commensurate with the level of activities and managerial control required. Additionally, except where the regional utility ownership mix makes the issue academic, the 25% limitation on the participation of private utilities in the Center's generation projects is undesirable.

3. The Energy Center Management Corporation

The goal of effective, integrated development and management of a Center, addressing even-handedly the needs of public and private utilities, is the objective of the Energy Management Corporation, an organization within which public and private utilities can participate differently, yet enjoy the other benefits of single management and joint action.

(a) Functions

- Site planning and development;
- Overall responsibility for coordination of Center development with regional power-planning bodies;
- Develop and finance and operate projects in which public and private power participants would take an interest proportional to their need for capacity at that time;
- Finance and operate needed support facilities or induce private industry to make such investment through the development of joint venture arrangements, or long-term service contracts;
- Develop and manage research and development and undertake major demonstration projects, such as a breeder.

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(b) Management and Coordination

The Energy Center Management Corporation could be managed by a Board of Directors, including representatives of the public and private utilities served by the Center. In addition, in light of its regional role and implications for the host state, there could be a representative designated by the Governor of each state served by the Center, and two additional representatives of the host state, one having industrial development responsibilities and the other having environmental protection responsibilities. The activities of the Corporation would be carried out by subsidiaries and affiliates, as described below.

(c) Generation Corporation-Joint Action Agency

These two entities, functioning as tenants in common, would provide the vehicle for public and private utility investment in power generator projects at the Center. Such a mechanism would:

- Give the private companies a unified generating company mechanism for sharing in projects with a single joint action agency serving the needs of the public participants;
- Unify ownership as much as possible, and thereby lay the basis for "one company" thinking.

In general, it is not possible to have common ownership of facilities by public and private utilities without prejudicing the tax-exempt financing of the public utility's participation. The Generation Corporation can, however, join in a tenant-in-common arrangement with a Joint Action Agency made up of public utilities. The Joint Action Agency would issue its own tax-exempt bonds and fund a portion of the plant corresponding to its needs for new capacity. The tax-exempt

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status of the Agency's bonds is preserved and its lower money costs appropriately reflected in the cost of energy to the Agency's participants. The Agency can, in fact, commit 25% of its output to private utilities and retain exempt status.

The Generation Corporation would provide the funds necessary for the financing of the privately-owned portion of a project. Instead of advancing funds as necessary, to finance their share of plant costs, the private utilities would make a stock investment in the Corporation equivalent to 20 to 30% of the cost of the portion of a new project which they wish to acquire. Each utility may adjust its participation from project to project.

The participating private utilities would additionally agree to acquire the power output of the project under a power purchase contract which would, in essence, require that they make payments over the life of the project which would cover all the related costs, and amortize related debt. The power purchase contract would be on a "take and pay" basis, meaning that such payments would be made whether or not the plant was actually delivering power. The participating utilities would agree to provide funds as necessary to complete the project, and should any participant fail to meet its financial obligations the other project participants would automatically assume those obligations.

With 20 to 30% equity, and the foregoing structure of firm financial obligations by participants, the Generation Corporation could issue its own bonds to fund the remainder of the construction costs.

Such an approach offers significant financial benefits for the participating private utilities. Because of the diversity of ownership, and the various ways in which revenues are guaranteed, the bonds issued by the Generation Corporation may well be more favorably rated than those of the individual companies.

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Finally, the private utilities, using the Facilities Financing Authority described below, could finance those portions of their plant investment eligible for tax-exempt pollution control facilities financing.

(d) Other Organizations Which Would Be Subsidiary or Corollary to the Energy Center Management Corporation

1. Pollution Control Financing Authority

In order to garner for the Center the benefits of available Federally tax-exempt pollution control facility financing, a Facilities Financing Authority, or equivalent municipal bond-issuing entity, could be authorized by the host state. The Authority would finance such facilities as cooling towers and waste treatment facilities, which are a part of the property to be owned by the Generation Corporation. Public utility investment would, of course, be fully tax-exempt. The Authority could additionally finance pollution control facilities for industrial activities, such as fuel storage facilities and reprocessing facilities.

2. Energy Center Service Corporation

The foregoing organizational and financial structures are intended to create the basis for centralized management of the Center, and foster a unified, coordinated approach to its development. Implementation is accomplished by the Service Corporation. It plans new capacity and undertakes major portions of the design and licensing of generation units at the Center, using outside engineers and consultants as necessary, but maintaining major technical responsibility and capability. The Service Corporation is similarly involved in the construction and operation of plants and the management of fuel supply. This continuity provides an important feedback between operational

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experience and engineering and construction of new units. It also builds a stable engineering force, thereby strengthening project management, scheduling, cost control and quality control of projects. Relatedly, it builds construction labor force stability.

3. Energy Center Development Corporation

The aggressive development of the non-power plant additions to the Energy Center requires an organization focused on that objective. The Development Corporation would develop plans for support facility additions, and structure joint venture and other arrangements, where appropriate. In the nuclear fuel cycle activities particularly, an aggressive program to attract facilities to the site would appear indicated. While the Center's own generation units would constitute the major customer for such services, such activities would be intended to serve existing and new dispersed site power reactors as well.

4. Energy Center Research and Development Corporation

The Research and Development Corporation would serve the developmental objectives of the Center's users. A portion of the revenues derived from the sale of power could be devoted to research, and still result in a lower cost of energy to participants, as compared to available alternatives. Such Center-generated funds could be augmented by industry research funding, in addition to Federal programs.

The R&D Corporation would be particularly suited to undertake major programs such as the construction and operation of developmental and demonstration projects, such as a breeder. Through its access to the capabilities

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of the Service Corporation it would have strong ability to undertake a major design support effort, and to manage construction and operation. The Center's in-place financing mechanisms can assist in bringing diversified private and public utility financing to such projects where appropriate, and a portion of Center revenues can be devoted to the continuing support of such operations.

4. Federally Chartered Regional Energy Center Corporation

In view of the fact that the foregoing Energy Center Management Corporation concept involved a number of issues potentially requiring Federal and state legislation, and in view of the strong Federal purposes served by the Center, it is worth considering the merits of establishing a Federally-chartered Regional Energy Center Management Corporation. Operationally, this entity would function similarly to the Energy Center Management Corporation, but could overcome certain serious difficulties in implementing the latter.

(a) Management and Coordination

The directors of the Federal Corporation could include one designated by the Governor of each state in the region served, two additional directors designated by the Governor of the host state, one director designated by the Generation Corporation, one designated by the Joint Action Agency, and five directors appointed by the President of the United States, each residing within the region served by the Center, and not an official state or Federal Government.

This body would set overall policy for the development of the Center, to meet a portion of the region's long-range power needs. It would participate in the development of regional power system planning pertinent to the Center's development. The Federal legislation would direct a broad range of Federal Agencies to coordinate with, and appropriately foster, the development of the Center.

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A most important component of this Federal coordination could be the creation of a high degree of regulatory predictability for the Center. For instance, along the lines of regulatory efficiency improvements, which have been proposed in recent years and as earlier noted, the Center could be made eligible for site licensing. Under such a concept, a site-related application would be submitted. With benefit of NRC staff analysis of site-related issues and, as appropriate, ACRS and NEPA review, a decision would be made on the site-related issues by the ASLB. Such decision, if favorable, could cover some number of future plants, and be effective for construction permits applied for within some defined period. Such decision would be determinative as to site issues in any future construction permit issuance proceeding initiated during the period, unless it could be shown that new information had been developed which materially alters the basis for the original decision. Obviously, the process would be most expedited if a significant number of identical standardized plants, previously the subject of generic licensing, were proposed for the Center.

(b) Financing

Financing of public and private utility investment would proceed as outlined earlier, with one important exception, namely, that the debt securities of the Generation Corporation and the Joint Action Agency issued to finance generating facilities at the Center could carry a Federal guarantee. Such guarantee would be available upon a determination by the Regional Energy Center Management Corporation that such generating facilities are required to:

- (1) Assure reliability of regional power supply;
- (2) Achieve national goals for the reduction of petroleum consumption, or

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- (3) Undertake an important energy development and demonstration project.

The Federal Government would charge a fee for its guarantee, consistent with other guarantee programs.

(c) Assessment

Although the Federal Corporation may well use its guarantee only limitedly, it could prove critically necessary to the generation of the very substantial capital needed to develop the Center at a time of business, technological and economic uncertainty. The additional measure of regulatory and financial stability the Federal Corporation can provide may well be critical.

In addition, the establishment of a regional generating company may require the transfer of substantial economic regulatory jurisdiction from the states to the Federal Government - a transition made easier if the Generating Corporation is under the supervision of a Federal Corporation with direct public participation in its management.

Additionally, since "one company" structure may not be possible as long as major public and private power needs have to be met at the Center, there will in effect be "two companies". The needed long-term cooperative action by the Generating Corporation and the Joint Action Agency may be helped by having the relationship hammered out under the influence of the Federal Corporation and its broadly representative and influential directors.

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VI. CONCLUSION

Clearly, one can make a substantial case for public-interest benefits for the Center. The difficulty classically comes in the translation of these conceptual advantages into an acceptable arrangement. History shows that approaches where public and private utilities have tried to get together, and particularly where the concept involves a multiplicity of jurisdictions (i.e., crossing state lines), the several interests appear inevitably to come into conflict. Thus, almost all such efforts, albeit many of them have been similarly wrapped in the flag of public interest, degrade eventually into some form of relatively loose cooperation.

There would appear to be several imperatives if this history is to be avoided:

1. There must be a strong regional push which perceives the Center to be of great regional benefit.
2. The public-interest aspects must be "sold" as a counterforce, to overcome the self-interest resistance that must be anticipated from any number of sources.
3. The benefits have to be real and identifiable to the major players involved.
4. There are a number of ways that the concept can be structured, and different structures maximize benefits to different players. Thus, setting the organization approach which best suits the particular site is clearly one of the priority tasks in insuring the success of the overall concept.
5. Finally, and recognizing that the time and budget constraints of this assignment preclude any in-depth investigation, the study has also considered whether the Center could provide any new potential sources of revenue, as for example, to support nuclear power-related R&D.

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There would appear to be some merit in this line of thought, although it is admittedly speculative. Both the potential components of such revenues and a gross approximation of the contribution of each follows in the table.

POTENTIAL CENTER REVENUES (Per Plant)

Existing Services (Gross Revenues)

Support	\$2 Million to \$6 Million/Year
Low-Level Waste Disposal	\$500,000/Year
Portion of Power Plant Construction Savings	\$12 Million to \$24 Million
Payments in Lieu of Taxes	\$2 Million to \$5 Million/Year
Research Fund (1% of Gross Power Revenues)	\$2.7 Million/Year