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Review and Analysis
of all Responses to LWR
Inquiry Letter

by

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Fairchild Industries was requested to review and summarize all written responses to Robert Thorne's letter of March 31, 1975, which solicited comments from the nuclear industry regarding a proposed ERDA-FEA program in support of light water reactors. This report constitutes the major part of that review. An earlier report (FSEC-NSG-217-75-49) was issued on May 8 that was limited to review of the responses relative to the single question of support for the floating nuclear plant concept.

The size of the inquiry is indicated by Table I which shows the total number of inquiries sent out, subdivided in terms of the type of organization queried, and the total number of responses received.

Table I
Inquiry - Response Ratios

<u>Direct Inquiries</u>		
<u>Addressee</u>	<u>No. Inquiries</u>	<u>No. Responses</u>
Utilities (U)	94	35
NSSS Mfgs. (M)	5	5
A&E (E)	14	5
Institutes (I)	<u>5</u>	<u>4</u>
Direct Totals	118	49 (42%)
<u>Informational Letters</u>		
Gov't Agencies (G)	69	11
Unsolicited		2
Totals	187	62 (33%)

The response ratios are quite high in all direct inquiry categories, indicating a high level of interest, except perhaps for the A&E's from whom a greater response might be expected.

The size and content of the responses varied considerably. The largest contained 15 pages, the average about 3, and at the low end, 5 responses consisted of a single paragraph saying that the respondent

had nothing to contribute but his good wishes. Some respondents covered a few questions in great detail, some included many items with limited comments on each. In view of this complexity of responses, it was found difficult to summarize the total set of responses in a manner that would be both fair and brief.

The method chosen was to dissect each response into a number of sections, each covering a single technical point. In this report, these sections of letters are called "comments". All comments were then collected by subject matter and after careful consideration, some consolidation was done. The comments were grouped where possible into headings that correspond to the chapter headings of the Light Water Reactor Task Force Report (4/29/75 draft). Where there were additional comments not fitting the Task Force Report headings, additional headings were created. In general the new headings follow the logical organization of the TFR.

The procedure of dissecting the letters has the deficiency of destroying the continuity and logical pattern of the original letter. The relative degree of emphasis given to each subject by the author and interrelations between subjects is lost. Despite these recognized weaknesses, the method chosen is still felt to be the best compromise.

Table II shows the various subject headings that were selected and the numbers of comments made under each heading, subdivided by type of organization responding. This tabularization alone gives some indication of the various subjects of interest to the respondents and the relative degree of interest in the subjects. The numbering of the main headings corresponds to the chapters in the TFR.

In the sections which follow, a summary is presented of the substance of the comments in each heading shown in Table II. Where appropriate, editorial comments and opinions are added which should be recognizable from the content. It is attempted in these comments to minimize some of

Table II
Number of Comments Received

2.2 Performance Reporting & Analysis	U	M	E	I	G	Total
2.2.1 Performance Reporting	4	4	2		2	12
2.2.2 Availability/Capacity	3	1		1	1	6
2.2.3 Energy Storage	2		1	1		4
2.3 Component Testing & Development						
2.3.1 Component Testing	2		2			4
2.3.2 Component Development	4	2	1	2	1	10
2.4 LWR Technology						
2.4.1 Plant Derating	3	1		1		5
2.4.2 Fuel Elements	6	3		1	1	11
2.4.3 On-Line Instrumentation	9	3	2	2	2	18
2.4.4 Steam Generators	7	1				8
2.5 Water Chemistry						
2.5.1 Chemistry-Materials-Condensers	3	4	3	2		12
2.5.2 Decontamination	2	3		1	1	7
3.2 Floating Nuclear Power Plants						
Affirmative						19
Negative						10
3.3 Plant Design Technology						
3.3.1 Seismic Criteria	2		5			7
3.3.2 Flow Dynamics		1	2			3
3.3.3 Standardization	14	3	3		2	22
3.3.4 Modularization	3	1	2			6
3.3.5 Waste Heat	4	1		1	1	7

Table II (Cont)
Numbers of Comments Received

3.4 Field Construction Technology	U	M	E	I	G	Total
3.4.1 Construction Techniques	4	2				6
3.4.2 Manpower Training		3	2		1	7
3.5 Advanced Safety Design						
3.5.1 Emergency Core Cooling	6	1	4	1	1	13
3.5.2 Containment	1		2		1	4
4.0 Non-Development Items						
4.1 Economic Constraints	6		1		3	10
4.2 Regulatory Constraints						
4.2.1 Licensing Delays	5	2		1	1	9
4.2.2 Retrofitting Regulations	7		4		1	12
4.2.3 Review of Procedures	9	1	2	2	1	15
4.2.4 Safety R&D	7	1	2		2	12
4.3 Fuel Cycle	51	9	5	5	3	73
4.4. Other Institutional Constraints						
4.4.1 Env. and Siting Constraints	7	3	1	1	2	16
4.4.2 Public Opinion	6	1	2	1	1	11
5.0 Subjects not in LWRTFR						
5.1 National Energy Policy	6	4	2			12
5.2 ERDA Policy						
5.2.1 Policy Clarification	4	1	1	2		8
5.2.2 Action Through EPRI	9		1	1		11
5.3 Also Selected Short Subjects						
5.3.1 Stock Piling	1	2				3
5.3.2 Other Cycles	7		1		1	9

the deficiencies of the dissection process by pointing out interrelations between subjects where they exist. A difficulty remains in that an enumeration of comments fails to indicate the depth of understanding and the degree of enthusiasm of the author contained in his actual response. To combat this problem an Appendix I is attached which contains the full texts of all comments, organized according to Table II. While most readers of this report will not wish to read through Appendix I, it is suggested that a fast skim would be quite informative as to the size and detail of the comments under the various headings. It will also be of interest to note that some of the comments indicate a degree of antagonism toward ERDA. In addition, the summary discussions recommend a number of specific comments for reading as particularly lucid expositions of a position. An Appendix II is also attached which contains two complete responses which describe new developments of the respondents. This method is taken so that these new concepts will not get lost in the shuffle. In neither case is sufficient detail provided to permit a real evaluation of the concept but both are in areas of considerable interest and on that ground alone seem worthy of further investigation.

Summarizing discussions of each subject heading in Table II now follow.

2.0 Plant Operations

2.2 Performance Reporting

The basic reason for considering establishment of a performance reporting, or fault reporting, system is the expectation that doing so will tend to minimize the use of unreliable components in the power plants, thereby gradually improving plant reliability and availability. The responses in this area indicate several non-obvious interdependencies of considerable significance. To make this clear, this group of comments is discussed under three subheadings.

2.2.1 Performance Reporting (12 comments)

There are 12 comments that deal simply and directly with the concept that ERDA should collect, analyze, and disseminate data on plant

component failures as a method of improving plant availability. Many of the respondents feel that dissemination of data on component failures will improve plant reliability without the additional step of component development. Several respondents mention other data collection efforts (by NRC, EEI, and ERDI) and one is negative about the need for government activity in this field.

2.2.2 Availability- Capacity (6 comments)

These six respondents emphasize the question of plant availability/capacity. One of these comments by Pacific Gas and Electric raises a point considered to be very important. This is the fact that nuclear plants are not always operated to the maximum extent possible but may be kept off the line for substantial periods for economic reasons. PG&E notes that in 1974 their Humbolt Bay Unit 3 had an availability factor of 83.9% and a capacity factor of 66.7%. Their comment is unfortunately rather brief but its intent seems to be that the plant could have been operated at a factor of 83.9%, considering all physical constraints, but was actually only operated at a factor of 66.7% for economic reasons. In view of the potential for increasing power generation without capital investment if this should prove to be a common situation, further investigation is warranted.

No explanation of the controlling economic factors was provided by PG&E but the following explanation is thought to be correct. Due to the restrictions on rapid changes in power loading imposed on nuclear reactors, largely caused by fuel element limitations, the reactors cannot follow short-term changes in demand. The utilities try, therefore, to run the reactor at a constant base load and to follow the power peaks with fossil fuel generators. In many cases however, depending on the details of the local grid, it may be inefficient to run the nuclear plant at full power because doing so would require that a companion fossil plant would be running at least part time at a very low power rating at which it would be very inefficient. Clearly, the utility will seek to run its entire grid at the maximum overall efficiency. Evidently PG&E found this to result with Humbolt Bay Unit 3 running at only 80% of its availability.

To the extent that PG&E's problem is widespread, and there are a number of other oblique references to it, the solution must lie in the economic policy area as well as in the technical area. The nuclear plants will only run to the limit of their availability if it becomes national policy to so operate them as a means of conserving oil regardless of the short term economics of the situation. And some means will have to be found to compensate the utilities for their loss.

It appears that the term "capacity factor" is given widely different interpretations by different users. Clarification of usage would be helpful. The definitions of "availability factor" and "capacity factor" given as a footnote on page 2-1 of the Task Force Report seem acceptable as a basis. Unfortunately, the Report, on page 2-3, appears to violate its own definition. It is suggested here that "availability factor" accounts for all situations in which the plant is physically able to deliver rated power. It may be desirable to distinguish further between "planned" and "unplanned" outages. "Capacity factor" would be reserved to define the actual power that was delivered. The difference between the two could arise from the voluntary decision of the utility management, a slackening of demand, or a regulatory order to reduce operations.

2.2.3 Energy Storage (4 comments)

Energy storage is related to the capacity factor problem because the capability to store energy during low demand would enable nuclear plants to run at full availability despite fluctuating demand. Four other respondents have commented on the need for energy storage capability. They recommend early development of energy storage capability by the most expedient method.

Development of load-following fuel elements is another related subject that is discussed in a later section. The problem could also be mitigated if the plants were able to follow fluctuating demand more closely.

2.3 Component Testing & Development

Section 2.3 in the LWR Task Force Report is devoted to the need for government support for component test facilities and the generation of nuclear

standards. The responses indicate a strong consensus that component hardware R&D will also be required.

2.3.1 Component Testing (4 comments)

Three of these respondents make brief statements in favor of component testing and standards writing. One mention is made of valves and one of the possible use of an early power reactor as a test site. The fourth respondent makes a more detailed argument for the development of mathematical models for component evaluation.

2.3.2 Component Development (10 comments)

The general sense of these comments is that testing is only an adjunct to hardware development efforts. Valves are mentioned by 8 of the 10 respondents but generally as only one prominent member of a sequence of components needing further development. Also mentioned are pumps, pipe fittings, weld joints and welding equipment, tubing, seals and packing, re-fueling equipment, electronic controls, and fuel. Many of the specific items probably arise from a memorable problem the respondent suffered through. Preliminary results of the Performance Reporting effort would be invaluable in deciding what order of priority should be established for component support.

The wide variety of components mentioned suggests to this writer that a variety of dissimilar test facilities will be required for the entire program. It might be feasible to develop a series of component technology groups or centers at the National Laboratories or elsewhere to cover the spectrum of needs. Typical examples are: (1) Valves, actuators & controls (2) pumps & seals (3) welding (4) pipes, tubes, heat exchangers, etc.

2.4 LWR Technology

2.4.1 Plant Deratings (5 comments)

All five respondents stress that an immediate increase in power output would be available if current restrictions on operating levels could be relaxed. The specific technical problem cited in two cases is inadequate

knowledge of fuel element behavior under power transients and high burnups. It is implied that better knowledge of fuel element behavior would permit the reduction of statistical safeguards and increase power production with current fuel elements. Clearly, improved fuel elements would be of even greater benefit and in this area this topic is closely related to the next one.

2.4.2 Fuel Element Technology (11 comments)

These comments, although varying in length, are homogeneous in content. Most respondents recommend a research effort to generate a better understanding of failure mechanisms, particularly pellet-clad reaction mechanisms, and a development effort to improve the load following characteristics of the fuel rods. This latter point is related to the question of plant capacity factor as discussed earlier in Section 2.2. One respondent, Combustion Engineering, presents a well written, detailed discussion of the problem which expresses the group consensus well. (see Appendix I).

2.4.3 On-line Instrumentation & Tooling (18 comments)

These respondents are all concerned with the loss of operating time because of the recurrent necessity of shutting the plant down to perform required inspections and maintenance. Within this group, a large number of respondents (9) have essentially the same recommendations; development of instrumentation techniques to perform the NRC-required periodic inspections of the pressure system while the plant is operating. This problem is related to the decontamination problem discussed in a later section; as the residual radioactivity in the primary system builds up it becomes increasingly difficult to perform the inspections, even with the plant shut down. On-line or remote instrumentation and decontamination thus become complementary approaches to the same problem. A particularly lucid discussion of this area is presented by General Public Utilities (see Appendix I).

The balance of the respondents recommend a variety of specific development efforts. These include; (a) monitoring the "acoustic signature"

of active components such as pumps and motors to anticipate wear-outs, (b) measurement of primary or secondary loop leakage, and (c) computer systems for control and monitoring. Three respondents recommend the development of remote maintenance tools.

Colorado Energy Research Institute states that they are providing "seed funding" for what appears to be a highly sophisticated magnetic NDT process that seems worthy of further investigation. (See Appendix II).

2.4.4 Steam Generators (8 comments)

Combustion Engineering presents a thorough discussion of this problem, (see Appendix I). All respondents in this group are fairly emphatic that tube failures in steam generators constitute a serious cause of plant outage. It is suggested that solutions may lie in either improved materials or in better control of water chemistry. One respondent comments on the problem of introducing a new material: even though the designer may have cause to believe that a new material is superior to an old one, he is very reluctant to change because of the difficulties of qualifying a new material. This is an area in which ERDA could clearly be of help by generating adequate background data.

It is pointed out by another respondent that the steam generator problem may be related to condenser tube integrity because in-leakage in the condenser can seriously upset water chemistry.

No obvious routes to a solution are presented. The problem is closely allied to water chemistry and to material properties. It may be best approached by the establishment of a Technology Center, as suggested earlier.

2.5 Water Chemistry

2.5.1 Chemistry, Materials, Condensers (12 comments)

This group of comments is closely related to the preceding group on Steam Generators. Nine of the respondents make simple recommendations for R&D on the problems of general corrosion and stress corrosion cracking following the two approaches of better control of water chemistry and the

development of more resistant materials. Combustion Engineering presents a detailed comment, pointing out again that leaks in the steam condenser are a serious cause of uncontrolled water chemistry. Two other respondents also mention the condenser problem. They recommend that condensers be segmented and designed for easy detection, isolation, and repair of leaks and that water clean-up units be installed between the condenser and the feedwater pump.

2.5.2 Decontamination (7 comments)

Five of the respondents present brief direct recommendations that methods (presumably chemical) be developed for decontamination of the primary coolant system. Some mention is made of the desirability of developing materials resistant to the development of radioactive corrosion product deposits. Such deposits present a growing problem in plant maintenance as discussed earlier under On-line Instrumentation.

One respondent recommends support of large scale decontamination demonstrations such as the one planned for Dresden I. Two respondents comment on the related problem of in-plant rad waste handling and the need for better techniques. One respondent requests development of an on-line tritium removal system.

3.0 New Plant Construction

3.2 Floating Nuclear Plants

A separate report was submitted on 8 May covering all responses received at that time on this subject. Since then three additional comments have been received. All three comments are rather brief and add nothing substantive to the position already developed in the previous review. All three are, however, in the affirmative which changes the consensus to 19 to 10 in favor of support. The conclusions reached as a result of this review are:

1. Moderately affirmative consensus
2. Reasons cited highly variable
3. Responses in toto provide only weak justification for action
4. Most responses prefatory
5. Only viable option indicated for near term results is:
 - a. Licensing aid to Offshore Power Systems, and
 - b. Financial aid to Public Service Gas & Electric

For full discussion see FSEC-NSG-217-75-49, "Review and Analysis of the Responses Relative to the Floating Plant".

3.3 Plant Design Technology

3.3.1 Seismic Criteria (7 comments)

The opinion expressed by these comments is that in the absence of a firm well-qualified criterion for seismic design factors the plant designer is faced with an escalating factor of conservatism as additional problems are raised. The plea is for a program to establish firm design factors, accepted by NRC, so that this source of contention, delay, and escalating costs can be eliminated in the future.

3.3.2 Flow Dynamics (3 comments)

This subject did not elicit much discussion but one respondent (Sargent and Lundy) presented a detailed plea for a research program to develop a better understanding of fluid transient effects on plant performance and safety. The recommended study would include the effects of continuous operational vibrations and transients due to valve action etc. on piping and other components. The validity of current safety criteria is in question. The other comments are less detailed but follow the same line.

3.3.3 Standardization (22 comments)

While the total number of comments on this subject indicates a high degree of interest, the opinions are not homogeneous and reservations are

expressed by many respondents. It seems likely that many of the respondents have not thought too deeply before answering and for whom the word "standardization" may have a number of different meanings. The two extremes of this spectrum of meaning are (a) one "standard plant" for the industry, and (b) several different "standard plants" for each A&E, encompassing various available combinations of NSSS and BOP.

One group of 8 comments are uncritically in favor of standardization without, in most cases, making it clear what, exactly, they mean by standardization. Another group of 7 comments are generally in favor of standardization but caution that a major obstacle in the way of standardization is the imposition of changing regulations. They appear to view the major potential benefit to standardization to be simplification of the licensing process. Two more respondents say, in effect, that while standardization appears attractive in principle, they fear that in practice it may increase costs by imposing additional requirements or by not being firm. Two more respondents emphasize the cost burden of standardization to the smaller organizations and suggest (a) one industry standard design and (b) undefined economic incentives as solution to this problem. Finally, three respondents, somewhat belligerently, state that they will recognize the benefits of standardization and are on their way to that goal without ERDA assistance.

In summary, it appears that there is approval of the general principle and considerable variety of opinion as to specifics. ERDA's initial contribution might well be to work with NRC to develop a clear definition of a licensable standard plant, with due consideration to the varying capabilities within the industry.

3.3.4 Modularization (6 comments)

Two distinctly different ideas are expressed in these six comments. Three of them mention the regulatory obstacles to complete plant standardization and recommend modularization or standardization of components as being more practical for near term achievement. The other three interpret

modularization to mean shop fabrication of sub-systems. They urge this course, citing cost and quality advantages of shop fabrication, transportation, and field assembly of sub-systems. They recommend R&D to develop the required technology.

3.3.5 Waste Heat (7 comments)

This subject was not discussed in Chapter 3.0 of the TFR but received 7 comments and seems best to fit under Plant Design Technology. Three different opinions or ideas may be found in this group of comments. Several respondents request R&D on the subject of cooling towers vs the environment with the objective of establishing ground rules, with due regard to cost/benefit analyses, as to when cooling towers are required. Two respondents request further R&D on the use of water for cooling. Two others request R&D on the beneficial use of the waste heat.

3.4 Field Construction Technology.

There were few comments relative to this section of the TFR, none at all on Planning & Management Techniques or Preoperational Tests.

3.4.1 Construction Techniques (6 comments)

These comments are all brief and not very substantive. The most useful concept, recommended by two respondents, is that ERDA should study the most successful construction programs of the past, seeking to determine what beneficial procedures could be adopted for the future. Increased shop fabrication was twice mentioned as desirable. There are no specific recommendations regarding particular construction methods that ought to be developed. One respondent is negative, stating that ERDA cannot help in this area.

3.4.2 Manpower Training (7 comments)

These comments are generally brief and not particularly useful. Five comments recommend worker training programs, citing the need for high quality workmanship and potential labor shortages. One comment anticipates a shortage of nuclear engineers and recommends increased training

programs and increased use of computerized graphics to solve this problem. One respondent makes the grandiose recommendation that ERDA establish a national program to assure construction users that an ample supply of qualified and motivated workers will always be available. Unfortunately, he does not indicate how this is to be done; a successful solution to this problem would be roughly equivalent to the achievement of practical fusion power or the return of the 10 cent beer.

3.5 Advanced Safety Design

3.5.1 Emergency Core Cooling. (13 comments)

General Public Utilities presents a detailed and well-reasoned discussion of this problem area; reading of the text contained in Appendix I is recommended. The essence of their argument is that the present assumptions regarding ECCS and LOCA are overly conservative, leading to unnecessary design complications and operating restrictions. A research effort to "bring about a convincing resolution of safety system performance uncertainties" is recommended. Six other respondents essentially agree with GPU, also recommending that computer codes used in calculating energy release situations be verified. Four other respondents approach this problem by expressing various degrees of indignation over the delays in the LOFT program and recommending that it be accelerated. A quotation is appropriate; "We are dismayed at the continued delay in the integrated ECCS performance tests (e.g. LOFT) and the development of acceptable systems models to assess plant transients". One respondent takes a different approach: he recommends an experimental and analytical study of hydrogen generation, transport, and reaction in post-LOCA conditions. Finally two respondents present an entirely new concept called Passive Containment System (PCS). This system is not described in sufficient detail for evaluation but appears to be an ECC system employing water chambers within the containment vessel. These responses are reproduced in Appendix II so that a decision can be made as to whether further investigation is warranted.

3.5.2 Containment (4 comments)

These comments are all brief but are varied in content. Two respondents recommend research on structural responses to impact situations, including tornado-generated missiles and pipe rupture missiles. One more recommends development of computer codes for safety analysis of containment vessels, a similar problem. A fourth desires "an evaluation of steel-lined prestressed concrete reactor vessels". The final respondent makes rather specific requests for studies of concrete under impulsive loading and other accident-related situations.

4.0 Non-Development Issues

4.1 Economic Constraints (10 comments)

All respondents are in agreement that the current problems the utilities are having in financing new plant construction is a serious deterrent to expansion of capacity. There is no agreement on how the problem may be solved. Three respondents merely comment on the seriousness of the problem without suggesting a solution. The other eight suggest nine different possible solutions:

- o Federal subsidy programs for construction
- o ERDA loans
- o Federal Utilities Bank for low interest loans
- o Government-Industry cooperation as in the Clinch River Breeder Plant
- o Tax incentives
- o Tax exempt financing arrangements
- o Funding dividends as an expense item
- o Putting CWIP into the rate base
- o Federal pressure to allow rate adjustments commensurate with Federal standards and the individual utility's contribution to energy conservation

One respondent also comments on the need to resolve the Price-Anderson situation.

4.2 Regulatory Constraints

In terms of the number of comments received, the general area of complaints regarding restrictive and changing regulations and licensing delays, is the second most troublesome one to the industry, yielding only to concern about the fuel cycle. It has been found difficult to summarize these comments in a useful manner because of the variety of opinions and, in some cases, the heat with which they were expressed. The categorization into subheadings which follows is very approximate because most of the respondents mingled several different ideas in their comments. The most significant point to be noted is that a large segment of the nuclear industry considers the regulatory process in toto to be overly restrictive without justification and to be adding substantially to the cost of nuclear power. This is a source of animosity on the part of the industry toward the government.

4.2.1 Licensing Delays (9 comments)

These nine comments are directed primarily at the overall problem of delays without recommending specific corrective action. One quotation indicates the trend: "The major thing that would do the most to reduce capital costs and shorten construction time would be a system for expeditious licensing of new plants, both at the federal and state levels. Although this may not be an area where you have direct responsibility, it seems futile to perform R&D which should speed development only to find that the regulatory process does not, or cannot, respond with reduced lead times".

Under this category, we may also note that many respondents have expressed strong feelings that some form of control should be exerted over public intervenors. Such actions have obviously hurt considerably. The utilities do not ask that public intervention be stopped, but that when a question has been answered once it need not be answered again.

4.2.2 Retrofitting Regulations (12 comments)

The sense of this group of comments is expressed by a pair of quotations: "Plant construction schedules will not be as seriously hampered by

the regulatory process if decision making on the acceptability of a system design is completed in a timely manner. However, the orderly flow of procurement and construction work is seriously upset when design additions and revisions occur on a project at the time construction is proceeding at a rapid pace in closely interrelated areas of the plant".

And the second pertinent point: "One of the principle inhibitors for the selection of nuclear units today is management difficulty in precisely defining either cost or schedule for nuclear units due to the continuous escalation of regulatory requirements being imposed on the design, construction, and operation of nuclear power plants".

4.2.3 Review of Procedures (15 comments)

This group of comments is somewhat less homogeneous but, in general, they call for a review of the existing set of regulations. A major point of view is expressed in another quotation: " The current licensing requirements represent an often disjointed evolution of restrictions, conservatisms, and redundancies, which while established in the well-intentioned interest of safety, tend now to encumber nuclear power plant design and operation with many requirements whose costs and penalties may outweigh their true safety contribution. We feel that the development of an alternative set of licensing requirements is in order".

A second point made by a number of comments in this group is that better resolution is needed of the sometimes conflicting federal and state requirements. Two respondents cite the danger of anti-trust action.

Finally, the comment by Sargent and Lundy (see Appendix I) should be read as it cites eleven very specific points within the formal Regulatory Guide which it believes need clarification or revision.

4.2.4 Safety R&D (12 comments)

These comments generally recognize that safety regulations are not the responsibility of ERDA but urge ERDA to sponsor appropriate R&D to

improve the data base behind the safety requirements, thus justifying the reduction of conservatism and redundancies. The Rassmussen report, WASH 1400, is frequently cited as a model to be followed.

4.3 Closing the Fuel Cycle (73 comments)

This subject has been given a separate heading in this review because it is the subject most frequently and most consistently commented upon by the respondents. These comments all relate to the out-of-reactor portions of the fuel cycle.

A slight change of format with respect to the numbers of comments is being used on this subject because a change will, it is hoped, provide a more realistic summary of the opinions expressed.

The intensity of interest is indicated by the number of comments on this subject. The opinions are also quite homogeneous and consistent, although expressed in varying depths of detail. The respondents are uniformly quite concerned that at some time in the future the nuclear industry will grind to a halt because of a breakdown in the fuel cycle. And it is quite evident that an immediate pressure point exists in the present lack of viable reprocessing and waste disposal facilities. The utilities are concerned about having to shut down for lack of spent fuel storage and find themselves under effective pressure from public intervenors because there is no solution to the waste disposal problem.

Within the entire group, the total fuel cycle is discussed in terms of six segments, namely:

1. Ore availability	10%
2. Enrichment	15
3. Plutonium recycle	19
4. Reprocessing	22
5. Waste Disposal	29
6. Safeguards	5

In initiating this review, an attempt was made to extract specific comments on these items. It was found however the the total number of comments would then depend very strongly on the fineness of the dissection: many respondents commented generally on the fuel cycle problems and then mentioned a number of the above items in brief statements. Consequently, we note that there were 73 total comments in this area of which 14 are general statements on the fuel cycle, still further dissectable if one wished to slice finely, and the balance are predominantly devoted to one subject. We indicate the relative degree of interest in the individual subjects by showing in the listing above the percentage of individual comments so directed and discuss below the points made.

Ore Availability. ERDA is urged to encourage further prospecting, to develop improved ore extraction processes, and to publish the extent of known reserves.

Enrichment. Concern is expressed that private investment in enrichment will not develop. Part of this problem is the uncertainty in investors minds about potential costs for centrifuge and laser enrichment in the future. ERDA is urged to press on with development of advanced processes if they promise economy, and to expand government enrichment pending clarification of future costs.

Plutonium Recycle - A more expeditious solution to this problem than the one presently scheduled is urged. The utilities doubtless feel that they have an immediate financial stake in the plutonium.

Reprocessing - The lack of adequate commercial reprocessing capacity is viewed with alarm. No solution to the econmic problems are offered but ERDA is urged to do something to break the impasse. Interim use of government facilities is suggested by several.

Waste Disposal - Comments are most vehement on this point. Inter-venors have made much of the lack of a solution and many utilities are obviously concerned that they are going to be stuck with a very hot potato in the near future. No promising solutions are suggested but prompt ERDA action is strongly urged.

Safeguards A minor number of respondents are concerned about their responsibilities for safeguarding fissionable material within the fuel cycle.

The comment presented by General Public Utilities again represents a well written and comprehensive statement that all of the other respondents would probably endorse. Its reading is recommended (Appendix I)

4.4 Other Institutional Constraints

4.4.1 Environmental & Siting Constraints (16 comments)

A number of distinct but separate problem areas are discussed under this general heading. One group of respondents urges the establishment of sound environmental criteria. As expressed by one utility: "Establishment of alternatives to the adversary process as a means of establishing scientific facts in regard to environmental aspects of energy production". Another comment makes the useful suggestion that since all utilities are required to monitor local environmental effects, a national program could be established to correlate all this data and establish documented criteria. Several argue that cost/benefit analysis should be employed before requiring additional environmental restraints.

Two respondents relate siting criteria to environmental criteria and urge better coordination.

Five respondents on siting are arguing for pre-certification of sites as an aid to the licensing process.

Four respondents urge development of the Nuclear Park or Energy Center concept as a partial solution to many problems including siting. Additional benefits are seen in standardization and reprocessing areas.

4.4.2 Public Opinion (11 comments)

Although differing in the details of the arguments offered, these comments all have the same theme: The public needs to be better informed about the benefits and problems of nuclear power so that it will accept new plants more readily. ERDA is urged to take an active role in providing more complete and more positive information to the public. There is also the overtone that better progress in the areas covered in 4.2 and 4.3 would make the PR task easier.

The problem of intervenors is again raised with the suggestion that some way be found to make them responsible for their actions.

5.0 Subjects Not Mentioned in LWRTFR

5.1 National Energy Policy (12 comments)

These comments are similar to those discussed above under Public Opinion but go one significant step farther in declaring that an essential ingredient for the public acceptance of nuclear power is the generation of a clear statement of national policy , putting nuclear power in proper relation to overall national goals. A quotation makes the point forcefully: "There is an urgent need for the re-affirmation of nuclear energy as a National Goal. ERDA, FEA, NRC, and EPA should jointly prepare and publicize a statement--reaffirming the national position that nuclear energy is both necessary and desirable as a solution of our national energy needs."

A secondary point is also raised by several of the respondents. This is that a policy decision should be announced relative to the desirability of pushing nuclear power as a means of conserving oil. This point was discussed earlier relative to plant capacity factor, Section 2.2.2.

5.2 ERDA Policy

5.2.1. Policy Clarification (8 comments)

These comments are somewhat varied and are expressions of the respondents opinions of how ERDA should conduct itself. Four comments

urge that in the post-reorganizational environment ERDA assume the role of proponent of nuclear power and continue such AEC efforts as the Action Plans. One urges formation of ERDA - Industry advisory committees. Two offer ground rules for when R&D is appropriate. (They disagree). Two respondents recommend use of the National Laboratories to assist the utility industry. One expresses the opinion that the plant operators are better equipped than ERDA to improve existing plant performance and that ERDA should leave them alone.

5.2.2 Action Through EPRI (11 comments)

These comments uniformly recommend that ERDA conduct the LWR support program by acting through or in cooperation with the ongoing EPRI program. (The TFR does state that such cooperation is intended).

5.3 Also Selected Short Subjects

5.3.1 Stockpiling (3 comments)

These respondents forcefully argue that ERDA is going to have to take steps to enlarge the supply capability of the country with respect to major components such as pressure vessels, large forgings, etc. if the goal of expanded nuclear power is to be met. Advanced procurement and stockpiling is suggested as one method of accomplishing this end.

5.3.2 Other Cycles (9 comments)

These comments are quite varied but include recommendations of support for the following power generation cycles:

- High Temperature Gas Cooled Reactor (3)
- Breeder (3)
- Fusion
- Geothermal preheat for LWR
- Operation of Hanford N reactor for power
- Plutonium-thorium LWR cycle
- Tertiary working fluid cycles
- Non-nuclear advanced concepts

APPENDIX I

Full Texts of All Comments
Arranged by Subject Matter

Fairchild Space and Electronics Company
Germantown, Md. 20767

June 3, 1975

CID # 700
CALL # 14-02

2.2 PERFORMANCE REPORTING & ANALYSIS

2.2.1 PERFORMANCE REPORTING

COMBUSTION ENGINEERING

Current reporting by NRC of "Abnormal Occurrences" and the reporting of equipment failure statistics constitute a very valuable service to the nuclear industry in identifying potential trouble areas and therefore, in the planning of servicing or equipment replacement to improve system reliability. It is proposed that ERDA encourage extension of the collection of nuclear plant reliability data to include all components whose failure could adversely affect plant availability. The "feedback" of these data from operating plants to the component standards and hardware development activities would be expected to result in substantial improvement in equipment design and through the design, in plant reliability and availability.

POTOMAC ELECTRIC

Development of a reporting system and data bank cataloging component, system and equipment failures and malfunctions under service conditions and generation of reliability data and statistics. At this point we know of no such comprehensive system which exists on a national scale. The plant designer and NRC are considerably hampered by its absence, particularly in specifying redundancy requirements. A current example of where good component reliability data is needed arises when attempting to design off-site sources of power for nuclear plants in compliance with the new NRC Guide 1.93. This guide requires shutdown of a plant in 72 hours if component failures reduce the number of operational off-site supply sources to one. Without adequate reliability data on electrical component failure rates the designer is faced with the decision of taking a risk of plant outage on expiration of the specified time period or alternatively, increasing the capital investment in plant to a significant degree by providing much spare equipment to reduce this completely unknown probability of failure. The challenge for ERDA is to design ways of accomplishing this without destroying a competitive components manufacturing industry.

Develop plant probabilistic models for use by the industry for availability modeling. Such mathematical models could be used in conjunction with the reliability data determined from the program described in 1. above, to assess the effects of component and system design on probable overall plant availability.

BURNS & ROE

Although the abnormal operating report and EEI are making available a great deal of information on the reliability of system and component performance of nuclear power plants, there is still lacking a timeliness and an interpretation of all this information so that engineers and manufacturers can factor in this experience in new designs. An information system has to be developed that gives both prompt feedback of equipment failures and analysis of the failure as well as rapid communication to the cognizant manufacturers and engineers and utility operators for corrective measures. This is badly needed if we are to improve the reliability of nuclear systems and equipment and power plant availability. Parenthetically, I would say that the same feedback should take place in the fossil fired power plants because the same manufacturers, and frequently the same equipment, is used in the fossil units.

GIBBS & HILL

Develop an experience data bank for all major components in currently operating nuclear plants which may be used as a reference by designers who are writing specifications and selecting equipment for new plants. This data bank should provide information concerning availability and maintainability of the various components based on type and manufacture.

Further, such a data bank would permit meaningful event/fault free analyses of safeguards systems. These analyses, with a proper data base, could be used to design safeguards systems to a common level of failure probability which would be set by NRC. This would eliminate the ultra-conservatism in safeguards systems design and thereby achieve economies in design, construction and operation.

Develop an "early warning" system amongst operators of nuclear power plants to expeditiously disseminate information on operating problems.

Institute a concerted effort on the part of the industry and government, which would include plant designers as well, to identify and resolve latent operating problems in a nationwide plant betterment program as a means of enhancing availability of existing plants that would equally benefit those under design and construction. This program would be aimed at improving systems reliability throughout the plant. Through proper planning of necessary modifications, alterations could be accomplished with minimal impact on plant outage, exposure to operating personnel and operating costs.

While we are aware that NRC is maintaining a periodic listing of Abnormal Occurrences at each nuclear power plant, we are unaware, in spite of informal expressions of interest by various parties, of any systematic studies under way evaluating the reliability of the installed equipment which might affect plant availability using the event or decision tree methodology similar to that utilized in WASH-1400 (Rasmussen Study). In our judgment, these studies should be undertaken for each of the so-called standardized plants probably as a joint industry-ERDA cooperative program. The objectives of such a program are fairly clear with the principal ones being the identification of single failure potentials and the relative reliability of different systems and components having the same function.

DUQUESNE LIGHT

We suggest that ERDA provide continued and expanded financial support to the efforts of the Electric Power Research Institute in funding the R&D activities which are underway in the areas of materials performance, inservice inspection, water chemistry, plutonium recycle, and equipment reliability diagnostics. Emphasis is being directed toward the reliability of standard plant components which affect availability rather than just safety. The performance data collection mechanisms are in existence, and the identification of those specific components which contribute most to unavailability is underway. We feel that the R&D efforts related to materials application of these components will result in improved performance. Contrary to the recently expressed opinion of Mr. Train, Director of NRC's Office of Program Analysis, we feel that an expanded program of independent and redundant reliability data collection and analysis by NRC is not needed. The utility industry, along with vendors and engineering consultants, are working through such organizations as the American National Standards Institute, Electric Power Research Institute, and the Atomic Industrial Forum to exchange data and set guidelines for evaluation.

COMMONWEALTH EDISON

Better characterize operating and maintenance experience on older BWR and PWR demonstration plants as an aid to improving future plant designs as well as operating and maintenance procedures.

At present there are a number of industry efforts aimed at collecting failure and reliability data. In addition, there is much valuable experience in this area available from other industries. However, there should be a review of existing and planned data collection programs and selection of the best one for industry-wide implementation. This should eliminate unnecessary duplication and hasten the feedback of such information to plant design, construction, operating and maintenance.

GENERAL ELECTRIC

The Edison Electric Institute has initiated a program to collect operating availability and specific component reliability data from nuclear plants and to reduce the data to definition of causes and effects. This program has significant potential for near-term improvement of plant performance, by subsequent corrective action plans, and ERDA might consider providing increased support for this program.

WESTINGHOUSE

There is a pressing need for data related to the reliability of nuclear plant components affecting plant performance. Data must be comprehensive, accurate and current. It must include all components affecting the dependability of nuclear plants, not just those relating to plant safety. This data will help determine the most effective methods to improve plant performance.

FLORIDA POWER

Efforts by ERDA to accomplish the primary objective of increasing the energy availability of nuclear plants can only be accomplished by ERDA gathering and disseminating data from operating plants concerning areas where reliability can be improved, on fuel performance, on-line monitoring, inspection methods and improved water chemistry, etc. This data should be gathered by continual visits to operating plants by knowledgeable individuals from ERDA.

DEPARTMENT OF THE INTERIOR

A somewhat novel approach to operating and construction difficulties would be to establish joint industry-government study teams to solve problems with generic implications. Such a group would be able to develop an organized statistical study of the delay elements experienced in the construction and commissioning of a good cross section of plants operating or under construction. Such a study would be extremely helpful in solving future problems.

Intensive quality control efforts are required to assure a high degree of plant availability once units have gone into commercial operation.

BABCOCK & WILCOX

Extend the existing reliability data program to include the identification and categorization of equipment failures or operating errors which lead to plant outages.

Initiate development programs to upgrade equipment, operating procedures, designs, or instrumentation identified above.

2.2.2 AVAILABILITY / CAPACITY.

PACIFIC GAS & ELECTRIC

We have considered which activities might be suitable for ERDA involvement to increase near-term electrical generation from nuclear power. Before commenting on this, I would like to stress that there appears to be some confusion in the industry between availability and capacity factors for nuclear units. Many nuclear plants may be available for higher capacity factor operation but are actually operated at a low capacity factor because of system load conditions. You might be interested in the most recent year's figures for our nuclear unit at Humboldt Bay Power Plant Unit No. 3: For 1974, availability was 83.9 percent and its capacity factor was 66.7 percent.

PUERTO RICO WATER RESOURCES AUTH.

ERDA should participate and support R & D activities to improve the nuclear plants capacity factors from the low current value of about 58%. The fact that there are nuclear power plants operating with much higher capacity factors, shows that a large margin of improvement can be accomplished. A detailed study of the causes for low capacity factors could provide the necessary information for the needed improvements (e.g. better components reliability, improved on-line monitoring, improved maintenance and operational procedures). A 20% capacity factor improvement on the existing power plants will provide about 60×10^6 Mw-hr/year.

GENERAL ELECTRIC

Improvements in the availability and capacity factors of existing nuclear plants and those under construction could significantly reduce the consumption of liquid and gaseous fuels. Approximately 40,000 barrels of oil are required to generate replacement electricity for a one-day outage of a 1000-megawatt nuclear plant.

The duration of the approximately annual refueling/maintenance outage for nuclear plants has been excessively long. Detailed studies of the causes of the long duration could provide directions for improvement. For example, studies should be conducted to determine how much reduction is possible through better planning and management, better training of maintenance and service personnel, improved equipment, and changes in work rules and practices. It is believed that reduction of this outage time is one of the quickest routes to availability improvement.

IDAHO 00

Although research and development of the Light Water Reactor concepts has been extensively executed for a number of years, in view of the increasing costs of electrical power production from fossil sources, there are many areas in which previously rejected ideas may now be shown to be cost effective. The major emphasis, in our opinion, should be to improve LWR availability and efficiency with resulting lower overall power production costs.

YANKEE ATOMIC

- . Detailed analysis (on a plant-by-plant basis) of the causes of poor availability and/or capacity factor.

NAT'L RURAL ELECTRIC CO-OP

study the use of nuclear plants for peaking and cycling;

2.2.3 ENERGY STORAGE

BURNS & ROE

In order to increase the load factor of all power plants, which reduces the cost of power generation, continued work should be carried out in energy storage systems which would permit the base loading of all the large plants. The energy storage should consider not only the pump storage but also the decomposition of water to hydrogen as well as the storage of heat and air and electric power. The possibility of integrating a nuclear power plant with the production of methanol with off-peak power should also be considered as an energy storage system.

EPRI

It should be recognized that maximum success for a national objective requires looking across discipline lines; for instance, essentially all non-hydro peaking power today comes from oil so that energy storage must be a high priority component of the budget.

CONSOLIDATED EDISON

- Providing support for the rapid development of the energy storage systems identified as most promising by the current ERDA-EPRI study on advanced energy storage systems. The availability of these systems would help insure the maximum usage of nuclear capacity.

YANKEE ATOMIC

-
- Increased R&D in energy storage technology.

2.3 COMPONENT TESTING & DEVELOPMENT

2.3.1 COMPONENT TESTING

GIBBS & HILL

Conduct accelerated aging studies of critical plant components to determine a reliable and economic means of meeting standards such as IEEE 323.

Conduct tests to establish the capability characteristics of different cable tray designs to withstand loads imposed under seismic excitation.

Develop simplified standards for testing complex equipment to qualifications under dynamic load.

COMMONWEALTH EDISON

Provide Facilities for Inservice Testing of Components, Fuel and Operating and Maintenance Techniques in a Commercial Power Plant Environment:

There is a need to provide for such testing in as realistic an environment as possible. Use of existing LWR's such as Dresden 1 and Yankee-Kowe where modifications to equipment, fuel, instrumentation and operation and maintenance techniques can be demonstrated under actual operating conditions in commercial nuclear power plants without adversely affecting plant availability should be considered.

Valves

Valve and valve operator malfunctions are a major contributor to power plant availability and reliability difficulties as well as abnormal occurrence reports to the NRC. Design review against failure data, as noted in 1 c) above, and inservice testing prior to component application will help to improve the reliability of these vital plant components.

YANKEE ATOMIC

- Component reliability, including the use of fault and event tree analysis in determining critical paths in system reliability considerations.

SARGENT & LUNDY

An effort in "operability qualification" for active equipment in the nuclear power plant would be desirable. Supporting and qualification tests for a wide range of representative active components for nuclear applications are desirable to demonstrate the following:

- a. The possibility of developing new assumptions to be used (or checking the validity of assumptions that are being used) in analytical calculations.
- b. The reliability of verifying the operability of an active component by analytical calculations only (using a mathematical model and assumptions consistent with the results of (a) above).
- c. The significance of applying all probable loadings of different plant conditions simultaneously.
- d. The severity of interaction between different components on one assembly.
- e. The level of sophistication needed in construction qualification programs for various active components.

In the area of equipment flexibility, research and development efforts are desirable to:

- a. Determine the effects of equipment flexibility on system response.
- b. Establish techniques for determining the flexibility of major plant components.

2.3.2 COMPONENT DEVELOPMENT

PIONEER SERVICE & ENGINEERING.

Development contracts with the manufacturers of pipe fittings, valves, and pumps directed toward obtaining a consistent level of quality in castings and forgings through improvement in techniques or redesign of the product to avoid particularly troublesome techniques.

Development contracts to design suitable automatic welding equipment for nuclear power plant construction and to encourage the dissemination of successful techniques for its use by demonstration at selected sites and government installations.

Development contracts to design weld joints requiring a minimum amount of weld metal and to adapt joint design to automatic welding systems.

Study contracts to prepare reference plant layouts that might optimize the use of shop fabricated piping sub-assemblies and automatic field welding techniques.

Study contracts to prepare reference plant layouts and system arrangements to test whether a wider use of factory assembled electrical control systems with pre-fabricated cabling and cable support systems is feasible.

BALTIMORE GAS & ELECTRIC

In the area of activities relating to existing and on-order plants, we have identified several general problem areas which might be suitable for investigation, possibly in conjunction with EPRI and manufacturers. Basic materials research is common to several of these problems. A high rate of wear is frequently experienced in the seal areas of positive displacement charging pumps. Solution of materials problems for this application could result in improved plant reliability and reduced downtime. Further improvements are needed in valves, which occur in large quantities in nuclear plants. Candidate areas would include such things as improved packing methods and materials, optimization of materials for specific types of service (such as borated water) and overall improvement in valve operation reliability. Materials used as tubing in various applications require study and improvement. This would apply to areas such as steam generators, heat exchangers, condensers, and nuclear fuel rods. Associated with the materials aspects are mechanical considerations such as erosion and adaptability to construction processes, and chemical considerations relating to tube corrosion and control of water chemistry.

COMBUSTION ENGINEERING

Improve Reliability of Plant Components

Statistics show that a substantial portion of the outage time of nuclear plants is the result of failure of components. One approach to improving components considered by the Federal Energy Administration (FEA) is the development of component standards applicable to central thermal power stations. Combustion Engineering supported this concept in its letter of November 26, 1974 to Mr. Edwin A. Kuhn, Acting Associate Assistant Administrator for Energy Conversion of FEA, noting that components for which improved standards are desirable include, for example, valves, valve operators, and pumps. Toward achieving this objective, Combustion Engineering endorsed maximum use of the professional societies and industry associations already involved in developing standards.

Combustion Engineering sees certain difficulties in upgrading specifications for nuclear components and in achieving and upgrading of the industrial products. In general, committees have a tendency to develop specifications to include virtually all currently-available products. At the same time, it is believed that the suppliers of components to the nuclear industry have had insufficient incentive to improve their products. It appears that they do not have confidence that the industry will select the higher quality product and be willing to pay not only the cost of the improved product but also a pro rata portion of the cost of development.

It is proposed that ERDA sponsor a program to test currently-available components. The components to be tested would be principally those supplied to the nuclear industry for the engineered safeguard systems, chemical and volume control systems, reactor instrumentation protection systems, and radioactive waste handling systems.

Concurrently, it is proposed that ERDA develop with industry standard specifications for the components to meet nuclear plant conditions and assure high reliability. As a final step, ERDA might sponsor the design, development, and construction and test of prototypes in those instances where acceptable models are neither available nor under development by industry. The results of these programs would be made freely available to industry.

The need for improved component reliability and ways of accomplishing it have been described in Section 1. (Increase Plant Availability). In addition, we believe that a substantial contribution to improvement in plant maintainability can be made in the design of systems to improve reliability. This should be, of course, a design objective in the modular plant development referred to under item 2 (Shorten Plant Construction Time).

C.E. (CON'T)

Design Components and Installations for Easy Access, for Simple Decontamination, and for Rapid Repair

It has been suggested earlier that ERDA support development of high reliability components for specific application to nuclear. The modular concept is particularly attractive insofar as it permits supplementing individual component tests with tests of components in operating systems. A testing program for a module should include demonstration of maintainability of the system and components under conditions which would be expected to prevail during fault conditions or following an abnormal occurrence in an operating plant.

CAROLINA POWER & LIGHT

Reduction of component failure, both in the nuclear and non-nuclear portions of the system, would do much to increase plant availability and consequently aid in reducing consumption of fossil fuels. Based on the analysis conducted by the AEC (NRC) and set forth in "Summary of Abnormal Occurrences Reported to the AEC During 1973," Report No. OOE-05-001, dated May, 1974, Table IV, valves are the component having the highest frequency of failure and malfunction.

There were, for example, one hundred and sixty (160) reported abnormal occurrences involving valves during 1973.

We recommend a study be conducted to codify the causes of failure, identify what R&D programs are needed to improve valve design and manufacture, conduct appropriate R&D; and based on program results, cooperate with valve manufacturers for the purpose of improving product reliability through improved design and manufacture.

Although valves are the component most subject to failure or malfunction, other components discussed in the AEC Report No. OOE-05-001 could be the subject of similar programs for improving their reliability.

DUKE POWER

From data now available from the NRC, identify those components that are causing down time and delineate R&D tasks that could lead to improvement of reliability of those components. An example might be valves and valve packing, and reactor coolant pump seals.

CONSOLIDATED EDISON

- Improved valves and valve operator designs which require less attention to packing and seat maintenance.

EEI

Component reliability -- Research and development can lead to better valve design and manufacture. Review of Abnormal Occurrence Reports might also suggest other components and systems which can be improved by appropriate research and development.

GENERAL ELECTRIC

Reduction of refueling/maintenance outages

- o Improved refueling platform and grapple.
- o Reduction of vessel head removal time.
- o Improved access for maintenance.
- o Improved equipment for handling large components.
- *o Full-scale training aids/mockups.

Valve improvements

- o Development of Main Steam Isolation valve with lower leakage, longer interval between maintenance periods and shorter time to service.
- o Development of Safety/Relief valve with lower probability of inadvertent opening or failure to close and better assurance of no leakage.
- o Development of a Flow Control valve having maximum operating life and minimum maintenance
- *o Development of improved gasket, seal, and packing materials.

IDAHO 00

Development of improved fluid system component performance and reliability. Components which could be improved include pumps, steam generators and other heat exchangers, turbines, condensers, and other tertiary heat rejection devices and valves.

NAT'L RURAL ELECTRIC CO-OP

Increase R&D efforts to improve the availability (plant factor) of nuclear power plants endeavoring to:

- a. **improve the electronic equipment which helps control nuclear power plants;**
- b. **accelerate research on valves for nuclear steam supply systems;**
- c. **improve welding techniques;**
- d. **eliminate piping cracks;**
- e. **improve nuclear fuels to prevent fuel failures;**

Conduct additional applied research to improve existing concepts, designs, construction methods and the quality of basic components used in the nuclear steam supply system.

2.4 LWR TECHNOLOGY

2.4.1 PLANT DERATING

MIDDLE SOUTH UTILITIES

In some operating reactors, the permissible power level is constrained below the design power level due to recent restrictions based on safety analysis. Reactor Operations in our MSU System are at design power level but are narrowly constrained in control rod positioning due to limitations derived from safety analysis. These safety analyses contain many conservative assumptions on reactor behavior due to inadequate test data to validate more realistic reactor behavior parameters. It is recognized that ERDA already has a significant research program in investigation of reactor behavior in simulated accident conditions. A continuation of this ERDA safety activity is encouraged. A supplemental ERDA program is recommended to encompass the following:

- a. Review of fuel behavior under transient conditions to identify those fuel behavior parameters that are performance-limiting parameters and on which additional test data would be beneficial in reducing the statistical uncertainties in the behavior parameters.
- b. Initiate experiments to more precisely measure the fuel behavior parameters identified in the above review.
- c. Initiate the improvement of the analytical description of fuel behavior under transient conditions. The improvement of the form of the equations to more precisely conform to observed fuel behavior could further reduce the conservatism in safety analysis.

WESTING HOUSE

Tests and Inspections

A balance needs to be struck between the amount of safety related tests and inspections required in operating plants and the requirement for continued operation at a high power level. Testing and inspection requirements should reflect the need for high plant availability and capacity factor.

Regulatory Power Limits

A number of plants have temporary restrictions on their licensed power level. These limitations should be critically reviewed in order to allow the plants to increase power level as early as possible.

Plant Updatings

A number of nuclear plant operators are currently evaluating the possibility of uprating their units to higher power levels. Every effort should be made to simplify the licensing process associated with such updatings.

CONSOLIDATED EDISON

Several LWRs (including our Indian Point No. 2 and 3) have stretch capability for increased power output if their license limitations can be relieved. Since licensing limitations are often generic to a class of reactors, consideration should be given to ERDA working with the manufacturers and utilities to develop generic approaches for realizing the stretch capability of these reactors and thus accelerating the realization of the full potential of our society's investment in nuclear power.

In some instances the stretch capability of LWRs might be increased by instituting relatively minor plant modifications (e.g., replacement of a pump or other auxiliary component with insufficient capacity to support the maximum potential of the main plant components. Even main components can sometimes be modified to eliminate or relieve certain types of capacity restrictions). ERDA should encourage tests and studies to determine the potential for such improvement and encourage their implementation.

ARKANSAS POWER & LIGHT

In particular, ERDA should expand one of the current and proposed EPRI fuel performance projects in order to provide a large statistical base of operating data and thereby allow the removal or reduction of the current light water reactor operating restrictions. Uncertainties in the fuel performance response to large power ramps, high power densities, and high burnups need to be reduced or removed and could be done with adequate data. Current power change limitations result in a loss of up to three to four effective full power days each time a reactor returns to full power following a trip or shutdown, and this alone can result in an annual loss in capacity factor of six to eight percent.

ERDA should review those plants presently on-line in order to determine their status relative to their ability to achieve a higher stretch power rating. If some specific R&D and/or data base needs to be established for the lead unit of a group in order to upgrade it, then this should be looked at very closely because it may be the way to quickly increase the maximum electrical energy generation with the plants presently on line.

EPR1

The highest priority item should be the resolution of those issues that currently require plant deratings. Every plant returned to full power represents immediate oil replacement. Next in priority is the resolution of issues raised by NRC that lead to plant shutdowns for inspection, testing, etc. R&D to narrow uncertainties so that "tech spec" margins can be relaxed is also an important item.

2.4.2 FUEL ELEMENTS.

COMBUSTION ENGINEERING

Improve Fuel Rod Integrity

Fuel failures are common to all light water reactors in the U.S. and throughout the world. While there are many clues and several theories, full understanding of the underlying phenomena is lacking.

It is proposed that ERDA undertake a program of post-irradiation examination of both failed fuel rod specimens and fuel rods which have successfully withstood long-term irradiation at high linear power densities. The manufacturers of the fuel rods would be required to completely characterize the specimens submitted for testing; only details of the manufacturing process would be held proprietary. The results of the storage pool and hot-cell examinations would be made public, as well as the fuel rod characteristics and the mode of operation in reactor.

Understanding of causes of fuel failure would lead to immediate corrections in design and in specifications for manufacture. All the LWR industry would benefit, with an attendant reduction in plant shutdowns for removal of failed fuel; longer cycles could be expected with an attendant increase in plant reliability and availability and decreased fuel cycle costs.

To broaden the base of the program in the metallurgy of zirconium and zirconium-base alloys, it is proposed that ERDA establish a channel for transferring from the Naval Reactors Program data relevant to civilian reactors, such as irradiation growth data on the alloys of zirconium and, where appropriate, fabrication process data relative to the development of specific textures and properties of the materials.

Testing Program to Establish Ramping Capability (Present Designs)

Operating experience with existing nuclear plants suggests that rapid changes in power can contribute to fuel rod failures. It is also suspected that changes in local power distributions (due to control rod movement) which produce a rapid change in the linear heat rating of a fuel rod are potentially damaging to the fuel. While fuel-to-cladding interactions are suspected to play a role in the failure mechanism, detail knowledge is lacking upon which to base changes in design, materials, manufacturing techniques, or operating procedures.

It is proposed that ERDA sponsor with industry a testing program to establish the safe ramping capability of fuel rods of the designs now being used in power reactors. Since an important parameter in failure statistics is the burnup of the fuel rods at the time the change in linear power rate takes place, a large portion of the testing program should be carried out with pre-irradiated fuel which has experienced burnup of one or more plant cycles. This program would establish for each fuel design tested safe limits for reactor operation, i.e., ramping rates which would minimize fuel rod failure and thereby maximize plant availability.

All fuel submitted by industry for testing under this program would be fully characterized by the manufacturer, and the utility would provide the irradiation history. Only manufacturing details would be proprietary; other data and the results of the test programs would be made public.

Development and Testing of New Fuel Rod Configurations Designed for Extreme Load Cycle Conditions

Current experience suggests that the results of the testing program described above may be less than optimum with respect to plant load following capability. In order that nuclear plants may have maximum availability (and reliability) when operated in a load following mode, improved designs of fuel rods (and fuel assemblies) should be developed. It is proposed that ERDA sponsor with industry advanced fuel rod designs, particularly tailored to extreme load cycling conditions. The design or designs developed and proven through ramp testing in a reactor facility would be freely available to all manufacturers.

CAROLINA POWER & LIGHT

In reviewing possible needs for additional R&D activities to further improve the reliability of nuclear fuel, it is concluded that the various current ongoing programs should yield the desired output. Therefore, it appears that the maximum near-term benefits can best be achieved through supporting and accelerating the completion of existing activities.

In particular, a current concern with nuclear fuel performance reliability is fully understanding all the contributing factors which lead to fuel rod failure through a pellet-clad mechanical interaction. Currently, due to this concern and the lack of total understanding of this fuel failure mechanism, operating units are constrained to increase operating power levels in a very cautious and closely observed manner. These actions are believed overly conservative and result in some loss of unit availability. Until the pellet-clad interaction mechanism is fully understood, fuel design modification implemented preventing this mechanism from producing significant fuel rod failures, these contingency measures imposed on operations are necessary.

ERDA, EPRI, and other industry members have programs underway investigating pellet-clad interaction. Acceleration and possible coordination of certain aspects of this research should maximize the return from these programs.

IDAHO 00

Presently, the availability of LWR's is decreased by fuel cladding failures as well as refueling shutdowns. The mechanisms of these failures should be studied.

Areas in which further research may improve the fuel cycle economics include:

1. Fuel cladding materials
2. Fission gas removal from the fuel pins during operation
3. Chemical control materials and the synergistic effects associated therewith (i.e., the clad corrosion rates of current and improved clad materials at the nominal and anticipated abnormal LWR operating conditions)
4. Different burnable poison-fuel material combinations

GENERAL ELECTRIC

Fuel improvements

- o Development of fuel more tolerant of transient conditions.
- o Pilot bundle fabrication and testing of promising candidates.
- o Improvement of equipment and techniques for detecting and locating failed fuel.
- *o Development of techniques for improved fuel utilization.

BABCOCK & WILCOX

Design, test and inspection of fuel pins in LWR's to assess effect of design changes including advanced fuel pin designs.

Extension of existing hot cell examination programs of irradiated fuel to gain performance data for future fuel pin designs.

Extend present in-core power distribution instrumentation development programs to permit plant operation with minimum power peaks.

Develop and test failed fuel detection systems to permit locating and removal of failed fuel.

YANKEE ATOMIC

- Fuel reliability and materials technology including: the effect of changes in fuel rod dimensions and linear heat ratings on fission gas release, fuel swelling, and fuel-clad mechanical interactions under both steady power and load-following operations; the effect of rod prepressurization and fuel density variations on hot gap conductance, fuel failure modes, and fuel response to LOCA's as a function of fuel lifetime; development of statistical fuel failure models; and effects of various fission products and fuel impurity levels on fuel integrity; means of avoiding pellet-clad interaction under normal transient conditions and for load following.

COMMONWEALTH EDISON

Fuel performance improvement is of obvious importance. Specific areas we offer for consideration include:

- a) Higher burn-up. Better achievement of design exposure will result in significant reductions in the cost of nuclear generation and a lowering of enrichment capacity requirements. The influence of pellet-clad interaction, hydriding and densification on fuel burn-up should be further studied with the objective of further up-rating fuel performance.
- b) Improving nuclear power reactor load following capability and lifting restrictive, fuel related power change limitations.
- c) Improving on-line and off-line fuel leak detection capability.

EEI

Fuel performance -- A better understanding of the contributing factors which lead to fuel rod failure through pellet-clad interaction mechanisms can lead to the establishment of realistic criteria which will permit plant operation at increased power levels. Current knowledge of this phenomenon has fostered restrictive operating procedures which probably result in some loss of unit availability.

PENNSYLVANIA POWER & LIGHT

ERDA could expand existing programs on fuel material properties and modeling fuel behavior under operating conditions such as those now underway by Aerojet Nuclear Corporation on the computer codes FRAP-T, FRAP-S and MATPRO for both uranium oxide and mixed oxide fuel.

Restore support of light water reactor fuel calculations such as by developing a complete set of neutron cross sections on isotopes used in light water reactors and data on neutrons per fission for plutonium isotopes as a function of neutron energy.

CONSUMERS POWER

Plant availability is also significantly restricted by rates of power escalation after shutdown. These fuel design imposed limitations can be reduced through continued development of fuel designs less subject to failure by mechanical interaction and thermal cycling.

OMAHA PUBLIC POWER

R&D directed toward better load following characteristics of nuclear plants.

2.4.3 ON-LINE INSTRUMENTATION. GENERAL PUBLIC UTILITIES

The current in-service inspection regulations have proliferated the requirements to assure continued plant integrity. The consequence of these expanded inspection programs are manifested not only in increased costs and potential extended outage periods, but also in a significantly increased radiation exposure to personnel who conduct the inspections. With the implementation of "as low as practicable" limitations on plant personnel radiation exposures, the requirements for decontamination will become more pressing. Decontamination experience to date indicates much trouble ahead if such operations are to be required. These conflicting interests and demands suggest the need for R&D efforts in three areas:

- a. The technology of plant decontamination methods must be validated to insure that safe, simple and time-expedient processes will be available when and if they are required.
- b. The need for and efficacy of performing the expanded in-service inspection programs now being enforced by the regulations should be assessed on a cost/benefit basis to evaluate the extent to which these inspections are truly warranted.
- c. Improved in-service inspection techniques should be developed and brought to operational maturity. Development of advanced devices could result in significantly reduced personnel radiation exposures if properly applied.

BALTIMORE GAS & ELECTRIC

Efforts directed at minimizing the need to remove nuclear units from service, or to reduce the duration of outages, could contribute significantly to overall plant availability and economics of operation. A positive step in this direction would be the development of in-service inspection methods acceptable to the Nuclear Regulatory Commission. One such technique for accomplishing in-service inspection may be the acoustic emission approach to monitoring of the integrity of thick-walled pressure vessels.

GILBERT ASSOCIATES

R & D in support of current plants should be concentrated on continuous in-service monitoring devices and methods. These devices and techniques should be developed for continuous monitoring of safety-related pressure boundary integrity, active component operability and control circuit performance. Also, continuing development of decontamination techniques will pay off as long-lived activation and fission-product levels continue to build up in operating plants, complicating and slowing down maintenance and inspection activities.

POTOMAC ELECTRIC

Development of pressure boundary flaw detection methods and equipment to facilitate reduced plant outage periods currently required for in-service inspection.

BABCOCK & WILCOX

Development and testing of improved in-service inspection equipment, methods and definition of acceptance criteria.

Refine existing techniques and develop new techniques for PWR steam generator tube inspection, plugging and/or repair.

Development and long-term testing of operational monitoring and diagnostic systems such as acoustic emission for pressure boundary integrity, loose parts detection, operating equipment status and neutron noise measurements

OMAHA PUBLIC POWER

R&D in the field of in-service inspection requirements that would result in reducing the frequency of plant outage to perform in-service inspections. The project could include more sophisticated equipment and procedures that would permit performing inspections while the plant was on-line or at least reduce outage time for inspection.

YANKEE ATOMIC

- Improved in-core instrumentation.
- Improved acoustic monitoring techniques for system integrity.
- Statistical approach to surveillance and inspection; possible reduction of low power tests consistent with adherence to statistically derived criteria.

COMMONWEALTH EDISON

Inservice Inspection

Inservice inspections are crucial to assuring primary system integrity. Improvements in such techniques and related equipment are needed to assure a higher degree of reliability and reproducibility. Among areas for R&D consideration are the development of adequate on-line methods and the improvement of the present off-line techniques. Improvements in the off-line area should be concentrated on achieving lower radiation exposure during inspection, reducing the influence of operator experience and increasing use of automatic, hands-off applications.

COMBUSTION ENGINEERING

With the increasing availability of computers to newer nuclear power plants, their use is being extended to do more and more monitoring of the nuclear systems. This is particularly true of "active" components such as motors and pumps. Examples are the monitoring of temperatures and coolant water flows with the computers performing "trending" and alarm functions.

It is recommended that ERDA undertake programs to foster advanced techniques of monitoring equipment "on line". In particular, the concept of "signature analysis" is seen as a more sophisticated scheme of in-service checking for normal versus abnormal performance by analyzing, for a piece of equipment, its noise, vibration, acceleration, etc. Development of such techniques for use by all of industry would permit detection and diagnosis of incipient problems in equipment, permitting timely ordering of replacement parts and making possible scheduled maintenance in advance of equipment failure.

CAROLINA POWER & LIGHT

Another item for consideration is measurement of leakage from primary/secondary systems into the containment vessel. A reliable on-line system for leakage flow rate measurement does not exist. Many systems are now in use which give a reliable detection of leakage (not leak rate), but the most accurate leakage rate determination is system volume inventory. An accurate means for quickly determining leak rate could assist the operator in determining if continued operation is safe.

IDAHO 00

Development of more reliable instrumentation components and control systems. Improvements in nuclear, process, reactor control instrumentation, and control systems would not only provide added safety, but would also improve plant availability by reducing the number of unnecessary shutdowns and optimize the plant utilization.

Development of on-line inspection techniques and refueling capabilities.

Development of improvements in overall plant maintainability.

OMAHA PUBLIC POWER

R&D of new and more reliable computer systems that could be used for plant control and monitoring.

GIBBS & HILL

Determine if there are methods of surveillance that can be used to obviate the need for pipe rupture restraints.

CONSOLIDATED EDISON

- Improvements in non-destructive testing techniques such as eddy current and ultrasonic examination to improve accuracy and reduce radiation exposure to inspection personnel.
- Maintenance techniques including remote and underwater welding and remote weld examination.

WESTING HOUSE

In order to improve the maintainability and serviceability of nuclear power plants, funding is needed for development of improved remote maintenance and inspection tools. Better tools and techniques are needed to improve the overall reliability of nuclear plants, and at the same time keeping personnel radiation exposure as low as practicable.

COMBUSTION ENGINEERING

It is expected that, with most components and system modules, it will be feasible to make all substitutions and repairs by direct access with minimum exposure to radiation of maintenance personnel. Where radiation levels can be expected to be high and decontamination and local shielding are not feasible solutions, development programs should be sponsored for remote maintenance tooling and procedures for use of that tooling.

CONSUMERS POWER

New methods should be developed for improving in-service surveillance of pressure boundaries by acoustic emissions or other means.

Another area of R&D work with high potential for reducing outage maintenance time and costs would be the development of specialized maintenance tools and procedures for such purposes as remote cutting, welding, and stress relieving.

2.4.4 STEAM GENERATORS

COMBUSTION ENGINEERING

Loss of PWR plant availability has occurred and continues to occur as the result of failure of tubing in the steam generator. Extensive work by the manufacturers has identified some of the cause-effect relationships, which should reduce the tubing corrosion problem. However, the spectrum of variables is so broad and the desired lifetime of steam generators is so long that much more experimentation is needed to establish design and operating conditions which will insure the long-term, satisfactory operation of steam generators.

Procedures for repairing isolated steam generator tube faults should be developed so that full power output capability can be maintained despite corrosion of a significant fraction of the tubes.

Chemical cleaning procedures should be developed for removing contaminants from steam generators without harm to the tubing.

It is proposed that ERDA sponsor continued metallurgical investigation of alternate steam generator tubing materials and continued testing of all available, promising materials in a variety of secondary water chemistries, including fault chemistries. Fault chemistries would include those encountered as a result of in-leakage of condenser water and would represent a variety of cooling water sources, such as river waters, sea water, cooling towers, cooling ponds, etc. Effects of feedwater train corrosion products should also be investigated. Experience has shown that steam generator geometry can have an influence on the variables affecting integrity of steam generator tubing. Therefore, the development program would include testing in model steam generators representing the designs of the manufacturers as disclosed by them. All materials, chemistry, and testing data would be made public. Only the manufacturers' fabrication process details would be withheld as proprietary.

To broaden the program and to make it most efficient, it is proposed that ERDA establish a channel for transferring from the Naval Reactors Program technical data relevant to the steam generator program. At the very least, duplication of work already accomplished should be eliminated.

COMMONWEALTH EDISON.

Service Related Failures in Austenitic Stainless Steels

A R&D program is needed to find better materials for use in piping and related components. Currently there are a number of cases where substitution of improved materials in nuclear applications is incumbered by lack of experience and "qualification" of replacement materials. An example involves the application of Type 304 Stainless Steel. This material has some known limitations and while its replacement in new designs is often considered, the final choice is usually to continue using 304 because experience with the alternate alloys is inadequate to justify the change. An in depth review of piping and other boundary materials should also be made with the objective of standardizing material application, identifying areas where further R&D is needed and optimizing piping system designs in line with corrosion and decontamination experience.

Corrosion in Steam Generator Tubes

Ongoing integrity of steam generator tubes is of major concern to the utility industry. More R&D is needed to identify and optimize design and operation of PWR steam generators. Similar work is needed on main steam condenser integrity since failure in condensers affects steam generator performance.

The problems with these systems may be more than materials related. Design review and simulated inservice testing are needed to improve operation of these systems in commercial applications.

CONSUMERS POWER

We would urge emphasis placed on R&D activities with regard to all facets of steam generator tubing integrity including design, materials, water chemistry, in-service inspection, and nondestructive testing. Research needs to be supported on a national basis on the methods and reagents for chemical cleaning of steam generators and other nuclear plant heat exchangers. Perhaps ERDA could help in securing the release and evaluation of the vast amount of U.S. Naval experience and technology in all of these areas relative to steam generators.

SAN DIEGO GAS & ELECTRIC

Two of the PWR vendors' steam generators continue to suffer from tube wastage and tube failures. ERDA should undertake a short-term study, assembling a task force from specialists in the National Laboratories and augmented by vendor personnel, to investigate the technological improvements required to reverse past experience. Key areas to be studied include:

- (1) fabrication techniques, criteria and standards,
- (2) secondary coolant fluid distribution,
- (3) tube vibration and fretting, and

KANSAS GAS & ELECTRIC

Items with the most uncertainty in PWR plant design today involve the integrity of steam generators and the associated feedwater treatment and chemistry. A well-planned development and testing program could yield results that may alleviate a major operational and maintenance problem.

OMAHA PUBLIC POWER

R&D regarding water chemistry control and steam generator tubing materials which would result in reduced plant outages caused by steam generator tube failure.

POTOMAC ELECTRIC

Investigation of corrosion phenomena and protection measures in nuclear applications, e.g., Steam Generator Tubes, Suppression Pool Liners.

PACIFIC GAS & ELECTRIC

It appears to us that there may be R&D that could be done on water chemistry for steam generators for pressurized water reactor plants which could decrease tube failures and increase availability for such plants.

2.5 WATER CHEMISTRY

2.5.1 CHEMISTRY-MATERIALS-CONDENSERS

GENERAL ELECTRIC

Materials problems have continued to limit nuclear plant availability in several instances. In particular, more extensive programs to understand better stress corrosion cracking and to develop more resistant materials would be beneficial. Additionally, development of materials that contribute less to radioactive "crud" build-up than some of the materials currently used would aid in reducing maintenance time and radiation exposure.

SARGENT & LUNDY

A study of fracture mechanism and related areas for safety grade piping, including the causes of cracking and the mechanism of crack propagation, needs to be undertaken in order to better understand this phenomenon. A better understanding of this phenomenon may result in decreased inservice inspection requirements with a commensurate improvement in plant availability.

PACIFIC GAS & ELECTRIC

ERDA may also wish to become involved in research on the present problems associated with intergranular stress-assisted corrosion cracking of austenitic stainless steel piping systems in boiling water reactors. Another area could be that of turbine blade performance. It is my understanding that EPRI has given such areas considerable thought. I expect that EPRI may give you similar comments.

COMMONWEALTH EDISON

Water chemistry control is basic and vital to efficient nuclear power plant operation. R&D effort should be aimed at finding better methods for water chemistry control. For example, the problems attending the switch from Phosphate to AVT treatment in certain FWR systems indicates that there is much room for improvement in water chemistry control. Included should be research on better corrosion inhibiting methods, on-line decontamination methods and reduction of stress assisted cracking through oxygen suppression.

COMBUSTION ENGINEERING

Improvements in Condenser and Feedwater Train

As noted in the preceding Section (1.b), "fault chemistry" is of serious concern in the preservation of steam generator integrity. At best, however, it appears impractical to consider operation beyond a very limited time with "fault chemistry" such as from a condenser leak. Shutdown or partial load reduction to repair condenser leaks is a contributing factor to lower nuclear plant availability. A solution to the problem of condenser leakage is especially important to LWRs, i.e., BWRs and PWRs; at the same time it is very important to fossil-fired generating units especially the high pressure, once-through boilers.

What is proposed for sponsorship by ERDA is a condenser development program encompassing design studies; materials development and testing (for tubing materials); and testing of tube materials in various water chemistries typical of the most common sources of cooling water: the ocean, brackish estuaries, rivers, lakes, cooling ponds, and cooling towers. It is deemed desirable to include design studies in this program (but not in the preceding programs) because of the feasibility of on-line repair of condenser defects and because of the need to develop optimum designs for detecting and locating leaks and for segmenting the condenser for servicing.

The chemistry of the water on the secondary side of the steam generator is also strongly affected by the feedwater train. It is proposed that ERDA sponsor metallurgical and chemistry studies related to the design of the feedwater heaters. The objective of this program would be to minimize contamination of condensate by corrosion products generated within these components.

The feasibility of using partial-flow condensate polishers in conjunction with segmented condensers to keep feedwater at the desired purity levels while condenser leaks are being located and repaired should be investigated. Any secondary corrosion effects of the demineralizers such as introduction of sodium into the feedwater should be checked out.

EPRI

In the longer range, applied work in water chemistry and materials is very important to provide a base for increasing the mean time between failures--an essential ingredient in increasing plant productivity. Since a major fraction of the outages are due to BOP items, this effort would also lead to increased reliability of fossil plants. The water chemistry program should also address the question of corrosion product and fission product deposition.

EEI

Water chemistry practices and materials selection in nuclear reactor systems -- Increased understanding of water chemistry requirements and materials behavior would assist in solving current problems with steam generator and tube leakage and BWR pipe cracks. Appropriate programs should emphasize studies conducted under plant operating conditions rather than those performed in a laboratory environment.

DETROIT EDISON

Applied research in the area of water chemistry and corrosion as it relates to components such as steam generators, turbines, and pipe cracking could play an important role in improving plant reliability. ERDA efforts should be supplemental to private industry's programs.

BABCOCK & WILCOX

Establish detailed programs to evaluate water chemistry program effectiveness for the programs in use by the several manufacturers.

SAN DIEGO GAS & ELECTRIC

- (4) effect of coolant chemistry on Inconel corrosion.

GIBBS & HILL

Development of high temperature demineralization equipment and resins to permit polishing of the condensate at the output of the feedwater heater train, thus removing metal oxides and metal ions at a location closest to the reactor.

Participate with the ASME Research Committee currently studying the effects of steam impurities on steam turbines.

Development of alternate designs for steam surface condensers to enhance leak-tightness throughout the equipment's lifetime.

2.5.2 DECONTAMINATION

GENERAL ELECTRIC

In-plant radiation level reduction

- o Selection of materials with less radiation build-up potential.
- o Extension of water chemistry control studies
- o Development of improved operating procedures
- o Development of decontamination methods and equipment.

....., radiation levels of operating plants have been increasing with time, due to transport and deposition of radioactive contaminants inside the nuclear systems. As a result, increased numbers of maintenance workers are required, in order to stay below personal exposure limits. In addition to plant technology studies to pinpoint and reduce the sources of these contaminants, development of plant decontamination methods deserves high-priority consideration.

BARBCOCK & WILCOX

- 4. Extend existing radiation survey programs to more completely define characteristic radiation levels in plants, expected source strengths, fission product transport, contamination distribution and other radiation associated parameters. Such data will permit prediction of expected levels and better planning for maintenance and inspection activities.
- 5. Extend existing radiation programs to characterize efficiencies and operating procedures for filters, demineralizers, evaporators and other waste management equipment. This would permit more effective control of radiation and reduced maintenance and inspection times.
- 6. Development and testing of decontamination solutions and procedures to reduce radiation levels in components requiring inspection and maintenance.

CONSOLIDATED EDISON

- Decontamination methods for reactor primary systems.
- Chemical cleaning methods for PWR steam generator secondary side.

COMMONWEALTH EDISON

Implement Methods for Reducing In-Plant Radiation Levels

Large Scale Decontamination Demonstrations

ERDA and industry support are needed to carry out several large scale demonstration decontamination projects such as the one planned at Dresden 1. Federal support for two or three such projects will help provide needed experience for designers and plant operators alike. The demonstration projects should be selected to provide experience with decontaminating the several light water reactor types now in common use.

Expand Research on Corrosion Product Build-Up, Transport, Activation and Deposition

There is a need to support basic research in corrosion product transport, activation and deposition. This will help minimize future activity build-up and lower in-plant radiation levels.

Radioactive Waste Handling and Disposal

On-site radwaste liquid and solid waste processing at existing nuclear power plants continue to be an area of concern because of high maintenance costs and potential capacity limitation. Development of improved design and component application is needed. This item and those noted in 4 b), c) and d) below indicate the advantages that could be gained through use of better inservice test capability where engineering, design and component application can be given more realistic testing before being put into commercial application. These test facilities could include vendor sites, "Demonstration Power Reactors" as discussed in 1 above and built-for-the-purpose facilities such as those developed for the LMFR program.

NAT'L RURAL ELECTRIC CO-OP

develop new and better methods for the
decontamination of nuclear facilities.

IDAHO 00

Development of improved primary and secondary system chemistry control methods and radiochemical cleanup systems.

Performance of basic and applied research on on-line tritium removal systems to decrease reactor maintenance down time.

3.0 NEW PLANT CONSTRUCTION

3.2 Nuclear Floating Power Plant

The majority of the comment texts were reproduced as an Appendix to the May 8 report on this subject, FSEC-NSG-217-75-49. The three comments received since then are included here for completeness.

GENERAL PUBLIC UTILITIES

We believe increased industry attention to developments such as standardized plant design and floating nuclear power plants are clearly warranted. However, we believe these programs suffer not so much from lack of R&D attention as they do from lack of active nuclear power plant procurement and construction activities to bring them more quickly into fruition. In his letter of April 7, 1975 to Mr. Thorne, Mr. E. R. Eberle, Chairman of Public Service Electric and Gas Company, points out that financing and licensing participation of the Federal government could significantly accelerate the development of the floating nuclear power plant program. We would encourage ERDA to explore the feasibility of following these recommendations.

WESTING HOUSE

The floating nuclear plant represents an important alternative to meeting the nation's nuclear power needs. Its inherent siting advantages and ability to be constructed on an assembly line basis makes it an attractive candidate for expanding the nation's nuclear energy capability on a short schedule. We encourage you to support the early utilization of the floating nuclear power plant.

CONSOLIDATED EDISON

The floating plant demonstration program would be an appropriate step toward encouraging new nuclear plant incentives and would help provide power in the early '80s when the shortages due to the current slowdown in new plant development will have greater impact. The flexibility of the concept was demonstrated by us in our barge mounted gas turbine applications. This type of facility offers the potential of faster construction and licensing.

3.3 PLANT DESIGN TECHNOLOGY

3.3.1 SEISMIC CRITERIA

SARGENT & LUNDY

Research and development efforts are desirable to establish a rational procedure for the selection of the design earthquake levels, considering historical data, probabilistic analysis and the mechanism of earthquakes which could preclude extended discussions in the establishment of plant design parameters.

Research and development programs are desirable to enable reassessment of the present conservatism used in determining seismic load factors as well as the overall conservatism utilized in the qualification of nuclear power plant structures, systems and components. More specifically, there is a need to reassess the present conservatism used in plant structure design, i.e., a factor of 1.4 for containment subcompartment pressure design coupled with a structural factor of 1.5 with a resultant factor of 2.1 for pressure considerations.

Research and development efforts are desirable in the area of seismic analysis to:

- a. Institute a test of analysis program which would determine the effects of the parameters listed below on a physical system:
 - i. Closely spaced modes
 - ii. Gapped restraints, limit stops
 - iii. Spring hangers
- b. Determine the overall level of safety at each step in seismic analysis from ground spectra through piping equipment design to prevent excessive conservatism at any step in the procedure.

Research and development efforts are desirable to experimentally verify three dimensional finite element models and analysis of power plant structures for seismic loads and soil-structure interaction analysis.

PIONEER SERVICE & ENGINEERING

Study and research contracts to develop reasonable and acceptable simplifications in modeling parameters for seismic analysis. Among these would be the soil-structure interface models, etc.

GIBBS & HILL

Establish a procedure whereby both the NRC and the applicant utilize the same panel of specialty consultants to arrive at the site geologic model, the design acceleration factor, the response spectra, the damping values, and other specific structural design criteria that is site dependent. The objective of this procedure would be to eliminate the competition that sometimes exists between consultants and to minimize the time needed to agree upon critical structural design criteria that must be established so that site preparation and foundation designs may be prepared.

Study and standardize procedures for the dynamic analysis of soil structure interaction rather than the many different procedures which are currently in vogue.

Establish "go-no-go" standards so that questionable sites may be quickly eliminated from consideration without expenditure of significant time and money. These rules should enable an applicant to know within 90 days whether he has a site that is licensable or not.

Conduct studies to determine the stability characteristics of soils under vibratory excitation and develop therefrom clear guidelines with respect to liquefaction and/or subsurface grouting.

BURNS & ROE

The effect of earthquakes on the safety of nuclear plants has been a major reason for ratcheting of nuclear power plant designs. NRC is constantly changing the criteria based on another Professor's paper, and each new paper becomes more conservative and more costly to the nuclear power plants. This problem should be put to bed once and for all by proper modeling and actual testing of simulated earthquake conditions so that we can stop this game of redoing every new plant under changing seismic criteria.

SAN DIEGO GAS & ELECTRIC

Analytical methods for evaluating soil-structure interaction effects during seismic events are only approximations and are generally a source of contention between the utility - architect/engineer and the NRC staff. Large uncertainties, in the proper methods to be employed in representing soils properties, filtering of frequencies of the earthquake spectrum, and modeling of the soil and structure by finite elements, result in the requirement of excessive conservatism by the NRC staff and increase the capital cost of nuclear plants. A combined experimental and analytical program of research by ERDA could evolve a firmer, more accurate description of the phenomena involved, reducing the time required to obtain NRC and ACRS approval of both PSAR and FSAR as well as limiting conservatism and the attendant effect on plant capital cost.

KANSAS GAS & ELECTRIC

Major economic impacts in the design of a nuclear plant stem from the conservatism applied to existing technology by the NRC regulatory requirements. Research and development directed toward the generation of data that would reduce the requirements for this conservatism could be very beneficial. Designs related to missile protection during a tornado and building response to earthquake induce vibratory ground motion are two examples. The elimination of continual increased design requirements by NRC regulations and guides would stabilize capital costs resulting from the design.

3.3.2 FLOW DYNAMICS.

SARGENT & LUNDY

Additional analysis supported by research programs in the area of fluid transient effects on plant safety systems:

- a. Establish a test program to determine the relationship between a hydraulic event (valve closure, relief valve discharge, etc.) and the resulting force/pressure transients affecting the piping system and equipment. Some areas of concern are:
 - i. Pipe rupture and blowdown
 - ii. Safety/relief valve discharge into closed systems (tanks, etc.)
 - iii. Water hammer
- b. Determine the effect of operational vibrations on effective system life to determine acceptable vibration levels for systems based on frequency of occurrence, pipe size and system stiffness.

Research and development efforts are desirable in the area of piping system design to:

- a. Establish a program to determine if the NRC "high energy line" definition is realistic. The program should determine if the pressure/temperature cutoff points should be increased.
- b. Run pipe rupture tests on large systems to validate the current analytical models and techniques.
- c. Establish a test program to determine if the NRC pipe rupture location criteria, based on stress and "additional points," is realistic.
- d. Review the total pipe rupture procedure (from crack inception through impact) to determine total conservatism at each step in the procedure in order to avoid compounding conservatisms.
- e. Perform a parametric study of pipe impact/impingement on concrete walls to establish a simple method for determining if wall damage will result.

GENERAL ELECTRIC

Flow induced vibration

- o Extension of fundamental studies.
- o Development of plant monitoring equipment and analysis of data.
- o Small-scale system modeling.
- o Full-scale component testing.

GIBBS & HILL

Conduct tests to establish the mechanism and failure modes of pipe rupture and develop therefrom design guidelines for dissipation of energy released by pipe ruptures.

3.3.3 STANDARDIZATION.

CONSUMERS POWER

We wholeheartedly support the move toward standardization and modularization of nuclear plant designs to cut down on licensing time requirements and reduction of overall construction lead times. We believe, however, that an effort should be made on the national level, perhaps through ERDA, to study and assure that these standard plant designs are tailored not only for constructability and high operational reliability and safety, but also for a high degree of maintainability with emphasis on in-service maintenance procedures through the additional use of isolation valves, shielding and multiple fractional components where possible.

MIDDLE SOUTH UTILITIES

In the area of nuclear steam supply and plant system standardization, we believe that although a limited approach has been started that there are many areas of components and standardized reactor arrangements which would essentially fit the category of standard PSAR requests. Standardization should be encouraged by ERDA since it will reduce the design time considerably, reduce licensing time and achieve standardized construction benefits.

GENERAL ELECTRIC

Past efforts to achieve significant reduction of the many "custom" designs of nuclear power plants have been only partially successful. More rapid progress is essential. It is recommended that either ERDA or NRC attempt the acceleration of standardization by issuing draft "guideline" criteria for design of "standard" plant sizes for review/comment by the supplier, architect-engineer, and Utilities industries. After firming up and "freezing" these criteria, several NRC/ERDA-funded parallel design team studies of standard plant designs (total plant, not just the Nuclear Steam Supply System) should then be carried out.

BABCOCK & WILCOX

8. Fund design studies by all manufacturers on advanced, standardized 400 to 600 MWe designs by each reactor manufacturer. Studies to include balance-of-plant designs by an architect-engineer and detailed assessment of total costs and schedules. Basic NSS designs to be adequate to permit a preliminary safety assessment by the Nuclear Regulatory Commission. Objective is to see if a small highly reliable nuclear plant is competitive.

TVA

And, in response to area 2, in looking to the future, an overriding concern is that nuclear power plants for various reasons might not be built in the numbers that are needed by the time they are needed for national energy supply. Actions taken to resolve such inhibiting effects as capital cost increases and the lengthy time between planning and plant operation would be a significant improvement. A part of the solution is likely to be standardization; TVA is cooperating with the General Electric Company on a standardized plant proposed for a site near Hartsville, Tennessee, for operation in the 1983-84 period.

DUQUESNE LIGHT

To shorten construction time and reduce costs, utility companies could agree to standardize construction by utilizing the world's best and most modern and efficient nuclear plant in operation as a model.

YANKEE ATOMIC

Activities related to plant standardization.

VERMONT YANKEE

Accelerate research on plant and system component standardization using generic principles with special regard for public acceptability.

DEPT. OF INTERIOR

Increased standardization and a set of carefully established regulatory and environmental guidelines will shorten construction times and increase plant availability as experience is gained in operation of large units. For plants not yet under construction, we feel that efforts should continue to be placed on standardization and the licensing process to reduce the overall time from start of construction to the date of commercial operation. Streamlined licensing and hearing procedures using standardized plant designs are essential for continued nuclear growth. Further methods to avoid considering issues already resolved in earlier licensing and regulatory actions should be studied.

CAROLINA POWER & LIGHT

One approach mentioned in your letter, standardization, could offer a substantial improvement in this situation if the standardization could be frozen at some point in time to allow design to proceed with the minimum of potential for design change. If a given standard design is evaluated to be adequate, then it should be immune to the imposition of additional regulatory requirements, unless the regulatory agency fully justifies any additional requirements based on a comprehensive cost-benefit analysis. By freezing the design, cost could be reduced, construction schedules improved, confidence could be restored that the cost and schedule could be controlled; and at the same time, a plant designed to protect the public health and safety could be built.

N.Y. EMERGENCY FUEL OFFICE

The standardization programs undertaken some time ago primarily by nuclear steam supply vendors offer time and cost reduction but require expansion. Their expanded development is expensive and acceptance procedures with the Nuclear Regulatory Commission (NRC) require improved coordination. Expansion of this effort including balance of plant (BOP) for each vendor, improved coordination between NRC staff, vendors and users and increased modularization efforts could all be accelerated by intensive ERDA, FEA, and Industry support. Rapid production and acceptance of Standard Safety Analysis Report for each vendor's NSSS-BOP System or Systems should be the goal. This concept offers the greatest potential for schedule and capital cost reduction if approached on a total plant maximum modularization basis.

UNITED ILLUMINATING CO.

With regard to actions which would reduce overall capital cost and improve labor productivity we feel that standardization represents a major step in achieving cost savings. Standardization efforts more appropriately should be made by industry as in fact has recently occurred to some degree. These efforts are severely compromised though by nuclear criteria and guides which remain in a developmental stage through the various phases of a nuclear project. Efforts to firm these criteria would encourage further utilization of standardized designs.

NORTHEAST UTILITIES

One of the major factors in hampering the increased utilization of standardized designs is the lack of definitive government policy as to the degree of compliance during the various phases of a nuclear project (e.g. planning, commitment, construction, operation) with NRC safety criteria and guides in the current time frame of extensive development of such criteria and guides.

LONG ISLAND LIGHTING

A comprehensive plan and timetable for developing nuclear plant standardization should be undertaken. This should establish a timetable and several avenues for implementing standardization, identifying the action required of utilities, architect-engineers, constructors, vendors and regulators.

PIONEER SERVICE & ENGINEERING

Studies to comprehensively demonstrate the merits of standardization to the industry. The realities of these benefits, if the studies so demonstrate, could more clearly bring into focus a common goal for the industry to achieve standardization. Perhaps these studies could best be accomplished by an ERDA stated willingness to assist regional study groups of utility representatives.

Continued and further expedited assistance to industry/government efforts producing standards which can be fully accepted by NRC as a code for nuclear plant design and construction.

BOSTON EDISON

Standardized designs offer prospects for reducing costs and shortening schedules for nuclear power plants. However, the immediate effect of the proliferation of national standards has been to significantly increase engineering manhours, material quantities and construction labor manhours forecasted for those units now under design. This occurs because the new standards frequently prescribe new design and construction requirements rather than document the design and construction practices used in the past. Presumably, the payoff from standardization will be realized once the significant national standards all become stabilized and available. We believe that in the near term, replication of approved power plant designs offers the greatest opportunity for reducing costs and shortening schedules and that replication

should be encouraged as the nationally preferred alternate at this time by regulatory agencies. Adoption of replication, of course, requires a discipline of restraint on further licensing requirements justified only by state-of-the-art developments.

CONSOLIDATED EDISON

The momentum in NRC, the manufacturers and users toward standardization and modularization should be encouraged. If this trend succeeds in reducing regulatory time lag and delays due to design changes, and spreads design costs over several plants, substantial capital cost savings are bound to be realized. Standardization is practical only where firm design bases can be established. The past and present history of standards promulgated by government regulatory agencies is one of almost continuous change. The changing standards extend the licensing procedures and, where they result in a design change during construction, the schedule is extended and the cost increased.

The degree to which units would be standardized appears to be an appropriate matter for further exploration and discussion between ERDA and the manufacturers and users. ERDA might consider sponsoring a conference or survey of LWR users to help in evaluating industry feeling regarding the degree of flexibility that can or should be allowed the users in selecting auxiliary components for standardized unit designs.

COMBUSTION ENGINEERING

Standardization of nuclear steam supply systems is moving ahead, although slowly. Combustion Engineering and other NSSS manufacturers are working with NRC to obtain licenses for their systems, as described in their standard safety analysis reports. Total plant standardization is proceeding but not on a broad front. Stone & Webster has submitted their SWESSAR for a standard plant, incorporating any one of several NSSS, one of which is Combustion Engineering's 3817 Mw(t) System 80. While at least one other A/E has an "internal form of standardization", other, smaller A/Es are not aggressively pursuing standardization although this offers substantial savings in construction time.

One A/E has pointed out that he is too small to afford the development of a standard plant to accommodate each manufacturer's standard and to repeat this design process for all the manufacturers' sizes (thermal ratings) of NSSS. The small A/E points out that he does not receive enough business during the "economic life" of such a design to pay out his investment in the initial development of the design.

To solve this industry problem, it is proposed that ERDA support development of criteria and an overall design for an "industry standard plant". An essential part of such a development would involve exchange within the industry of design information on plants, with the data obtained being freely disseminated to all parties. Combustion Engineering believes that this program would be most effective if the concept were to incorporate the concept of modularization described in the next paragraph.

GIBBS & HILL

Develop an incentive program whereby designers of nuclear projects may recover a portion of the costs of developing standard designs through a governmental reimbursement system or through a preferential taxing structure.

NORTHERN STATES POWER

Regarding ERDA support for standardization efforts, we believe that the advantages of standardization of land-based and floating nuclear plants are so obvious and attractive that there is no real need for ERDA involvement in standardization, except insofar as suggested in the previous paragraphs in promoting simplification of the complicated regulatory process.

NSP is familiar with the virtues of standardization since we are one of a group of five utilities participating in a joint effort to build five duplicate nuclear generating units within an organization known as SNUPPS (Standardized Nuclear Unit Power Plant System). Implementation of this standardization concept does not require new or improved technology, but the process would be encouraged by a regulatory climate, at Federal and State levels, which would reduce the overall duration and cost of the standardized plant projects.

KANSAS GAS & ELECTRIC

KG&E through its participation in SNUPPS is demonstrating its commitment to standardization (or more precisely, duplication) in the pursuit of lowering capital costs and improving reliability of the plants. Industry-wide involvement in standardization and duplication could produce a significant reduction in capital and operating costs. The SNUPPS project is actively evaluating the savings that may be obtained through modularization of equipment with off-site fabrication concurrent with on-site construction.

SARGENT & LUNDY

We, at Sargent & Lundy, have been actively engaged in many aspects of standardization programs for many years. We believe that the use of standards and standardization have contributed to reduced cost and construction time in the utility industry for many years. At the present, we are engaged in many of the standardization efforts being undertaken within the nuclear industry. We have been instrumental in promulgating various standardization concepts for plant designs; notably, the modularization concept, the duplicate plant concept and the replicate plant concept. We believe that these approach can lead to the earliest substantial reduction in the lead time associated with licensing and construction of nuclear projects. Accordingly, we have wholeheartedly supported these approaches to the solution of the long lead time problems.

3.3.4 MODULARIZATION.

COMMONWEALTH EDISON

Standardization and modularization are specifically mentioned in your letter as possible ways to expedite new generating capability. We agree but believe that major strides in standardization will be difficult to accomplish within the present regulatory environment, unless regulatory requirements can be stabilized. As we can see it, modularization may be a more fruitful objective to pursue.

PUBLIC SERVICE OF COLORADO

So far as plant design is concerned, it seems to us that standardized systems and modular systems are more likely to be achieved than standardized overall plants and believe that the application of R & D in this area could be fruitful.

BALTIMORE GAS & ELECTRIC

The second general area concerns activities directed toward improvement of the nuclear power generation situation over the next 10 years. Productive activity in the area may be somewhat limited in view of the fact that required lead time for establishment of new nuclear generating facilities now approximates 10 years. It is not entirely clear that technological approaches can bring about significant shortening of lead time over the next 10-year period, since many of the factors contributing to the extended time are institutional in nature. Nonetheless, certain technological areas have already been suggested, and we believe that some improvement in lead time could be accomplished by increased modularization and standardization of components. Such approaches may well lead to a decrease in field erection time, which could be of significant benefit. It is important, however, that developments in these areas be consistent with applicable standards governing the components and systems involved. To this end, the ERDA program might profitably include cooperative efforts for the development of new techniques and demonstrations of their applicability to the construction of nuclear plants.

BURNS & ROE

I believe a study that modularizes large portions of the nuclear power plant in a preassembled unit by shop skills could expedite the construction and reduce the cost of nuclear plants. My conception of modularization is not limited to packages that meet present transportation methods, but rather major plant assembly, such as the primary heat transfer system within its own containment that is assembled and transported to a prepared foundation. The logistics of transportation and the development of special handling equipment will have to be developed for this concept. However, there should be an appreciable savings in time and money in such an approach.

COMBUSTION ENGINEERING

The concept of modularization is not new; efforts in the past in this direction have been frustrated by lack of time. In the view of at least one A/E-constructor, modularization, as exemplified in the factory construction and delivery to the site of entire systems or sub-systems on skids, presents no field labor problem. Similarly, there was seen to be no problem in field handling of skid-mounted systems of large size; it was believed that the field could accept and use the largest modularized assemblies which could be delivered to the site.

It is suggested that ERDA consider sponsoring efforts by A/E-manufacturer teams to arrive at criteria and modular designs of systems or sub-systems which might be factory assembled and transported to a site. By taking advantage of the various material and labor-saving concepts already in use in various parts of the industry, it is believed that substantial reductions could be achieved in the cost and time of construction.

The modular concept of nuclear plant design appears much more attractive than the floating nuclear plant concept because it represents a minimum of extrapolation in technology. Modularization is already being incorporated by Combustion Engineering in the design of the control room panels, the reactor instrumentation and protective equipment, and the plant computer. Modularization should present minimum problems in licensing. The concept would also be adaptable to all parts of the country (not just to coastal and riverine locations). Modular assemblies would be transported by rail or by conventional barge (with minimal risk during ocean transport) and would be sized to permit passage through existing locks for inland sites. The modular concept could take advantage of manufacturing and assembly capabilities of existing shops where trained workers are available. Government sponsorship of the modular concept, carrying it through the demonstration phase, will be a less costly approach to increasing near-term nuclear energy generation than would be the case with a demonstration program for complete floating nuclear plant.

PIONEER SERVICE & ENGINEERING

Studies investigating the applicability and benefits of modular plant arrangements to land-based and floating nuclear plants. High productivity construction techniques applicable to the complete dry-dock assembly of floating nuclear plants should also be considered for the in-place construction of land based facilities. These studies might also include a determination whether the techniques are more readily adaptable to plants in the 600 MWe range thereby resulting in the possibility of adding generating capacity at a faster rate using a multiplicity of smaller units. Among other considerations, the apparent higher reliability and availability of the smaller units should be evaluated.

3.3.5 WASTE HEAT

WESTINGHOUSE

Sponsor R&D on Waste Heat Disposal: Economic and Environmental Effects of Once-Through Cooling, Wet and Dry Cooling Towers, Cooling Ponds, Use of Waste Heat

An integrated plan of R&D on waste heat disposal, covering the economic and environmental effects of once-through cooling, wet and dry cooling towers and cooling ponds, as well as the uses of waste heat, would be beneficial. Research and development is currently under way, but it appears to be rather diffuse, and has little impact on general decision-making. Integration of plans and, particularly integration of results, are needed in order to form a sound basis for decision-making and to avoid such things as the arbitrary requirement of cooling towers over general geographic or political areas without consideration of the characteristics of individual sites.

DUQUESNE LIGHT

(15) In order to reduce overall capital costs of new nuclear plants and conserve water, a realistic approach should be taken with respect to the water cooling requirements where a cooling tower is required by law but is of questionable value to the environment. Not only is capital cost a factor, but operating and maintenance costs are additional costs passed on to the rate payers.

PACIFIC GAS & ELECTRIC

The second area in which comments were invited bears upon actions which might resolve issues tending to inhibit the installation of new nuclear plants. One area which might improve the ability to site nuclear plants would be to develop the concepts of dry and saltwater cooling towers as expeditiously as possible.

NAT'L RURAL ELECTRIC CO-OP

improve the design of cooling water intakes and outlets to eliminate or reduce the effects of entrainment and entrapment of fish;

modify cooling towers to improve plant efficiency;

OMAHA PUBLIC POWER

R&D to improve existing systems or to develop new methods and systems of dissipating heat from circulating water systems for condenser cooling.

IDAHO 00

An area which provides the potential for significant additional benefits is that of waste heat utilization. Areas of promise include:

The use of waste heat for space heating and industrial process heat.

The use of waste heat for agricultural purposes, such as tree farms.

VERMONT YANKEE

Perform a comprehensive evaluation of the potential societal benefits for applications of low-heat-quality condenser effluent water. Such applications might include lengthening the growing season for agricultural crops, heat source for aquaculture, etc.

3.4 FIELD CONSTRUCTION TECHNOLOGY

3.4.1 CONSTRUCTION TECHNIQUES

OMAHA PUBLIC POWER

ERDA should study the construction plans for those plants which were built in the shortest time at the most economical cost to see if there are common factors in project organization, contractual arrangements, scheduling, technical expertise, or other areas which could be successfully applied to plants now in the early stage of planning.

BABCOCK & WILCOX

Prepare detailed studies of construction sequences and techniques to identify areas of high construction costs and/or long schedule items.

Review construction techniques and sequences used in European plants to see if they can be used to reduce construction times in the United States.

Establish programs to reduce schedule times identified in 2 above.

POTOMAC ELECTRIC

Develop improvements in existing construction techniques with the objective of improving the field labor intensive nature, and construction lead times of nuclear projects. In particular, evaluate methods of prefabrication and modification of reinforced concrete structures without adversely constraining design schedules. Similar studies conducted on a generic basis should be conducted to reduce field labor requirements for erection of structural steel, piping, plant cabling, and support trays.

LONG ISLAND LIGHTING

Methods of shortening construction schedules should also be studied. Increased shop fabrication and round-the-clock shift work would be examples of areas for potential study.

COMBUSTION ENGINEERING

Shortening plant construction time is generally recognized as a highly desirable objective. The overwhelming importance is recognized when one reads that with allowance for funds during construction running 8%/year and escalation continuing at 7-1/2%/year these two components constitute at the time of completion of the plant over 50% of the capital cost. That shortening of plant construction time is a realizable objective seems obvious when statistics can be quoted to show that ~~for~~ plants incorporating nuclear steam supply systems of the same rating and the same manufacture (and built on the same schedule) have differed in the quantity of certain materials by a factor of 2. When one project has almost twice as much structural concrete as the second, and if there is a comparable difference in the efficiency of labor, then it appears there are ample opportunities to shorten plant construction time through improvements in plant design, standardization of design, and training of construction workers.

NORTH EAST UTILITIES

It is not clear to us on how ERDA or FEA can assist the nuclear industry in reducing overall capital cost, shorten construction time, and improve labor productivity and quality. We believe the industry can and must singularly address themselves to these needs.

3.4.2 MAN POWER TRAINING

BABCOCK & WILCOX

Conceive and implement (or support) programs to train equipment and instrumentation technicians with emphasis on:

- a) Special techniques for work in high radiation fields.
- b) High quality workmanship leading to high component reliability.
- c) Development of special training aids such as closed circuit television and mock-ups with simulated radiation fields or contaminated surfaces.

Develop training programs for construction technicians to ensure high quality workmanship and minimize rework.

COMBUSTION ENGINEERING

As has been indicated above, there is ample evidence that productivity of labor has a strong influence on the cost of a nuclear plant and the length of the schedule required for the field work. The need for training of construction workers has been pointed out, as for example, in the meeting of the nuclear group at the FEA's Utility Oil Savings Conference. Combustion Engineering believes that ERDA should endorse and support such training programs.

IDAHO O O

Development of procedures, training methods, and personnel selection criteria to reduce losses due to operator inadequacies.

DEPT. OF INTERIOR

Construction manpower availability and productivity need study to avoid worker shortages, morale problems, and needless minor labor disagreements.

BURNS & ROE

I think it is amply clear from all recent surveys that the nuclear industry will be affected by an inadequate number of engineers. The solutions to this problem will have to follow a number of routes: namely, increased enrollment in nuclear power engineering courses at universities, as well as the use of computerized graphics for drafting and standardization of systems and components for nuclear power plants. This whole problem has to be studied and a program plan developed by placing all these factors together so that there are adequate technical people and machine applications to permit the nuclear industry to grow.

CONSUMERS POWER

Construction work is reduced at present and there is a shortage of construction workers. However, it is clear that with restoration or acceleration of projects there will be greater shortages. Recognizing that ERDA will become a large user of construction within the industry, it is suggested that ERDA in conjunction with other interested construction users and/or construction industry groups assume a leadership role in promoting the establishment of a national program of construction manpower planning - utilization; ie, a national program aimed at assuring

construction users that the construction industry will have the proper number of properly qualified and motivated craftsmen, technicians and professionals in its work force to carry on the work that has to be done.

3.5 ADVANCED SAFETY DESIGN

3.5.1 EMERGENCY CORE COOLING GENERAL PUBLIC UTILITIES.

There appears to be a consensus that the current evaluations of ECCS consequences in conformance with the requirements of Appendix K of 10CFR50 are overly restrictive. The lack of solid technical data and validated correlations have necessarily led to the adoption of what may well be ultraconservative assumptions and derating of operating nuclear plants at a time when efforts are being made to improve their performance. The recently released recommendations of the Lewis Study Group call for an improved and better-funded safety research program to bring about a convincing resolution of safety system performance uncertainties as quickly as possible. We concur with these recommendations. While we recognize that much work is being done in this area, we feel that additional test programs should be identified and implemented by ERDA and the nuclear industry. In addition, there is clearly room now for a comprehensive technical review led by ERDA of the assumptions, requirements and restrictions which have been adopted to promulgate Appendix K. Hopefully, this review could result in basis for short-term relief from derating of operating plants.

The acceptance of the LOCA accident has probably directly or indirectly caused greater complication in the design and operation of nuclear plants than any other single safety issue. In spite of increased quality assurance to guarantee high integrity systems, careful analyses to

GPU (CONT)

demonstrate safe stress levels, increased inspections of systems and components, and the mounting test evidence that shows catastrophic failures to be extremely unlikely, the regulations continue to impose a mounting variety of supports, restraints, barriers, components and systems to protect against and to mitigate the consequences of LOCA events. A technical assessment of this trouble area to take into account all the currently available technical data would stand a high chance for success in producing minimum and stable set of plant design requirements and should be given serious consideration for funding and technical support by ERDA.

IDAHO O O

Development of more reliable and effective engineered safeguards, including improved emergency core cooling systems, reactor shutdown systems, and containment systems.

Development of improved quality assurance methods and practices for all of the plant in addition to the nuclear steam supply system.

DALLAS POWER & LIGHT

Research and development programs are necessary which provide answers to generic questions, e.g. emergency core cooling system functioning and turbine missile hazards. Once these questions are completely investigated, the repetitious hearings on such matters can be eliminated.

BOSTON EDISON

Development of improved analytical methods for evaluating ECCS performance and additional testing to refine ECCS acceptance criteria are desirable to reduce power limitations and fuel restrictions at operating plants. The objective should be to develop information necessary to justify reduction of unnecessary conservatism in present methods of analysis and in present regulatory acceptance criteria. If justification for higher power operation of individual operating plants can be developed and assuming other licensing constraints can be resolved, then present operating plants may be capable of operation at higher power levels. Assuming licensing constraints can be resolved, then selected equipment modifications may be justified in present operating plants to uprate the present output of these plants.

EEI

Emergency core cooling systems -- More experimental work and quantitative analysis can verify the necessary safety criteria and assure that these requirements are not overly conservative.

NEW ENGLAND ELECTRIC

Loss of coolant R&D should be accelerated. Too much emphasis has been placed on preventing the accident (QA, redundancy, multiple failures), rather than coping with it after it has happened. Consideration should be given to a meltdown test in a LOFT-type facility, where the core is actually allowed to melt into the ground. Measurements of fission product release should be made, leading to a realistic assessment of the hazard involved, and to means of protecting the public even if a meltdown does occur. Without such an approach, the safety question can never be put to bed completely.

SARGENT & LUNDY

Completion of LOFT tests should be expedited in order to experimentally verify the design parameters used for the ECCS and containment models, fission product source terms and system loads. Also, the experimental verification of various computer codes used in calculating sub-compartment pressurization following LOCA and high energy line breaks (inside and outside containment) should be included as part of the current research and development effort related to the LOFT program. The results of the tests could then be used to reevaluate the degree of conservatism presently employed in accident analyses.

NORTH EAST UTILITIES

We are dismayed at the continued delay in the integrated ECCS performance tests (e.g. LOFT) and development of acceptable systems models to assess plant transients. Lack of such tests and analytical tools have burdened the industry with very conservative safety criteria which are impacting on presently operating plants.

PIONEER SERVICE & ENGINEERING

We note that there is already an extensive collection of federally funded nuclear R & D programs directed toward an understanding of the reactor safety issues. Programs such as LOFT, power burst facility and others come to mind. We would urge that ERDA take steps to reestablish clear objectives and schedules for these programs already in progress. Overcoming the inertia and schedule indifference of these programs, we believe, could go far in assisting the early implementation of more nuclear power generation.

CAROLINA POWER & LIGHT

Other areas of research which have significant potential for near-term returns are the examination of and quantification of the decay heat over time domains of importance to loss of coolant and accident analyses and quantitative returns from a currently stagnate LOFT program.

BURNS & ROE

ERDA has taken too long to run demonstration tests on the safety of water reactors. The ECCS's hearing delays would never have occurred if a safety program had been carried out years ago as planned. ERDA and FEA should be accelerating simulated tests to put to rest the doubt about guillotine pipe breaks, the reliability of ECCS, the fracture reactor vessels, and the other safety questions that are constantly arising on the licensing of plants. These tests should be carried out in full scale mock-ups so there is no doubt about the results of these experiments.

SARGENT & LUNDY

4. A quantitative experimental study is desirable to determine the hydrogen generation from radiolysis of water by fission products during post-LOCA conditions.
5. An experimental and analytical study is desirable to determine the mixing of hydrogen in a containment atmosphere and the effects of burning, in local regions of the containment, of the excessive hydrogen-oxygen concentrations.

3.5.2 CONTAINMENT

SARGENT & LUNDY

An extensive research and development effort to test the ability of concrete to go beyond yield in situations resulting from explosive overpressures should be undertaken.

A quantitative experimental and analytical study is desirable to determine the quantity of entrained water in flow between subcompartments for given thermodynamic conditions and flow rates.

Experimental verification is desirable for: a) computer codes that perform numerical model synthesis analysis of power plant substructures subjected to forced vibration, and b) computer codes that analyze cracking of reinforced concrete shell structures using a finite element displacement method that uses the material nonlinearity.

A study of tornado generated missiles needs to be undertaken to derive more realistic models, particularly with regard to the size and velocity of the missile. Additional research in this area should be directed toward relating missile size and velocity to structure height. This area is being addressed by an EPRI study.

PIONEER SERVICE & ENGINEERING

Study and research contracts to establish a design code for acceptable structural analysis regarding missile impacts. Experiments should be conducted to obtain fundamental and empirical data on the impact phenomenon of tornado generated missiles, pipe rupture, and others.

PENNSYLVANIA POWER & LIGHT

Provide research to result in publicly obtainable computer codes and/or calculational models, especially for the boiling water reactor, applicable to safety analysis including the containment vessel and its components.

IDAHO O O

An evaluation of steel lined pre-stressed concrete reactor vessels.

4.0 NON-DEVELOPMENT ITEMS

4.1 ECONOMIC CONSTRAINTS.

N.Y. EMERGENCY FUEL OFFICE

I share your concern regarding the type of government/industry cooperation that is necessary to increase our energy capacity. Such efforts have already been initiated by New York State in assisting Consolidated Edison with the construction of two new plants. It is my feeling that there should be greater federal financial assistance for utility construction. The establishment of subsidy programs for all regions of the country, corresponding to the assistance provided to the TVA, would assist in equalizing the energy costs borne by the residents of all regions of the country. It might be useful to explore the benefits that real property relief at the local level might have in establishing reasonable electricity rates or promoting more orderly plant capacity growth.

PUERTO RICO WATER RESOURCES AUTH.

ERDA should consider to enter on loan agreements with the utilities to finance nuclear power plants under licensing process or under construction, which are in danger of being delayed or canceled, due to economical problems.

BURNS & ROE

One of the major difficulties facing utilities in an expanded power economy is the financing of new nuclear plants. The U.S. has encouraged developing countries for many years to purchase American equipment by financing their power program through the Export-Import Bank by offering attractive terms to foreign governments and their utilities. It would seem to me one way to help the utilities to finance their expanded program is for the Federal Government to establish a domestic form of the Export-Import Bank to help the U.S. utilities finance their expanded programs through attractive interest rates. There are many other possible financing schemes that might be discussed, but this is one example where there is a model for the U.S. to use that is now successfully working.

The other question regarding Government-industry cooperation in financing I believe is a desirable approach. I believe the present arrangement between ERDA and the utility industry on the Clinch River Breeder Reactor Plant is a good example of such a model, providing the management of the program is consolidated within one group.

ARKANSAS POWER & LIGHT

Encourage government help in capital formation problems of utilities through tax incentives and direct government participation in prototype development.

SAN DIEGO GAS & ELECTRIC

ERDA and FEA should promptly promote indirect Federal Government financial assistance to the utility industry. The following matters are of crucial importance:

Solicit and lobby for putting construction work in progress (CWIP) in the utility rate base.

DUQUESNE LIGHT

Capital cost construction requirements could be handled through tax-exempt financing arrangements and serious consideration should be given to allowing utilities to handle dividends as an expense item on the income statement, such as debt interest is now handled.

Resolve promptly the Price-Anderson insurance problem.

SAN ANTONIO PUBLIC SERVICE BOARD

The ability to finance new generation is perhaps the utility's greatest deterrent to early application of nuclear for either displacement or added capacity. It would thus seem appropriate for the ERDA, FEA and the utilities to jointly seek and work with this country's most able economic experts to derive alternates to present financing methods and their inherent constraints. Concurrently, technical experts must be engaged to reduce overall plant capital costs by more intensive design innovation and by acceleration of the conventional cost reduction ventures in progress.

DEPT. OF INTERIOR

Because of the enormous capital costs involved in constructing and owning nuclear plants, and the relative decline in financial marketability of utility securities, many companies find it difficult to maintain construction schedules and are deferring construction for financial reasons. Any improvement in construction time, possibly through improving utility earning ability, would significantly reduce capital costs and plant delays. Several of the methods suggested under Specific Comments are aimed at reducing construction times. Unless utilities are able to finance new construction and construct plants within reasonable schedules, long-term abilities to meet loads and maintain system margins will be jeopardized.

DUKE POWER

Ability to finance on reasonable terms is currently the greatest deterrent to additional nuclear commitments. Alternative Federal roles in solving financial problems might well be the highest priority for a joint ERDA-FEA study with industry cooperation.

NORTHEAST UTILITIES

We have been hopeful that FEA and/or ERDA would be of assistance to the electric utility industry in developing the necessary climate for a responsive investment community in meeting our financial needs. I have suggested several such areas for consideration in the past:

First, the federal government should exercise its leadership to provide the state regulators with the public climate that will permit them to grant appropriate levels of rates necessary if the industry is to meet national objectives.

Second, the federal government should express its clear support for getting put in place essential utility facilities, and help the public to understand its dependence on the fullest utilization of existing coal and nuclear technologies as the base for capacity expansion during the coming decade.

Third, the federal government should establish national energy objectives and state regulators should be furnished guidelines by the federal government to test utility actions in the context of national objectives. Where these are being met, regulators should assure that rates are allowed adequate to provide electric utilities the financial ability to go forward with the expansion necessary to achieve those national objectives. For example, the federal government could establish criteria for the levels of return to be allowed to electric utilities and then require state agencies to adopt implementation plans to achieve such criteria, with review by a federal agency as to the adequacy of the state implementation plan. If the federal agency were not satisfied with the adequacy of the state implementation plan, it could promulgate its own plan. This is, of course, analogous to the type of implementation plans which states are required to develop to implement the Clean Air Act and the Water Quality Control Act.

Fourth, to the extent utilities are attempting to conform to national energy objectives in the development of conservation policies and rate structures to restrain the growth of uneconomic consumption of electricity, state regulators should be encouraged to permit a higher rate of return to the utility for these efforts.

Fifth, during periods of unprecedented rates of national inflation and where national constraints have been imposed on the expansion of the money supply to reduce nonessential capital expenditures, it is particularly important for regulated utilities, which must continue their expansion programs to meet national objectives, to be placed in the best position to compete effectively for the limited funds available. To assure that utilities have this financial capacity, state regulators, during such times, should be urged to allow utilities to automatically increase rates, subject to the regulators' continued surveillance, to assure the industry's ability to earn at least previously approved rates of return.

4.2 REGULATORY CONSTRAINTS

4.2.1 LICENSING DELAYS.

PACIFIC GAS & ELECTRIC

The major thing which would do the most to reduce overall capital costs and shorten construction time would be a system for expeditious licensing of new nuclear plants, both at the federal and state levels. Although this may not be an area where you have direct responsibility, it seems futile to perform R&D which should speed development only to find that the regulatory process does not, or cannot, respond with reduced lead times.

WESTINGHOUSE

Safety and Licensing Related Issues

The effect of licensing requirements, licensing schedule and changing criteria must be minimized in order both to reduce the time between a new plant order and plant commercial operation. Some specific points in this regard follow:

- a) The elapsed time between authorization to proceed and issuance of a construction permit for domestic plants is approximately three years. This compares with about one year for a domestic plant ten years ago or a foreign plant today. A significant benefit can be obtained by a reduction in this time span. Improvements may be realized by increased use of limited work authorizations, pre-qualification of sites, and increased emphasis on standardization.
- b) New regulatory guides and requirements continue to be developed. Additional requirements should be limited to those areas where substantial safety issues are at stake.
- c) Westinghouse is receptive to participation with the Energy Research and Development Administration in cooperative R&D programs, particularly involving the elimination of safety related issues. Cost sharing arrangements could involve the Energy Research and Development Administration and the Electric Power Research Institute. A number of similar cooperative programs are, in fact, currently being carried out.

Although the above issues may not fall within the scope of the National Energy Research and Development Plan, we believe that it is essential to balance the regulatory requirements with the need for increased power generation. We believe that the Energy Research and Development Administration and the Federal Energy Administration should highlight the need for maximum nuclear power generation.

SOUTH CAROLINA ENERGY MAN'G'M'T OFFICE

We in South Carolina wholeheartedly support efforts in above area. There should be added, the area of licensing of fuel reprocessing plants such as one currently being constructed in South Carolina. Delay in resolution of this problem will impact severely on potential of this energy source.

BOSTON EDISON

The lengthening duration for licensing nuclear power plants represents a major cause of the longer lead times required for a nuclear plant now relative to those actually required ten years ago.¹ These licensing schedules delay the operation of nuclear power plants and significantly increase the final cost of these plants as a result of larger escalation costs and larger costs of interest during the construction period. Substantial efforts to shorten the duration of regulatory review have been expended recently and promising progress has been made in managing the review process performed by the NRC staff.

GENERAL ELECTRIC

• Reduction of Capital Costs

The deteriorating financial health of a major portion of the Electric Utility industry has been the most significant recent impediment to the acceleration of nuclear power. Nuclear plants, particularly are being delayed by the Utilities in an attempt to reduce current or near-term capital expenditures.

In addition to other Governmental actions that may be necessary to improve the financial state of the Utilities, it is highly desirable to find ways of reducing the capital costs of nuclear plants, such as

Reduction of licensing delays

The total time consumed in all the steps of the licensing process is one of the major factors in stretching nuclear plant construction cycles from five years in the mid-sixties to the current eight to ten years. Time is money in a construction program and this factor of delay is one of the major reasons for Utilities' reluctance to build nuclear plants. Obviously, a drastic streamlining of this licensing process is essential.

EL PASO ELECTRIC

El Paso Electric Company has had no direct experience in nuclear R & D activities and, therefore, can add nothing to the suggested activities you list. El Paso Electric has participated in the nuclear R & D effort through financial support of the Edison Electric Institute Breeder Reactor Program and the Texas Atomic Energy Research Foundation. However, from an operational viewpoint, we fully support the need to decrease nuclear construction time by means of expediting the licensing process, improving construction methods and increasing design standardization, together with improving the operation availability.

EEI

The main inhibiting factors to an expanded use of nuclear power in the near term are the difficulties utilities are experiencing in financing new construction and the prolonged licensing procedures which utilities must undergo in order to construct and operate nuclear power plants. While the solution to these problems are not primarily research and development endeavors, both FEA and ERDA can contribute to the resolution of these impediments. FEA can foster government actions which will help utilities to keep pace with cost increases and to regain their position as attractive investments, thereby restoring the financial strength of electric utilities so that they can continue and expand the nation's nuclear power program. ERDA can undertake research and development to minimize safety and environmental issues in the licensing process and thus expedite the construction and operation of nuclear power plants. Reversing the trend of the continuous escalation of regulatory requirements being imposed on the design, construction and operation of nuclear power plants by providing a sound technological basis for the promulgation of such criteria can reduce costs and improve the scheduling of nuclear power plants.

DUKE POWER

Whereas construction times can be shortened by streamlining regulation, more importantly both design and construction can be expedited and accomplished more efficiently if the talents and energies of our technical leadership were not drawn away from their primary tasks by the increasing burden of regulation and multiplicity of agencies. We believe standardization will also help reduce costs and improve productivity and quality.

DUQUESNE LIGHT

(2) If ERDA intends to continue the hearing process during the construction and operating permit procedures, some kind of elimination process should be instituted that would prevent unsuccessful intervenors in past hearings from raising the same objections repeatedly.

4.2.2 RETROFITTING REGULATIONS

PIONEER SERVICE & ENGINEERING

Other areas of general concern that are receiving attention and, we believe can be benefited by ERDA, are the timeliness of regulatory review on technical issues and the criteria used to determine whether an issue in contention has a significant safety impact or not.

Plant construction schedules will not be as seriously hampered by the regulatory process if decision making on the acceptability of a system design is completed in a timely manner. However, the orderly flow of procurement and construction work is seriously upset when design additions and revisions occur on a project at the time construction is proceeding at a rapid pace in closely interrelated areas of the plant. Even relatively minor revisions at that time can have significant consequences on job productivity and scheduling.

Previously the regulatory review has been intensive until the safety evaluation report for a construction permit could be issued by the AEC staff. Then there was a lull in regulatory review activities. This lull came during the phase of the job when many of the design details were being settled, procurement documentation finalized and construction drawings prepared. As the regulatory review started again late in the project (at the time of the operating license application), resultant revisions had a disproportionately detrimental effect on construction schedules because of the inappropriate timing. We would urge NRC to continue their review without interruption following the safety evaluation report at the construction permit stage. Recent NRC statements indicate that this will be done for standard plant and duplicate plant applications. We would recommend that this procedure also be considered for custom and replication applications.

In our judgment, ERDA can also benefit timely decision making by authorizing research programs directed to provide guidance to NRC reviewers through generic studies on the sensitivity of standard NRC criteria (or regulatory guidance) to variations in selected parameters. Specifically, the NRC reviewer, armed with results of suitable sensitivity studies sponsored by ERDA, would not have to reopen design decisions in which the variations under contention are within reasonable tolerances.

We believe that the Rasmussen Report was a good start in this direction, but considerable follow-on study should be authorized. We could visualize that the ultimate development here might be an acceptance criteria based upon a defined ratio between the increased safety resulting from either operating restrictions or design enhancements and the loss of kilowatt hours not generated or delayed. If this ratio is small, the unit under construction or in operation should not be altered.

PIONEER (CON'T)

Perhaps the early studies could most profitably investigate the safety/availability benefit ratio of some current operating restrictions. Those that come to mind readily are:

1. Use of diesel generators as system peaking units.
2. Inspection and in-service test requirements that cause units to be unavailable or to operate at reduced output.
3. Limits on power distribution within the core.

CAROLINA POWER & LIGHT

In evaluating what efforts ERDA might extend in resolving issues which inhibit the procurement of new nuclear plants during the next ten years, one must recite some issues for which ERDA does not have responsibility; but, such recitation is necessary to fully illustrate the problem.

An important aspect of utility management decision making regarding the procurement of new units is the precise identification of unit cost and the schedule for bringing a unit into commercial service. The reliability of service is directly related to having the necessary generation available at that point in time when additional load demands must be met.

One of the principal inhibitors for the selection of nuclear units today is management difficulty in precisely defining either cost or schedule for nuclear units due to the continuous escalation of regulatory requirements being imposed on the design, construction, and operation of nuclear power plants. With the difficulty in defining cost and schedule within reasonable accuracy, management is reluctant to commit to the procurement of nuclear power plants since history to date indicates that ultimate cost and the ability to bring the plants into service on a schedule consistent with the load growth is becoming even more difficult to achieve.

This is not to suggest that all regulatory requirements are unnecessary or unjustified. Rather, there needs to be a clear and precise definition of what is actually needed for reactor safety; and once the design satisfies this criteria, only those changes having a substantial improvement in the protection of public health and safety should be required to be incorporated in the design, and then only if it can be shown that the current design is inadequate or the risk too great to remain unchanged.

CAROLINA (CON'T)

There is a serious need to reevaluate the manifold increase in design criteria for nuclear power plants and determine if many of these are actually needed for safety, or if we have collectively gotten ourselves into a "more is better" syndrome.

These continuously changing regulatory requirements have had a substantial impact on the cost of nuclear units both by increasing the equipment required to comply with the requirements and in many cases, causing the engineering of a project to have to be redone a number of times. These problems have also caused significant extension of construction schedules and low productivity.

We recognize that matters of licensing are not the responsibility of ERDA; however, licensing delays and uncertainties constitute one of the prime causes for delay of nuclear power plants being brought into service and a prime cause for inhibiting the commitment to nuclear power in the future. Any action which ERDA could take to reduce the licensing schedule, reduce the uncertainty of design requirements, and reduce the ever growing regulatory requirements would in all likelihood reduce overall capital cost, shorten construction time and improve labor productivity. We encourage ERDA, within its scope of responsibility, to address itself to this area of possible improvement.

GIBBS & HILL

- (d) Adopt an effective system for dialogue between Engineers and Regulators to minimize the issuance of new regulatory guides over the next 10 years. Limit new guides to those that both parties agree are unambiguous and necessary.

BURNS & ROE

Mr. Thorne's letter of March 31st invited my comments regarding possible joint study areas by ERDA and FEA in connection with increased needs for near-term electric energy generation from light water power plants. Although the Nuclear Regulatory Commission is not part of the scope of study, I might point out that the major cost savings to the U.S. will be achieved if NRC would stop ratcheting the commercial designs and expedite the licensing on nuclear plants. In spite of the youth of NRC, they are gaining the reputation for increasing the time of licensing rather than decreasing the time as requested by President Ford. In my estimation, the NRC approach of questioning decisions of previous regulation by AEC is detrimental to meeting the objectives of near-term needs of nuclear power.

WASHINGTON PUBLIC POWER

- a. Any effort to decrease the number of changes required by the Nuclear Regulatory Commission (NRC) to nuclear power plants which are in the design or construction stages would be most helpful. An example of the effects of these changes in a single plant are contained in the General Accounting Office staff report on the Tennessee Valley Authority's (TVA) Sequoyah Plant (Atomic Energy Clearing House, Congressional Information Bureau, Inc., Volume 21, No. 12, pages 10-25, March 24, 1975.) In this document, TVA officials assert that NRC has had a major impact on the plant's schedule by issuing several new industry-wide Regulatory Guidelines. NRC's primary concern is to insure that nuclear plants are designed and constructed to operate safely and little consideration is given to the effect of these guidelines on delaying schedules. NRC officials state that the period from 1968 thru 1974 was a time of great evolution for nuclear regulatory requirements; hence the need for change. During that period of time, the NRC formulated and continued to upgrade its regulatory guides to provide more detailed guidance on an acceptable method of design and construction. NRC officials acknowledged that this caused schedule delays because applicants could not foresee these changes during a plant's early design stages.

We believe this upgrading of safety requirements has not decreased significantly and that this factor continues to be a major reason for the delays in the design and construction of present nuclear plants. We suggest that research and development or other activities are desperately needed to show that changes of the type mentioned above should be decreased or eliminated entirely. One possible method of accomplishing this would be to show by analysis that the increased safety benefits are not sufficient to justify the increased cost and schedule penalties, especially in light of the nation's desperate need to achieve energy independence.

As a specific proposal to accomplish this, we would suggest that the techniques employed in WASH-1400, "Reactor Safety Study - An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants" be used to assess the need for any changes. These techniques should not be used on individual power plants because of their high cost and the potential of causing even further delay. However, consideration should be given to using these techniques for a class of plants of similar design. The objective would be to show that plants under design and construction are acceptably safe without any additional changes. As you know, WASH-1400 concluded that "the consequences of potential reactor accidents are no larger, and in many cases, are much smaller, than those of non-nuclear accidents. These consequences are smaller than people have been led to believe by previous studies which deliberately maximize risk estimates." This study was based on reactor designs developed in the late 1960's and much progress has been made in improving safety since that time. Thus a favorable conclusion could be expected.

YANKEE ATOMIC

- Streamlining of regulatory bottlenecks, minimization of racheting, coordination of EPA and Corps of Engineers permit requirements* with timing of NRC licensing actions.

* For example, EPA 402 discharge permits and 316(a) thermal variances are required to be filed before discharge to bodies of water can be made. These permits are for five years. This conflicts with the early site approval concept which may result in site designation 10 or 15 years in advance of use.

FLORIDA POWER CORP

Actions that tend to inhibit the procurement of new nuclear plants to help meet the national energy needs are in most part a result of the bureaucratic maze that must be untangled in order to obtain site approval and then obtain a construction permit. Some of this appears to have been overcome, or is in the process of being overcome, by having designated sites certified for nuclear plants. The time required from permitting to completion of light water reactor plants should be no more than six to seven years whereas now the time required is nine to ten years.

Elimination, or at least a reduction to a minimum, of back-fitting that causes delays. Light water reactor plants are now proven. Changes in design after a plant is under construction causes in many instances needless delay and cost escalation.

ARKANSAS POWER & LIGHT

a. ERDA and NRC acting together should resolve with the nuclear industry their intent to continue participation in the nuclear codes and standards programs. The standards groups have done a commendable job thus far, but there is still a great deal of work ahead. Standards have to be written carefully and then reviewed by all concerned parties. At the present time, the recent issuance of a multitude of regulatory guides has had a tremendous impact on the nuclear industry as well as the standards groups. Some of these guides are written in conflict with the proposed standards covering the same subject. Regulatory guides and nuclear codes and standards must have specific and appropriate applicability criteria. It can be very costly, and there is great potential for schedule delay if every new guide and standard issued is made applicable to every nuclear plant regardless of the stage of design and construction.

ERDA and NRC acting together should reach an agreement that unlimited backfitting must stop on nuclear plants in the operating license review stage. The granting of a construction permit should mean that a nuclear power plant can and should be built to the criteria and standards referenced in the PSAR. To disregard the PSAR requirements and impose new and more restrictive criteria at the operating license stage is extremely costly, causes significant schedule delays, and destroys the morale of the project team and the utility building the plant, as well as site labor productivity.

DUQUESNE LIGHT

The avoidance by NRC of changes in regulatory standards relating to the design of nuclear plants except where safety is of paramount importance.

The elimination of the tendency of NRC to make a new review of matters of design and construction which have been reviewed and settled in previous license proceedings.

A general standardization of requirements for consideration and design.

The expediting of standards to be established in the rulemaking procedure now under consideration with respect to proposed Appendix I.

Strict enforcement of rules covering conduct to proceedings to avoid delays in hearings on construction permits and operating licenses resulting from prolonged presentations on matters not germane or of significance to the hearings.

In view of the utilities' responsibility to determine the need for power and to provide that power at the lowest cost possible and the financial burden a utility must undertake to install power capacity, there seems to be little incentive to over-build. On this basis, the "need for power" as an issue in NRC licensing seems to be a redundant matter which merits minor consideration or elimination.

Provide allowance so that construction may proceed pending completion of antitrust review.

DEPT. OF INTERIOR

NRC and industry must establish designs and regulations early to avoid costly last-minute back-fitting and changes.

DUKE POWER

Increased nuclear generation will also result from fewer construction delays and plant shutdowns if we can stop racheting and retrofiting except where absolutely essential.

Our financing comments given in connection with encouraging new commitments to nuclear also apply to plants currently on order which continue to be exposed to more deferrals.

GILBERT ASSOCIATES

Many of the steps that were strongly urged by members of our staff in response to your letter related to regulatory matters beyond ERDA's responsibility. Of particular concern in our discussions was the impact of broadly implemented unit shutdowns in response to specific problems developing in similar units and the reflex action of mandated backfitting across a broad spectrum of units. Even though the regulations are beyond ERDA, it appears that these regulatory concerns could be addressed by ERDA by development of data bases, independent analyses and research so that the technical and statistical magnitude of the problems could be ascertained and specific units identified for review. ERDA's championing of reliability activities from a solid base of data and methods would assist in minimizing the impact of regulatory edict. Such activities by ERDA would not only increase the energy output from current units, but would encourage those currently reluctant to commit to nuclear energy because of uncertainties in regulatory actions after a plant has achieved commercial status. It was the suspicion of conflict of interest within the AEC that led to the separation of federal nuclear regulation and development responsibilities this year. Now, without the burden of regulatory responsibility, ERDA will be free to pursue the goal of adequate, economical energy in a positive way.

4.2.3 REVIEW OF PROCEDURES

GENERAL PUBLIC UTILITIES

1. The current licensing requirements represent an often disjointed evolution of restrictions, conservatisms and redundancies which, while established in the well-intentioned interest of safety tend now to encumber nuclear power plant design and operation, with many requirements whose costs and penalties may outweigh their true safety contribution. We feel that the development of an alternate set of licensing requirements is in order. This activity should take a comprehensive fresh look at the safety requirements for nuclear plants in the light of today's knowledge and develop a rational, quantitatively based set of overall requirements. It appears that the Rasmussen Study, WASH-1400, could form the quantitative cornerstone for this development. Such an effort, even though it is large and would require significant expenditure of funds and commitment of the best available technical resources, could be successfully undertaken as a cooperative venture under the leadership of ERDA with the support of NRC and the nuclear industry. The potential payoff from such a program appears high enough to warrant it on a priority basis.

OHIO EDISON

In connection with licensing, addressing all plant related issues for both construction and operating permits at the construction permit public hearing stage could help avoid delays. Generic rules covering nuclear licensing certainly would be helpful in reducing delays. For instance, it would be helpful to devise rules which would prevent the litigation and relitigation ad nauseum of a generalized opposition to nuclear power per se while permitting the consideration of legitimate and specific local concerns related to specific installations.

NORTHERN STATES POWER

Concerning action which ERDA might take to expedite the construction of new nuclear plants during the next ten years, we suggest that the multitude of overlapping governmental bureaus and jurisdictions which are involved in the licensing of various aspects of nuclear power plants results in significant increases in project duration and cost, and, in some cases, deters power suppliers from embarking on a nuclear power plant project. ERDA could perform a useful service by implementing a management study and action program which would lead to a clear, unequivocal statement of policy by the Federal government, in all its bureaus and departments, to support accelerated construction of light-water nuclear plants, and their associated fuel reprocessing facilities, to help meet the energy needs of the Nation. The study could identify the overlapping and conflicting agency positions and policies which now hamper the expeditious development of nuclear power projects. ERDA could propose workable solutions to streamline the existing licensing process, in all its tortuous ramifications.

VERMONT YANKEE

Comprehensively examine the planning, construction and licensing procedures from the utility and public viewpoints, for nuclear plants, including state regulatory, intervenor, and Federal interests as well as financial and practical operational matters. Develop effective ways to integrate these competing factors efficiently and in the best interest of all parties, so far as practicable.

SAN DIEGO GAS & ELECTRIC

ERDA and FEA should immediately seek the concurrence of NRC and EPA on the desirability of accelerating the licensing process. A key action would be to obtain a ruling from the U. S. Supreme Court confirming the position that the Federal Government preempts the State Governments in the regulatory process. Such action would eliminate the duplication and proliferation of document submittals, agency hearings and approvals, etc. currently required by State statutes that closely parallel the requirements of the NRC and EPA.

LONG ISLAND LIGHTING

We believe a study should be made of the regulatory requirements and administrative procedures now in effect, both on the federal and state level. This Company's experience in our Shoreham Station licensing proceedings has demonstrated that such procedures present almost insurmountable obstacles to a project which faces opposition, regardless of the merits of the opposition or whether or not this opposition represents a significant portion of the public. As a result of such protracted procedures, the applicant loses control of schedules, cost and factors which affect reliability. In addition, because of the importance of the timely receipt of appropriate permits, many of our best engineers and managers are lost to this non-productive effort, which further reduces an already critical manpower shortage.

Administrative procedures, rules, regulations and the implementation of existing laws by State Public Service Commissions and Environmental Departments, coupled with overlapping federal agencies such as the NRC and EPA, thus form a barrier to most energy supply projects that seriously threatens the availability of economic and reliable electric power.

A review of the effectiveness, usefulness and detrimental effect of codes and standards should be undertaken. Codes and standards are intended to promote safety, reliability of systems, standardization, and reduction of cost. They should not be promulgated simply to provide easy tools for regulators, protect vendors, or enhance the employment of certain segments of the industry.

AMERICAN PUBLIC POWER ASS'N

1. Use of predesignated sites and plant standardization, coupled with early antitrust, safety, environmental, and safeguards review, to reduce time schedules for nuclear power plants.
2. Development of a single composite application which would be the sole application required for Federal approval and designation of the Nuclear Regulatory Commission as lead Federal agency in handling of the application.
3. Creation of priorities and deadlines for regulatory action.
4. Establishment of cooperative State-Federal procedures aimed at elimination of regulatory duplication, such as the preparation of separate environmental impact statements.

GILBERT ASSOCIATES

Many states are in the process of making, or have made, power plant licensing regulations which are more time consuming than NRC regulations. For example, although the NRC has stated a willingness to issue an Environmental Impact Statement within 12 months to facilitate the issuance of an early limited work authorization (LWA) the Ohio Power Siting Commission (OPSC) specifically requires 2 years to review the state application. Since the NRC theoretically cannot issue an LWA without state approval, proposed nuclear plants in Ohio could be delayed by at least 12 months. The licensing process could also be delayed by required state public hearings for the plant in addition to those for the federal ER. This provides potential intervenors with two opportunities to delay construction in legal intervention. It is very possible that other states might model their power plant licensing regulations on those of Ohio.

I doubt that ERDA or the FEA has any influence over state regulations, but it would be valuable if they meet with state legislators and attempt to persuade them to amend their regulations to at least;

- (a) permit joint public hearings for state and federal regulations
- (b) agree to review state applications for new power plants within the same time framework as the NRC.

We hope our suggestions prove to be of some use to ERDA and are willing to discuss any of them at your convenience.

DEPT. OF INTERIOR

A. Further legislation and improvement must be made in licensing and regulatory procedures for new plants on both the State and Federal levels.

BABCOCK & WILCOX

Implement programs to assess equipment capability to meet requirements of regulatory guides. Develop criteria and specifications to guide equipment manufacturers to reduce time for Regulatory review.

MIDDLE SOUTH UTILITIES

An area that has lengthened the time for the consideration of nuclear power and may have deterred utilities is the matter of considering anti-trust as part of the licensing considerations. As Louisiana Power & Light Company has expressed our position in the past, it seems that anti-trust matters can be raised at any time and that they should not be an essential consideration with respect to the need for power or should not be an essential consideration as far as the safety conditions or the environmental conditions are concerned. They should be considered in parallel and not prior to the time that you get a construction permit. At the present, arrangements have the potential of adding anywhere from six months to three years to the licensing time required.

DUQUESNE LIGHT

It has been previously announced that the national aim was to reduce the construction time for nuclear units by approximately two years through streamlining the licensing procedures. This is a worthy goal but unfortunately apparently little progress has been made in this direction. If anything, the requirements for anti-trust reviews on the national level and such items as power siting requirements on a state level indicates further extending the licensing procedure. Substantial coordination is required.

Expanded standardization of plant design would serve to expedite licensing as might the establishment of designated sites. If the siting aspect were decoupled from the direct licensing process, the utility could identify a location well in advance of the start of construction. ERDA support of proposed House Bill HR 3995 would assist in this area. Separation of the review of the financial qualifications and need for power from the license application review would also serve to expedite the granting of construction permits. We feel that such non-safety related reviews might be more appropriate to FPC jurisdiction.

SARGENT & LUNDY

A research and development effort is desirable to better substantiate the necessity of a primary containment purge system required by Regulatory Guide 1.7 in light of the limitations of Regulatory Guides 1.3 and 1.4 and the improved technology of hydrogen recombiners.

Experimental verification is desirable to justify the NRC's position of precluding the use of fault current actuated interrupting devices as an isolation device.

A research and development program is desirable to demonstrate that a more efficient means of surveillance of ungrouted post tensioned tendons is feasible with a smaller sample size than is currently used. We believe that the results of such a study would yield an equivalent level of plant safety at a lower cost and reduced testing time.

A program to verify the assumptions of Regulatory Guide 1.78, "Assumptions for Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release" should be implemented.

SARGENT & LUNDY (CON'T)

Initiate charcoal adsorbent research, which was dropped some years ago. This research would be to study the efficiencies of present adsorbents for low concentrations of iodine in ventilation exhausts. If tests prove that adsorbents are not effective, it could save industry much money by precluding retrofitting charcoal systems on older plants. Other adsorbents could be identified and studied as alternatives to present adsorbents.

A research program to establish more realistic iodine loading criteria than that presented in Regulatory Guide 1.52 for adsorbents is recommended. Most evidence shows that a conservative factor of at least 5 is being applied, thus leading to greatly oversized atmosphere cleanup systems.

Experimental verification of NRC meteorological assumptions such as plume rise, building wake effects, etc., used in accident dose calculations is desirable. We believe there is an extremely high level of conservatism which only incrementally increases plant safety at a high cost penalty.

Continued research and development efforts to determine the spray system efficiency in removing post-LOCA fission product particulates in the containment are desirable.

Experimental verification of assumptions in accident analysis Regulatory Guides such as Regulatory Guides 1.3, 1.4, 1.25, etc., as well as the TID-14844 source term, is desirable.

An experimental study to quantitatively determine the mixing efficiency of containment sprays for post-LOCA hydrogen generation is recommended.

Research and development efforts are desirable to verify the requirements of Regulatory Guide 1.75, especially the separation distances listed, since, to our knowledge, no experimental basis exists for such requirements. Actual testing of the separation and safety distances needs to be performed in order to determine if the Regulatory Guide requirements are overly conservative.

The bases for the requirements listed in Regulatory Guide 1.63, "Electric Penetration Assemblies in Containment Structures for Water-Cooled Nuclear Power Plants," for self-fusing characteristics within the penetration conductors, need to be justified on an experimental basis. We do not believe the requirements for self-fusing represent an acceptable design approach because of the associated problems that could result, i.e., fire hazards.

4.2.4 SAFETY R & D.

COMBUSTION ENGINEERING

Beyond assurance of the fuel cycle, the LWR enterprise needs assurance that healthy commercial technological development can flourish without an overwhelming burden of parallel safety R&D. This means that the Government should sponsor safety R&D of the positive kind: That which will broaden the basic understanding of safety questions and have as its main thrust the improvement of safety design rather than the assessment of hazards of existing designs. The current emphasis on hazard assessment, and the reluctance of the Government to bear a large share of the costs of generalized safety R&D inhibits manufacturers from making design improvements. The manufacturer cannot afford to make a change in his design when that change would lead to the requirement for redoing safety tests that were carried out at great expense for the existing design.

NEW ENGLAND ELECTRIC

Ever-changing safety criteria are a major deterrent to utility commitments. What is safe today is not safe tomorrow, as a new crop of graduates enters government service. ERDA should work toward firm safety criteria, which cannot be changed at the whim of each recent graduate engineer, or new ACRS member.

IDAHO O O

Research in the nature of "confirmatory research" of the reactor safety of LWR's has not been included in the attachment since the programmatic requirements in this important area are assigned to the Nuclear Regulatory Commission. Nonetheless, it would be desirable, in our view, for ERDA to undertake an independent evaluation of the cost effectiveness and potential impact on the LWR industry resulting from the execution of the confirmatory assessment research under the prime direction of NRC. An example of a probable situation may help to clarify this point of view: Assume the results from the LOFT experimental series show that the existing computer representations provide extremely conservative clad temperatures in comparison with the measurements. What motivation will there be for NRC to improve the computer calculations to decrease the capital costs associated with the emergency core cooling systems? Independent assessment of these results by a small highly, technically competent ERDA staff could result in substantial reduction of the capital costs of an LWR. Recognizing the possibility that neither the vendors of the nuclear steam supply systems nor the utilities will attempt to place the results of the confirmatory research conducted by NRC in proper perspective and that potential improvements in the engineered safeguards systems will not be addressed, ERDA should consider investing some of its resources in this potentially important option. An initiative by ERDA in this area could result in a jointly funded undertaking by ERDA and the private sector (e.g., EPRI).

PUERTO RICO WATER RESOURCES AUTH.

The Atomic Energy Act of 1954 intended to promote the peaceful use of the atomic energy for the benefit of our civilization. To fulfill this objective a program was sponsored by the Atomic Energy Commission to persuade the public in general and the electric utilities in particular of the advantages of the nuclear reactors for generating electricity. A tremendous progress has been achieved since 1957 when Shippingport went critical for the first time. However, for the past 18 years many people have been concerned mainly about the safety of the nuclear power plants. The public does not know, does not understand, or does not want to believe the safety philosophy used in the design of these plants. Part of it comes from the fact that the proper Commission has relied heavily in mathematical modeling. Henceforth, to placate the anger of nuclear power plant critics and to relax the public about the fear of an accident where the core may melt down, ERDA should rely more on full scale modeling to the extent possible. The emergency core cooling system, the containment spray, the containment cooling system, and all the engineered safety features should be modeled this way. It is, we believe, the best way to erase the doubts for ever from those worried minds. If this can be done, the psychological man will be tranquil and will be ready to work out the solution to the other technical problems.

The licensing process is too long and the capital investment too high mainly because of all the safety requirements and delays during the construction stage. ERDA should display a great effort to demonstrate to the satisfaction of all, which safety requirements are truly unnecessary, if there are some at all, and how the capital investment can be reduced without jeopardizing the health and safety to the public.

CAROLINA POWER & LIGHT

(A) Investigation of surveillance test frequencies could lead to changing some of the test frequencies to longer intervals. Testing more frequently than is necessary to ensure safe operation increases the exposure of the plant to more frequent trips and equipment failures. It is believed that a serious study to determine an optimum test frequency considering safety and plant reliability would show that more testing is now being conducted than is necessary.

YANKEE ATOMIC

- Establish criteria via probabilistic risk assessment for determining whether proposed plant modifications involve significant safety considerations.

DALLAS POWER & LIGHT

ERDA should conduct tests in order to improve the analytical and experimental understanding of the performance and safety margin of nuclear power plants. Further tests need to be conducted to gather data to support current requirements and operating parameters. Such requirements and parameters should be modified if not supported by the data taken from operating plants.

GILBERT ASSOCIATES

Actions by ERDA which could influence wider application of fission energy plants in the future should be directed toward areas which would result in system redefinition and simplification. The redundancies and interlocks that result from "add-on" design to address safety concerns not only make nuclear plants expensive, but make them difficult to operate and maintain. Some benefits in this area could be derived from careful analysis of current system and component performance, but greater benefits are available from creative redefinition.

SARGENT & LUNDY

We believe that there should be better justification for the rigidity and conservatism under which nuclear power plants have to be designed and built, and that such a reassessment would serve 1) to enhance or at least to maintain the present level of safety in nuclear power plant design and 2) to reduce the overall costs associated with the design and construction of such plants. In certain cases, additional benefits would be derived from the research and development program.

GENERAL PUBLIC UTILITIES

The most recent requirements for preparing nuclear plant designs which protect against the consequences of a failure to scram following severe plant transient (ATWS) will probably result in increased plant complexity and cost. It appears that there is little quantitative data to substantiate the imposition of their requirements. A well-directed development program by ERDA could not only provide a valid perspective on the need for such additional protective devices, but could also develop alternate solutions to protective provisions that are demonstrably warranted.

4.3 FUEL CYCLE

GENERAL PUBLIC UTILITIES

The nuclear fuel cycle, its economics and its dependability, is at once the chief advantage and the most sensitive vulnerability of nuclear power. The current crisis in closing the nuclear fuel cycle must be resolved in a timely and rational fashion. The orderly growth of nuclear power and the continued economic operation of current nuclear generating units are dependent on reliability and predictability at all points in the nuclear fuel cycle. The achievement of the following goals as solutions to the major technical, socio-economic and political problem areas of the light water reactor fuel cycle should be the object of major ERDA efforts:

- a. Definition of domestic and world uranium ore reserves and formulation of governmental policies which would assure a sufficient degree of domestic independence in uranium supply.
- b. Definition of national objectives with regard to uranium enrichment capacity. An evaluation is required as to how much of a non-replacement natural resource can be sacrificed to provide marginal increase in existing governmental enrichment capacity today rather than push for achievement of new commercial enrichment capacity. For those who hold government contracts, a clear and timely definition of ERDA policy as to transaction tails level and SWU deferrals is overdue and essential.

GAU (CON'T)

- c. Safe, economic and timely methods must be developed to allow the closing of the fuel cycle through uranium fuel reprocessing, waste disposal and plutonium and uranium recycle. Policy and regulations must be established for private investors to make a risk assessment, define costs and set prices which will provide the return on investment necessary to warrant participation in the nuclear fuel industry.
- d. In addition to the technical and economic aspects of the nuclear fuel cycle addressed above, the more volatile and emotional aspects of these same issues must be openly evaluated, discussed and resolved. Clearly, the issues of long-term nuclear waste disposal, plutonium utilization and diversion of weapons-grade material are among the most controversial. It is incumbent upon ERDA and the nuclear industry to evaluate these issues and to provide the information and perspective to allow the decision-making process to go forth. The results will have long standing national impact; every effort must be expended to achieve an unambiguous and just conclusion.
- e. Items "c" and "d", above, will doubtless require significant time for resolution. In the meantime, the doubts are reinforced by the unavailability of any plan. The government should move rapidly to establish a baseline disposal plan which can demonstrate the availability of an engineered solution, which can serve the interim period and, if necessary, fill the ultimate requirement.

WESTINGHOUSE

Decisions are needed to clarify waste management and recycle issues. A key is the prompt resolution of Generic Environmental Statement on Mixed Oxides (GESMO) issues and the timely development of waste management capability. Definitive safeguards criteria are needed to resolve the GESMO transportation issue.

DEPT. OF INTERIOR

C. Industry has become reluctant to commit resources in the nuclear field because of what many feel has become an ever-changing unreachable target. For instance, plans for enrichment services additions seem to lack full consideration of the effects on the uranium market and current industry patterns. Although reprocessing and plutonium recycle problems seemed to be near resolution in the early 1970's, there is presently no long-range solution in sight. These problems are symptomatic of a general lack of complete and cohesive planning. The initiation of direct Government-industry dialogue on such utility problems is an extremely important first step toward redefining goals for the future.

PIONEER SERVICE & ENGINEERING

On issues tending to inhibit authorization of new nuclear plants, we believe ERDA and FEA can be most beneficial by defining the needed programs for enrichment facilities, spent fuel reprocessing plants, and waste storage facilities. Clearly defined national goals in these areas must be forthcoming soon to permit intelligent utility planning.

OHIO EDISON

It appears unlikely to me that new or increased R&D programs undertaken by ERDA would be effective in increasing the near-term (within the next 10 years) nuclear-electric output. There are substantial problems, however, with respect to licensing and fuel supply which if quickly solved could significantly increase the nuclear-electric output within the next 10 years. In my judgment, the solution to most or all of these problems resides in areas of activity other than R&D, but areas in which proper actions by ERDA could be very helpful.

In connection with fuel, enriching of uranium, recycling of plutonium, and nuclear waste disposal are currently very serious problems contributing to uncertainty about nuclear viability. Prompt and decisive action by ERDA with respect to basic policy would be a great step forward.

NEW ENGLAND ELECTRIC

Reprocessing, Waste Disposal, Plutonium Recycle

Lack of a policy in these areas introduces uncertainty, which will inhibit utility commitments. ERDA should work diligently toward a firm and clear policy in these areas, as early as possible. Let's face it, there are practical solutions to these problems available right now, if we can just stop the bureaucratic hand wringing.

GENERAL ELECTRIC

• Fuel Cycle Issues

The uncertainties involved in the so-called "back end" of the nuclear fuel cycle currently hamper realistic planning for nuclear power. These uncertainties concern potential Government regulations and policies affecting spent fuel storage, transportation, and reprocessing; plutonium (and mixed oxide) fuel fabrication, storage, and transportation; as well as interim and permanent waste disposal. Still further, at the front end of the fuel cycle, we urge that Government enrichment capacity be expanded by the CIP-CUP Programs. Early Government decisions and actions in all of these areas are urgently needed. Further, because there are serious questions as to whether additional enrichment capacity increments will in fact be provided by private industry, contingency plans and key decision milestones should be established for possible new Government enrichment capacity. To these ends, General Electric recommends that serious consideration be given by ERDA to:

a. A more active and direct Government role in the total nuclear fuel cycle

It may no longer be realistic to continue earlier assumptions that private industry can handle all aspects of the nuclear fuel cycle on the time schedules needed. This issue requires urgent attention to re-assess the Government/industry partnership needed to meet national energy policy objectives.

b. Government storage of spent fuel

Inadequate storage facilities for reactor-discharged spent fuel are rapidly becoming a major problem. A study should be undertaken now to determine alternative solutions for this problem. One alternative which should be evaluated is new storage facilities on Government sites for long-term storage (of the order of 10 years or so), which would provide significant fission product decay, additional time to work out the reprocessing and recycling problems, and safeguards to meet public concerns.

G.E. (CONT)

c. Integrated facilities at a Government site

To achieve early actions without licensing delays and provide public reassurance of direct Government control, an integrated facility at a Government site (such as Hanford or Savannah River) should be studied. Such a site might include facilities for spent fuel storage, reprocessing, plutonium fuel fabrication, and high-level waste treatment and storage. Its operations could provide a sound base of experience for future private sector or Government programs in later years.

DALLAS POWER & LIGHT

It is assumed that there is agreement that any viable future energy program in the United States depends on the survival and growth of the nuclear power industry. If the nuclear power industry is to survive, there must be an ensured reprocessing and refabrication of plutonium and depleted uranium. There must be an improvement in the use of available fissionable and fertile materials. The completion of the nuclear fuel cycle is a necessity. The lack of development of a program of recycling is more of an administrative problem than a technical one. This lack of development is affording nuclear power opponents their current and probably the most formidable issues which the nuclear industry has faced. If these issues concerning the "back end of the fuel cycle" are not resolved and resolved soon, the nuclear power industry is doomed. In response to intervenors challenges of these issues, the industry and the governmental agencies have chosen to talk of spent fuel storage and retrievable surface storage of high level waste without any direct, concerted effort directed toward the real solutions. ERDA, NRC, FEA and other governmental agencies must direct maximum attention toward resolving these issues if there is to be a future for the nuclear power industry.

BABCOCK & WILCOX

Implementation of programs to resolve uncertainties in the industry such as the use of plutonium in LWR fuel cycles; availability of spent fuel reprocessing facilities; availability of uranium and enriching facilities.

Programs to design and provide waste management and storage facilities for ERDA and commercial nuclear reactors and other facilities.

BOSTON EDISON

The nuclear fuel cycle could represent a severe constraint in any national attempt to significantly accelerate the installation of nuclear kilowatt hours (whether attained by increased capacity factors from presently planned units or by increased numbers of units), particularly if attempts to shorten lead times for licensing and construction of nuclear units is successfully shortened. Establishment of national energy policy relative to nuclear power objectives as discussed in 2d above is, of course, essential in order to provide confidence necessary to justify the new investment required. Regulatory uncertainties involving both feasibility and costs for reprocessing plutonium recycle and waste disposal must be resolved to reduce the present uncertainty in financial forecasts and unknown investor risks. Exploration for uranium ore must be expanded and reliable reports of discovery results and available reserves made public. Requirements for enrichment must be reliably forecast and necessary actions taken to assure supply. Failure to coordinate adequately the development of the nuclear fuel supply capability with the nuclear power plant demand could significantly affect the ability to substitute nuclear fuelled kilowatthours for oil fuelled kilowatthours.

PUBLIC SERVICE OF COLORADO

Your letter indicated that major issues associated with fuel cycle are under separate study, but you indicated that comments on these issues are welcome. It is our opinion that the many problems associated with the fuel cycle combine to present one of the critical issues facing the nuclear industry today. These problems are generally well known but if we may reiterate a few of these, they include a shortage of future enrichment capacity, uncertainty regarding plutonium recycle, lack of reprocessing facilities, lack of spent fuel storage facilities, uncertainty regarding waste disposal, and uncertainty regarding safeguards.

Since the issue of plutonium recycle is particularly uncertain, it appears that a decision may not be made for some time, possibly several years. We believe that it may be wise to explore alternatives. We urge that support of the thorium utilization program be maintained on a priority basis. It is suggested that the possible use of the thorium cycle in the light water reactor should be explored. Another suggestion would be an in-depth study of the toxicity of uranium-233 to assess whether there are any difficulties which might be encountered in the recycle of this material.

We would like to take this opportunity to mention that there are other aspects of the fuel cycle which relate to the possibility of shortening plant lead times that are not R & D topics. The eight year lead time that was applicable in ERDA enrichment contracts at the time contracting was suspended would result in a minimum overall project time for nuclear plants of 9-10 years.

KANSAS GAS & ELECTRIC

The greatest potential hazard to the survival of the nuclear industry has been created by the lack of progress in finding solutions to uranium enrichment, spent fuel reprocessing, plutonium utilization, and radioactive waste storage and disposal. Additionally, the lack of long-term assured supply of uranium feed stock creates a large uncertainty in the decision to build new nuclear plants. The prompt resolutions of these problems are the most important contributions that ERDA can make to the continued development of nuclear power.

EEI

Adequate uranium ore and enrichment, reprocessing and waste disposal facilities are needed to support an expanding nuclear power program. The government can do several things to help assure the availability of nuclear fuel, such as: support research and development of new uranium ore exploration techniques; provide assistance to private industry initiatives to build the next increment of enrichment capacity; and promptly establish regulations under which utilities will be permitted to use recycled plutonium in water-type reactors thereby decreasing demand for uranium ore and enrichment capacity and encouraging private industry to build necessary fuel reprocessing plants. ERDA can help support and carry out necessary research and development in the fuel cycle area, including investigations regarding the use of plutonium should it be determined that more knowledge is necessary to satisfy regulatory requirements.

A joint utility-ERDA planning organization should be established to assure efficient operation of the government's enrichment facilities and optimal resource planning.

COMMONWEALTH EDISON

Commercialization of plutonium recycle in light water reactor

Develop acceptable technology for interim and long term radioactive waste disposal including transmutation of actinides to fission products in fast reactors.

Develop improved operating and preoperating techniques applicable to improving nuclear material safeguards accountability systems.

Expand the base of knowledge concerning domestic uranium and thorium reserves.

Develop improved methods for uranium enrichment.

CONSOLIDATED EDISON

- Accelerating the National Uranium Resource Evaluation Program to better quantify domestic uranium resources. The availability of domestic uranium may well be the key to future nuclear power growth in the United States.

WESTINGHOUSE

The key to the assurance of future nuclear fuel supply is the availability of uranium. Actions to accelerate uranium exploration programs and to develop non-conventional uranium mining or extraction techniques would be beneficial to the achievement of the national goal of energy self-sufficiency.

AMER. PUBLIC POWER ASS'N

Initiation of Federal development of uranium located on Federal land

POTOMAC ELECTRIC

Develop guidelines to provide incentives for uranium exploration and to improve data on domestic reserves.

Review of the long-term needs for uranium stockpile in relation to plans for an enrichment pre-production stockpile, the expectations of securing foreign origin uranium consistent with the needs reflected in the foreign uranium embargo policy, and the possible requirements for modification of enrichment plant feed requirements to meet current contract obligations. The feasibility of a government to government transaction as a vehicle for maintaining the requisite stockpile should be explored.

Development of advanced uranium ore recovery technology, resulting in either lower extraction costs or improved resource utilization, which would make mining of small and low grade ore bodies economical, and uranium extraction from sea water, which could significantly expand the potential uranium resource base.

DUQUESNE LIGHT

ERDA should intensify its efforts to assure adequate uranium supplies for the industry. ERDA's recent tails change proposal has caused the long term possibility of major shortfalls or massive price increases for uranium to become more likely. Such efforts could be directed towards further development of laser enrichment.

Without firm assurance of an increase in enrichment capacity at least 11 years prior to need, continued growth of nuclear generating capacity is very doubtful.

WESTINGHOUSE

Action would also be desirable in providing an early resolution regarding the future additions to the United States' enrichment capacity. Decisions are needed dealing with both the form and nature of these future additions.

CONSOLIDATED EDISON

- Operating, or causing a government corporation to operate, the gaseous diffusion plants in a manner consistent with:
 - a. Assuring an adequate domestic stockpile of enriched uranium. Early budgeting and contracting for power supplies for the diffusion plants in this time of over-capacity would be one means of adding to the stockpile.
 - b. Establishing optimized tails assay for long-range planning for enriched uranium production based on long-range projections of uranium and diffusion plant power costs, and/or permitting enrichment customers to select a tails assay at the time each batch of fuel is delivered.
- Installation of the next needed increment of enrichment capacity as an add-on to one of the gaseous diffusion plants. This action is necessary as a means of guaranteeing the supply of enriched uranium at reasonable cost. In regard to creating this additional enrichment capacity, we have consistently expressed our preference for the establishment of a government corporation with the authority to self-finance.

POTOMAC ELECTRIC

In addition to an acceleration of the demonstration of commercial scale centrifuge enrichment technology, increased attention to laser isotope separation technology. In the latter case, the potential increase in the efficiency of the isotope separations process can effectively expand the uranium resource base.

SAN DIEGO GAS & ELECTRIC

ERDA should expeditiously evaluate the process of laser enrichment of uranium to eliminate the uncertainty in the commercial viability of alternative enrichment processes. Proponents of either the gas centrifuge or the diffusion enrichment paths to increased capacity cannot prudently commit to the massive capital funding required when the newer laser technology could render their facilities obsolete. This effort should be scaled to resolve the matter by about the end of calendar year 1976 to ensure adequate time to provide enrichment capacity for nuclear plants currently being purchased.

MIDDLE SOUTH UTILITIES

The fixed commitment enrichment contracts which the utility companies have signed with ERDA permit no flexibility in the amount of SWU tabulated in each contract. This is in distinct contrast with the SWU amount flexibility terms offered by Eurodif in their enrichment contracts. It is proposed that the severe terms in the ERDA enrichment contracts are unnecessary and should be modified to be comparable to those required in the commercial sector. This modification would ease the financial penalties imposed on utilities with changing enrichment requirements and contribute to an improved utility financial status as needed for new power plant commitments.

YANKEE ATOMIC

- Increased R&D activities in uranium enrichment technology.

FLORIDA POWER

Enrichment facilities must be increased. ERDA should move promptly and decisively to insure that sufficient enrichment facilities are available in the 1980s. These facilities could be either privately owned and operated; government owned and operated, or a combination of both.

NAT'L RURAL ELECTRIC CO-OP

There are other areas equally important in fuel processing that will require significant attention such as a commitment to construct future enrichment facilities and acceleration of development activities for the centrifuge process, in addition to the creation of a workable fuel reprocessing facility.

CONSOLIDATED EDISON

- Support of the industry effort to effect early, successful resolution of the Generic Environmental Statement on Mixed Oxides (GESMO) hearings. Investigation of new approaches to plutonium recycle, aimed at acceptable resolution of the safeguard and handling concerns, would be helpful. These investigations should include evaluation of techniques for recovering, storing, handling, and utilizing plutonium only in a dispersed or diluted form.

DUQUESNE LIGHT

Prompt completion of the review of plutonium recycling. Delay in completion of this makes it difficult for utilities to accurately assess the economics of nuclear fuel cycle.

DALLAS POWER & LIGHT

ERDA should accelerate research and development efforts in mixed oxide fuel utilization, processing, transport and storage. This is discussed more fully under 2. below.

BABCOCK & WILCOX

PLUTONIUM FUEL CYCLES

Implement programs designed to take advantage of plutonium fuel value for LWR's including manufacturing processes and security.

COMBUSTION ENGINEERING

Assurance of a Viable Fuel Cycle: Uranium Supply, Reprocessing Capability, Pu Recycle, Enrichment Capacity

Of the fuel cycle uncertainties mentioned above, those on which Government-sponsored R&D would have the greatest leverage are the assurance of uranium supply and the use of plutonium. It goes without saying that everything possible should be done to achieve reliable resource surveys, but the problem of supply is even more sensitive to reactor development directions than to ore quantities. Some means must be evident for extracting far more energy per pound from natural uranium if we are to proceed down the LWR path with confidence for many more years. That is to say, a commercial fast breeder is essential to confidence in our present direction of nuclear power exploitation; the first phase of which uses the LWR more or less exclusively.

NORTHEAST UTILITIES

It is extremely important that the NRC generic hearing on utilization of plutonium in LWR and high level waste storage handling be initiated immediately. As an advisory agency to NRC, your expression of concern as to the indefinite delay in these hearings would be very helpful to the nuclear industry. The delay in the initiation of these hearings has already impacted significantly on Northeast Utilities and other utilities with operational nuclear power plants. The unavailability of the criteria which would have evolved from these hearings has contributed to a delay in timely capital commitments to expand the nuclear fuel facilities needed to support even the presently committed nuclear power facilities.

ARKANSAS POWER & LIGHT

ERDA should move to establish firm guidelines and policies on the recycle of plutonium in light water reactors. Plutonium will quickly become a very important national energy source whose importance and timely recycle cannot be overlooked. Projected shortages in uranium and enrichment supply can be significantly relieved by plutonium utilization -- not to mention the overall financial savings of such a program. Urgent consideration and decision making is necessary to prevent significant industry complications and the loss of potential energy savings in the near future.

MIDDLE SOUTH UTILITIES

The lack of facilities for irradiated nuclear fuel reprocessing and the extended NRC schedule for reaching a decision on approval for plutonium recycle will defer the utilization of a significant energy resource in the utilization of plutonium in reactor refueling. The utilization of recycle plutonium would decrease the uranium feed and enrichment of the fuel cycle. The problem of fuel storage before and after reprocessing, safeguarding plutonium and the generic environmental impact of plutonium recycle fuel need to be resolved. These issues are interlocked and should be solved in a systematic approach rather than as individual issues. The technical capabilities of ERDA should be applied to these important issues.

UNITED ILLUMINATING

Matters affecting the nuclear fuel cycle are becoming progressively of greater concern and adding significantly to the uncertainties surrounding nuclear facilities. The issue of plutonium recycle (GESMO) yet remains unresolved and the generic hearings to be held on this matter have not been scheduled. There are some indications that this matter will not be settled until 1978. Recently we were disturbed to hear of an apparent shortage of uranium ore that could result in a shortfall in the late 70's extending into the 80's. Based on a required 8-10 year forward reserve requirement we do not see at this time any developments that will ease this apparent shortage of uranium. These issues prove to be counter-productive in our efforts to move ahead with nuclear additions. ERDA/FEA efforts in the fuel cycle area with particular emphasis on assuring adequate uranium ore supplies are needed if nuclear is to remain an economically viable alternative in meeting our goals.

PENNSYLVANIA POWER & LIGHT

Accelerate approval of plutonium recycle.

Accelerate government uranium exploration efforts.

GIBBS & HILL

Establish criteria and design guidelines that would permit the adoption of plutonium recycle into the fuel cycle of LWR's.

WASHINGTON PUBLIC POWER

We support study and public documentation of an evaluation of the Hanford "Purex" plant as an interim reprocessor of spent nuclear fuel. The nuclear industry presently projects a substantial undercapacity of spent fuel reprocessing facilities during the early and middle 1980's. Factors contributing to this include uncertainty about siting such plants, the emission levels that will be permitted, and safeguards measures required in the public sector for plutonium. It is possible that the Hanford "Purex" plant, originally built to reprocess fuel in the AEC production program, can be modified to handle commercial nuclear reactor fuel, and that the investment to do so could be repaid at government interest rates over a relatively short time (perhaps 10 years) with reprocessing charges corresponding to those projected for commercial plants. It is believed that, in this case, the siting problem is minimal because the plant already exists, the emissions are more easily handled because of the extremely low population density surrounding the plant, and the safeguards situation is temporarily sidestepped by storing the plutonium at the ERDA complex where established techniques have withstood the test of time. Additional benefits accruing from interim use of this facility are that a liquid waste system exists, solidification techniques are currently being used, and there is the possibility that the RSSF would also be located at Hanford, thereby removing one transportation step. This matter should be studied in some detail, and the results released so that those organizations wishing to participate in such a venture could identify themselves.

FLORIDA POWER

ERDA must move promptly to provide light water reactor spent fuel disposition (see data prepared by Savannah River Operations Office and Division of Production and Materials Management, United States Energy Research and Development Administration, March 1975).

MIDDLE SOUTH UTILITIES

In connection with the transportation of irradiated nuclear fuel, the alternatives are severely constrained. The present capabilities of highway transportation are limited to one or two fuel assemblies in each shipping cask because of either state restrictions or load restrictions. This will result in a large number of shipments and is not the most economic alternative. In the case of rail transportation a factor of ten to twenty more fuel assemblies per shipping cask can be carried and thus fewer shipments would be required. However, the rail industry and the rail unions are proposing severe constraints on the conditions of rail shipment procedures that would drastically increase the time required per shipment and this increase the required number of casks. Barge shipment is attractive but the number of nuclear power plants with barge access is very small. Air transport using lighter-than-air vehicles should be seriously considered.

A program by ERDA to evaluate the irradiated fuel shipment problem, determine the most reasonable method that should be used by the industry, and promote actions toward that goal would be a distinct service to the industry.

PORTLAND GENERAL ELECTRIC CO.

In this connection, we feel that it is most important that ERDA accelerate its studies of the fuel cycle outside the reactor. The portion that is most important commences with the removal of spent fuel from the reactor and continues through to the storage of waste material left after reprocessing.

As you know, opponents of nuclear power are concentrating on this portion of the fuel cycle and also on the recycling of plutonium. This effort is being carried forward on quite a broad scale and includes many state legislatures and other political bodies.

We feel that ERDA, with its broad access to military and other sources of information, is in a unique position to develop convincing solutions to these problems. We cannot over emphasize the importance of doing this quickly and thoroughly.

SAN DIEGO GAS & ELECTRIC

The closing of the fuel cycle is an urgent matter in which ERDA, FEA, NRC and EPA again must interact cooperatively and expeditiously. Every effort should be made to obtain approval of the Generic Environmental Statement Mixed Oxide report, WASH-1327. A consensus position of Executive Branch agencies is required to relieve the utilities of further expenditures related to spent fuel storage, reprocessing, and plutonium and uranium recycling. The current situation is wasteful of capital, energy (contained in the spent fuel) and resources, requiring greater consumption of ore and the energy necessary to operate the enrichment facilities of ERDA. This effort should include a clear statement of policy related to the handling, shipping and storage of high level wastes; the interim solution must be clearly announced to de-fuse the major arguments of anti-nuclear forces and the permanent solution must be sought expeditiously. Above all, the public must be informed of the progress being made and of the consensus conviction that the technology is in hand to avoid public hazard.

YANKEE ATOMIC

- Increased R&D activities relating to reprocessing and waste disposal.

CAROLINA POWER & LIGHT

The recent Savannah River Operations Office report, "LWR Spent Fuel Disposition Capabilities, 1975-1984," clearly indicates the serious industry need for spent fuel storage and reprocessing capability. Without an increase in the currently available spent fuel storage capacity, some reactors now operating face the prospect of shutting down in the future as a consequence of inability to discharge spent fuel. The seriousness of the problem is not significantly reduced by storage of fuel in the Allied-General Nuclear Services (AGNS) spent fuel storage pool or by increasing the capacity of the General Electric MFRP pool to 660 Mtu. From a licensing standpoint, the schedule for shipment of spent fuel to AGNS for storage is very uncertain. Early licensing of the AGNS reprocessing facility is unlikely. In view of the seriousness of the situation, and the lead time required for a substantial increase in spent fuel storage and reprocessing capability, we strongly encourage reconsideration of the use of ERDA facilities at Savannah River or Hanford for spent fuel storage and reprocessing. The shutdown of operating reactors due to inability to discharge spent fuel should not be permitted.

EPRI

The triangle of reprocessing, waste disposal, and safeguards is a very appropriate area for ERDA programs. It is historical fact that very large reprocessing plants operated safely for many years at both Hanford and Savannah River. However, the current societal issues of diversion, licensing, and regulation, together with technology increments required by higher burnup and plutonium recycle lead to revised requirements. Technical alternatives to physical security as a safeguards measure are an important area to be explored--the denatured fuel cycle for instance. The inherent safety of waste disposal due to earth crust immobility of the radioactive material and its sorption on soils and clays should be confirmed for more types of soils. Uranium supplies and enrichment should be assured. Plutonium recycle is important for several reasons--it displaces both uranium ore requirements and enrichment needs and it is probably the safest thing to go with plutonium in the near term.

CONSUMERS POWER

The major issues associated with the overall fuel cycle have been well delineated. We would encourage a vigorous national campaign to fully explore and air the viable alternatives, especially with regard to transportation and safeguarding; the short-term need for greater spent fuel storage facilities; the need for better understanding of overall fuel reprocessing economics; and the waste disposal problem.

IDAHO O O

Development of techniques to shorten spent fuel storage times

DUQUESNE LIGHT

Without acceleration of the resolution of the high level waste disposal problem, GESMO, and safeguards problems surrounding plutonium storage, shipment and fabrication, reprocessors will be unable to bring reprocessing facilities on line soon enough to avoid capacity reduction of nuclear power due to lack of spent fuel space.

POTOMAC ELECTRIC

Conduct economic and technical feasibility studies of novel spent fuel transportation techniques, including aerial and water shipment of large quantities of fuel per load.

TVA

In addition, we see potential future problems involved in getting nuclear fuel reprocessing plants into operation in a timely manner, thus leading to a possible shortage of interim storage capacity for spent fuel elements; in identifying new sources of medium- to high-grade uranium ore resources and developing economically feasible methods of extracting U_3O_8 from very low-grade resources; and in public understanding of the need for, and the safety of, nuclear power plants.

WASHINGTON PUBLIC POWER

We encourage those actions necessary to define, in a timely fashion, acceptable radioactive waste handling and disposal techniques. Accordingly we 1) encourage R&D in waste management, including demonstration facilities; 2) support a comprehensive, yet reasonable, categorization of nuclear wastes; and 3) encourage evaluation of acceptable forms for high level wastes, and projections of corresponding fee schedules for recovery of disposal costs. One major weakness in the current nuclear industry is the lack of any clear direction in disposal of nuclear wastes. A definitive program of research and development to select the best of those options presently believed to be technologically feasible and to demonstrate their application and effectiveness must be undertaken and implemented with all deliberate speed. A first step in such a program should be to categorize nuclear wastes so that disposal techniques appropriate to the waste may be established. Such categorization should not only take into account the potential requirements for treatment or handling, but should also be based on reasonable measurement criteria that will permit easy and rapid segregation of wastes in the workplace. Especially important, not only in terms of public acceptance but also in evaluation of alternative options, is the establishment of acceptable forms and associated fees for storage/disposal of high level wastes. For example, is a "throw-away" fuel cycle a viable alternative, or must fuel assemblies undergo some form of postirradiation processing before they can be released to the government for ultimate disposal?

ARKANSAS POWER & LIGHT

ERDA should hasten to initiate, evaluate, and establish firm policies and guidelines on the problem of retrievable long-term storage of radioactive waste. Specific federal regulations are ~~being~~ put into effect with strict requirements on the utility and the nuclear industry as to the disposition of waste products from various stages of the fuel cycle of the operating plant. Discussion, evaluation, and the change of regulations will be conducted as usual, but the initial proposed methods and regulations have not yet been defined to allow development of the proper waste storage method.

Spent fuel reprocessing is a required capability at the back end of the nuclear fuel cycle that does not presently exist. Unless such facilities as the AGNS reprocessing facility are allowed to be brought on the line in the near-term future, the existing nuclear power plants will have no place to discharge spent fuel. Federal decisions related to this capability need to be expedited.

MIDDLE SOUTH UTILITIES

Waste management appears to have made little progress and is basic to the long-term development of nuclear power. Until there is a viable waste management arrangement, and including the environmental statement accepted, there will be a great reluctance on the part of a good many to accept nuclear power. Continued work by ERDA on waste management plans and facilities is needed.

VERMONT YANKEE

Develop a demonstration model (including remote event sequences), acceptable to the public, confirming a solution to the long term radioactive waste disposal problem.

BALTIMORE GAS & ELECTRIC

Further attention should also be devoted to the disposal of radioactive waste materials. In addition to the ultimate disposal or

control methods, further development work should be carried out on methods and techniques for minimizing human exposure in the removal, packaging and shipping stages of radioactive waste disposal.

DUKE POWER

One major problem lies at the end of the fuel cycle. The Federal government must proceed with dispatch in defining criteria for the ultimate disposal of high level waste, for uranium and plutonium recycle including safeguards, and for reprocessing. If this is not done immediately, then the necessary facilities cannot be built and brought into service in time to avoid reduced nuclear generation because spent fuel storage pools are becoming filled. Continuing delay adversely impacts conservation of fuel resources because of inability to recycle.

OMAHA PUBLIC POWER

R&D regarding improved methods and systems for processing, packing, shipping, and disposing of low level radioactive waste. This would include solids, liquids and gaseous waste products. The increased accumulation associated with the "as low as practicable release" concept urgently needs attention.

BABCOCK & WILCOX

Continue to plan and implement major ERDA programs to process, transport and store radioactive wastes generated by commercial nuclear plants, ERDA facilities and fuel reprocessing plants.

WESTINGHOUSE

The alleged problem of radioactive waste disposal, which is a mainstay of many nuclear opponents, remains an open and provocative issue largely because a firm plan for disposal has not been adopted. This situation should be corrected as soon as possible.

BURNS & ROE

As long as there is no recommendation by ERDA to the permanent waste storage problem, there will always be a lingering doubt as to what to do with accumulated wastes. We should make studies now and develop a plan on what to do with the wastes, either for long-term storage or for recycling radioactive material for other applications.

GIBBS & HILL

Develop a sound engineering basis for the siting and construction of ultimate disposal sites for radioactive liquid and solid wastes, coupled with firm disposal and transportation criteria, which can serve to standardize the radwaste facility design of LWR's and operating logistics and costs for storing and disposing of radwaste.

EEI

ERDA also should establish the technological choice for long term radioactive waste disposal. The utility industry will continue to have difficulty in convincing the public of nuclear power benefits until the permanent storage issue is resolved.

CONSOLIDATED EDISON

- Completion of plans and programs for facilities to be used for immediate and long-term disposal of high level nuclear wastes. Steps should also be taken to insure the availability of storage sites for spent fuel until a decision is made regarding the use of mixed oxide fuels.

KANSAS GEOLOGICAL SURVEY

In my view, one of the major problems facing nuclear power development is storage of high-level waste. Having been associated with the problem of high-level radioactive waste storage in Kansas in an adversary role, I have followed developments with considerable interest. The problem has not been solved, prospects for solution are not in view, and the level of funding for solution of the problem is completely inadequate. Please be advised that our objections to storage in Kansas were based upon technical grounds involving inadequacy of the proposed site and absence of definitive information regarding heat flow, rock mechanics, and radiation damage.

I do not regard engineered surface storage as more than a temporary measure, and judge that permanent storage should be pursued with all vigor and a much higher level of funding.

OREGON STATE OFFICE OF ALLOCATION - -

Speaking for a state regulatory agency with siting approval responsibilities, I wish to address the second of your two general areas. The single most productive action which ERDA can take which would resolve issues tending to inhibit the procurement of new nuclear plants would be an all-out, high priority attack on the problem of ultimate disposal of high-level radioactive wastes. It is becoming increasingly essential that some acceptable resolution of this matter be arrived at before this state can continue to approve site certificates for additional nuclear power plants. The problem is comparable in importance to the problem of developing breeder reactors, and should receive commensurate funding.

SARGENT & LUNDY

Continued efforts are desirable to find the most economic, efficient and safe method of disposal of radioactive waste.

DUQUESNE LIGHT

One of the most controversial items associated with nuclear generation lies in the area of waste disposal. A realistic evaluation and program to provide for disposal or possible reuse of nuclear plant waste products would go a long way towards countering objections of the opponents to nuclear power.

POTOMAC ELECTRIC

Proceed with pilot scale demonstration processes for long term storage of radioactive wastes.

DETROIT EDISON

The entire waste disposal problem is probably the item of chief public concern. Immediate and vigorous action by ERDA in this area would be of immense benefit to the long-term utilization of nuclear power. I was pleased to note that the FY 1976 budget for the Division of Waste Management already includes funds to reinitiate development of permanent waste disposal techniques, particularly utilization of salt beds.

YANKEE ATOMIC

- Increased R&D in safeguards of special nuclear materials (including non-destructive assay and real-time monitoring techniques).
- Establishment of adequate criteria for safeguarding special nuclear materials.

VERMONT YANKEE

Develop a demonstration model (including remote event sequences), acceptable to the public, confirming the adequacy of safeguards for strategic nuclear materials.

Develop a demonstration model (including remote event sequences), acceptable to the public, confirming the adequacy of plant physical security measures.

4.4 OTHER INSTITUTIONAL CONSTRAINTS

4.4.1 ENVIR. & SITING CONSTRAINTS.

BOSTON EDISON

Nearly all operating nuclear power plants have ongoing environmental and radiological monitoring programs. Each plant develops data to demonstrate that environmental effects of plant operation are acceptably small. A nationally financed program to collect and evaluate the individual plant data may be justified to provide an experimental data base from which more refined regulatory cost-benefits analyses can be developed. Because of the lack of systematic evaluation of environmental effects data and lack of analytical methods, it appears that regulatory agencies such as NRC and EPA have developed environmental regulations to require significant margins of safety to avoid environmental effects (with resultant increased plant costs and delays) rather than to require environmental controls (and plant investment costs) consistent with the environmental benefits attained. The requirements of the NRC's proposed 10 CFR 50, Appendix I regulation and the requirements which appear to be evolving under the EPA's administration of Section 316(a) of the Water Quality Act are examples of inadequate environmental benefits to justify the large plant costs which are being required. The addition of equipment, frequently of new and unproven designs, which is environmentally unjustified represents not only an unnecessary investment cost which aggravates capital financing problems, but also represents added complexity in the plant design which eventually will adversely affect plant operating availability and operating and maintenance expenses.

YANKEE ATOMIC

- Establishment of alternatives to the adversary process as a means of establishing scientific facts in regard to environmental aspects of energy production.

OMAHA PUBLIC POWER

- ERDA should deal with the environmental impact consideration to such an extent as to objectively define what is a significant impact and what is not. This subject should be approached on a generic basis, such that every new or proposed plant will not have to analyze the same concerns over again.

NAT'L RURAL ELECTRIC CO-OP

Carry out studies to better assess and facilitate the acquisition of transmission corridors.

Conduct studies to assess the land use impacts of nuclear power plants.

NORTHERN STATES POWER

We suggest that a fruitful area for ERDA involvement could be an in-depth evaluation of the societal impact of the large amount of electrical energy which is diverted from the ultimate consumer because of in-plant usage resulting from requirements of Federal and State agencies as they promulgate regulations for public safety and for environmental protection. Obviously, no one quarrels with the theory of the worthiness of these goals, but there is need for a high-level governmental evaluation of the benefits versus the costs (including lost energy) which result from regulations by such agencies as the Nuclear Regulatory Commission, Environmental Protection Agency, and various State environmental agencies. This evaluation probably could be similar to the "economic impact statements" which President Ford reportedly directed last November be made by Federal departments and agencies. The results of such a study by ERDA might be useful in eliminating or modifying regulations which result in excessive consumption of energy in-plant without achieving corresponding benefits in public safety or environmental protection.

GIBBS & HILL

Establish definitive criteria to allow determination at the outset whether natural cooling bodies at each specific site are acceptable or if cooling towers are needed.

YANKEE ATOMIC

- Establishment of unambiguous, technically defensible siting criteria; establishment of mechanisms to coordinate interests of residents, local and state governments, EPA, Corps of Engineers, Coast Guard, Forest Service, and/or Bureau of Land Management in a timely manner.

N.Y. EMERGENCY FUEL OFFICE

The procedures for early site certification should be completed quickly and legislation allowing this concept is urgently needed. Early site certification and total plant Standard Safety Analysis Reports offer the potential for achieving a six to seven year construction schedule with attendant cost reductions. These objectives should be achievable within a reasonable time by concentrating major agency-industry efforts in these few areas.

NAT'L RURAL ELECTRIC CO-OP

Participate in joint efforts with states and regions aiming for one-stop review and to permit the pre-selection and approval of sites for nuclear power plants.

COMBUSTION ENGINEERING

Licensing of Pre-Designated Sites

By Section 207 of the Energy Reorganization Act of 1974, "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 regions, or other appropriate regional areas, to locate and identify possible nuclear energy center sites.". "...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,...". Combustion Engineering believes that this survey is an important step by Government which will be helpful toward increasing near-term energy generation by identifying sites which can be readily licensed.

We believe that any major LWR R&D program sponsored by ERDA should be relevant to the development of a nuclear energy center at any location in the U.S. As a consequence, from the standpoint of programs related to development of the total plant concept, the modular concept is very appropriate, in contrast to the floating plant concept which is so restricted from the standpoint of access that few, if any appropriate sites may be found. Of the two concepts, it appears that many electric reliability regions would be able to use only the modularized plant.

CONSUMERS POWER

Although legislative action and action by the NRC is necessary to utilize the concept of predesignated sites, ERDA could perhaps also serve the nation's interests by undertaking whatever studies are required to establish methods for precertification of designated nuclear plant sites and the development of environmental siting envelopes within which certain types of nuclear facilities could be built and operated. Environmental siting studies now proceed on a parallel path with other preliminary engineering and safety analysis studies. Shortening of only one of the parallel legs of the lead time requirement through plant standardization will not shorten overall construction lead time unless something is also done to shorten the leg relating to siting and site specific lead time requirements.

MIDDLE SOUTH UTILITIES

1. In the area of the environment, we believe that every effort should be made to get pre-approved sites and that effort should be pushed dramatically at this stage by ERDA. The principal purpose is to ensure that there are land sites available, power needs are given priority or, at least, equal priority with other uses that may be involved from present land use legislation. We believe there is a great opportunity to simplify and reduce the volume of environmental reports and PSARs through the incorporation of answers to generic questions, such as the amount of radiation, the amount of effluents, types of effluents and safety considerations.

We believe that this is one area where simplification and reduction of number of issues will go far to reduce the time necessary for approval.

COMBUSTION ENGINEERING

Develop Power Complexes Particularly Suited to the Use of Nuclear Energy

In the matter of plutonium utilization, the investigation of Nuclear Energy Centers as means of eliminating the need for transporting concentrated plutonium is very worthwhile. Here again, we see the need for a firm general nuclear energy plan, for the nature of such Energy Centers will vary according to whether the plan includes the fast breeder on a predictable timetable. The investment required for building such Centers will be far too large to be made if there are major uncertainties as to long-term plans.

NORTHERN STATES POWER

Accelerate research on the "energy park" concept, with special regard toward public acceptance of such a complex.

DEPT. OF INTERIOR

Concerted study on new plant siting approaches, such as the nuclear industrial parks, should proceed in hand with the nuclear industry.

GENERAL ELECTRIC

Energy Parks

General Electric participation in the National Science Foundation study of Energy Centers will be reported soon. Preliminary indications are that capital cost reductions of as much as 25% could be achieved by building standard, known plants on a multiple-unit basis and under controlled conditions. It is believed that this concept should continue to be pursued by industry and Government. While large Energy Parks will not contribute to generation in a significant way in the next 10 years, they could have impact on nuclear plant procurement practices during that period.

4.4.2 PUBLIC OPINION

BURNS & ROE

One of the major impediments to reducing the licensing hearing period has been the opposition to nuclear plants by uninformed groups. The major issues that are raised by people objecting to nuclear plants have been the radwaste storage and the safeguards issues. There has also been concern about plutonium recycling. I believe that ERDA and FEA should publically discuss the plans for radwaste storage and their inherent safety, as well as the procedure for safeguarding the possible theft of plutonium from plants. The issue of plutonium recycling should be settled quickly, otherwise it will continue to fester and be a deterrent to nuclear plant construction.

BOSTON EDISON

In contested licensing situations involving practiced intervenors, however, the NRC hearing process continues to provide opportunity for schedule delays as a result of procedural tactics with postponement of the ultimate accountability relative to any substantive content of the intervention. It is our belief that the role and effectiveness of intervenors in the regulatory process as representatives of the overall public interest deserves reasoned evaluation by all Federal agencies concerned with the energy problem. Adequate margins of safety to protect public health and safety are essential and in the public interest. We would suggest that availability of adequate and timely generating additions are also in the public interest. Is the overall public interest served adequately by existing procedures for public intervention in regulatory proceedings for nuclear plants?

SAN DIEGO GAS & ELECTRIC

Support strong opposition in the Congress of all proposals to provide financial assistance to intervenors.

In fact, a counter-attack seems appropriate, requiring intervenor groups to post a bond to ensure accountability; i.e., if an intervention is shown to be unsubstantiable, the group should be required to reimburse the injured utility for all costs incurred including power loss due to delay, escalation, interest during construction costs, etc.

DEPT. OF INTERIOR

Public information and education have been identified by essentially all organizations with interests in nuclear energy as areas needing further effort. ERDA and FEA should prepare and undertake long-range coordinated public information programs in conjunction with all major programs.

GIBBS & HILL

Develop a comprehensive public information program utilizing all forms of mass media to enhance the public's knowledge of the safety record of nuclear power, the design and construction safeguards used and the many benefits to society at large.

NAT'L RURAL ELECTRIC CO-OP

Increase R&D efforts on nuclear safety, management and disposal of nuclear wastes to allay public concern and thereby expedite availability of additional nuclear power plants.

Study and make available to the public the socio-economic impact of nuclear plants.

FLORIDA POWER

ERDA, NRC, utilities, architects/engineers and manufacturers of equipment for light water reactor plants must act jointly to educate and inform the public concerning the overall advantages and the necessity of generating electric energy in light water reactor plants.

WASHINGTON PUBLIC POWER

Analysis of spent fuel cask behavior during terrorist involvement or in typical accident sequences would be beneficial in allaying public fears about spent fuel shipments and in setting appropriate and realistic guidelines for cask and/or vehicle design and transportation constraints (such as reduced speed). A series of tests to explore cask behavior under potential terrorist attack should include attempted destruction or penetration by use of explosives and/or military arms, such as bazookas. Analysis of typical accident sequences should be directed toward an assessment of the amount of energy transferred to the cask in the accident. For example, it is possible that a 50 mile-per-hour collision of a truck carrying a loaded cask with a bridge abutment is no worse than dropping a cask on an unyielding surface from a height of 30 ft, in terms of energy available for deformation of the cask. Such a finding would have direct application in setting speed limits for spent fuel shipments.

COMBUSTION ENGINEERING

Prepare Handbooks for State and Local Governments

It is also suggested that ERDA sponsor the preparation of Guide Books on nuclear power for use by officials of state and local governments. These would minimize demands on technical expertise but would differ from "popularized" expositions in assuming that the reader has a serious interest and responsibility in the area and would, therefore, be willing to expend some effort in understanding and utilizing the information presented. Such Guide Books should avoid promotional characteristics and should make a sincere effort to present unbiased information.

DUKE POWER

Nuclear units now operating are clearly demonstrating lower generation costs and reduction of charges to the consumer under fuel clauses. Whereas much of our industry is now constrained in its advertising, there may be an appropriate Federal role in more widely publicizing these results with the objective of achieving widespread public appreciation of the economic benefit to them of nuclear.

VERMONT YANKEE

Develop demonstration tests to clearly confirm to the public the functionality and reliability of key reactor safety systems and system components, including projected plant operational and component system reliability throughout the plant life-cycle.

Conduct a research program to identify specific causes for public rejection of the nuclear power option. Develop

methodology, acceptable to the public, to overcome objections arising from erroneous technical and scientific information. This study should be developed concurrently with national goals for energy independence, environmental protection, and national economic growth. It should include an examination of the national (and perhaps international) consequences of rejection of the nuclear option in terms generally understood by the public.

Develop human factors reliability demonstration procedures, acceptable to the public, for nuclear industry personnel in sensitive management or operational positions.

Develop models and event sequences, including appropriate demonstration tests, to convince the public of the adequacy of plant decommissioning procedures and availability of the plant site for post-operational uses.

VERMONT YANKEE (CON'T)

Develop a demonstration model, acceptable to the public, of integrated fuel cycle costs as related to the price of a unit of electricity produced from nuclear power.

Investigate the impact of regulatory agency operational directives and statements upon the public acceptance of nuclear power and determine ways to best inform the public on plant operational matters without creating a long term bias either for or against nuclear power. This suggestion needs some amplification, which I will provide by an example.

Recently, cracks were discovered in plumbing associated with the emergency core spray cooling system of Dresden I. For generic reasons the NRC ordered all other operating BWR's to shut down within a few days (regardless of scheduled routine shut downs) and perform inspections for similar cracks. None were found. While this action demonstrated NRC concern for public safety and NRC efficiency in responding to potentially hazardous situations, it also created serious problems for operating utilities in two areas. These were: (1) the additional costs to electric consumers associated with an unscheduled outage (amounting to over \$1,000,000 for Vermont Yankee customers) and, (2) the increased public concern over reactor reliability which, I believe, had an

adverse impact upon some members of the Vermont Legislature. The latter consequence could have been mitigated if we had received notice of the shut down order at least 24 hours in advance of the NRC news release. We would then have been able to word our own news release appropriately with respect to plant operating conditions and the then prevailing local political climate. At the time of the shut down order, a bill requiring approval of both bodies of the Vermont State Legislature for construction of LWR's in Vermont was being debated in the Vermont House of Representatives. The bill subsequently was passed by both the House and Senate by a large margin and was signed into law by the Governor. Thus the way the NRC action was promulgated may have created a long-term bias against nuclear power. In the short term, the shut down order may have caused an unnecessary loss in generating capacity.

Please note that throughout my suggestions I have underscored public acceptance and the public viewpoint. Generally, I believe many of our current difficulties stem directly from prior activity conducted without sufficient regard for the ability of the public to assimilate economic and political and technical facts accurately and fairly. For this reason, I believe research programs should now be undertaken, or modified, to more clearly confirm the benefits of nuclear power for the economic welfare of our society in the eyes of the public generally.

5.0 SUBJECTS NOT MENTIONED IN LWR TFR

5.1 NATIONAL ENERGY POLICY

SAN DIEGO GAS & ELECTRIC

There is an urgent need for the re-affirmation of nuclear energy as a National Goal. ERDA, FEA, FPC, NRC and EPA should jointly prepare and publicize a statement for general release re-affirming the national position that nuclear energy is both necessary and desirable as a solution of our national energy needs. Such a statement would go far toward eliminating public confusion arising from conflicting statements reflecting governmental ambivalence and from deliberate distortions by anti-nuclear groups. It would help stem the tide toward a nuclear moratorium.

GENERAL ELECTRIC

• Public Acceptance

A variety of environmental and activist groups have raised national doubts about the acceptability of nuclear power. General Electric and the major segments of the national scientific and technical community firmly believe that the potential hazards of nuclear power are sufficiently well controlled to make the resulting low-level risks acceptable. The benefits to the nation of utilizing the nuclear power option as part of a multi-pronged energy policy far outweigh those risks. Since the ultimate decision is properly a national social/political policy matter, an early and clearcut Government affirmation of the nuclear power option is urgently needed. Assuming a decision to support nuclear power, responsible Government officials must publicly endorse this policy and follow through with positive actions aimed at gaining public acceptance of basic energy policy decisions.

WESTINGHOUSE

The Energy Research and Development Administration should encourage the development of a national energy policy with the responsible government organizations. Such a policy must address the economic and financial needs of the power industry. Failure to develop such a policy will result in a continued rapid depletion of our dwindling reserves of natural gas and oil. The recognition and solution of the financial problem is critical to obtaining the benefit of further developmental action directed at light water nuclear power plants.

BOSTON EDISON

Another major factor inhibiting the full and early development of nuclear power is the uncertainty in national policy relative to the proper role and relative priority for nuclear power in the nation's future energy program. Early resolution of a national energy policy

based upon reasoned evaluations adequate to ensure continuity of the basic policy for extended time periods is essential if the nation's industry is to effectively mobilize the resources necessary to significantly change the national dependence on imported oil as an energy source. The magnitude of the task has already been well scoped by a number of national studies. Clear and stable direction for national priorities must be established before the diversity of industries involved in engineering solutions can develop implementing plans with confidence that the large investments required are consistent with the public investors' and the public consumers' best interests.

Early construction of nuclear units may be justified by national objectives to reduce dependence on imported oil. Individual utilities have not attempted to justify construction of new nuclear plants unless added capacity was required to meet load growth projections. The results of energy conservation and current load growth forecasts for the New England region have permitted deferral of some of the nuclear capacity previously planned for the early 1980's. If justified by overall national priorities, construction of additional nuclear power plants earlier than now required by utility load growth may be in the national interest. Government action to encourage procurement of such plants prior to the time the plant would normally have been scheduled for operation may be one viable method for encouraging early expansion of nuclear power.

YANKEE ATOMIC

- Development of a clear, unambiguous public position by ERDA on nuclear power. Such statements as, "We have got to make sort of an overall national decision whether we want to rely on nuclear energy or not."*, should be followed with a clear statement explaining ERDA's view supporting nuclear power as a viable alternative.

* Mr. Seaman's, Electric Light & Power, Vol. 53, No. 3, Pg. 2.

- Activities directed toward establishment of assessment criteria for alternative energy sources, i.e., epidemiological studies and quantification of public health risk.
- Research in the energy cost of job opportunity; expansion of work identifying relationships between socio-economic activity and energy use.

ARKANSAS POWER & LIGHT

ERDA, NRC, FEA, and the entire federal government must act now and continue to look for ways to expedite putting nuclear power plants on the line. Nuclear power plants represent one of the two ways the nation can improve the present situation with regards to natural gas and fuel oil. We are fast approaching the time when we will be talking of producing adequate electrical energy, and we will not have the choice of the cleanest and cheapest fuels. It takes a long time to build a nuclear power plant, much longer than it will take the industrial organizations to recover once the present economic recession is over. With money available for expansion and the demand for the industrial products increasing, it is our belief that the need for electrical power will reach new plateaus -- ones which might well not be matched by this country's future generating capability.

ERDA should serve as a channel of factual information to the news media, to the Congress, and to the general public on matters relating to nuclear safety, nuclear economics, and the importance of nuclear development to the national security and well being. ERDA cannot be effective in the more technical areas of its responsibility unless and until there is broad acceptance of the importance of nuclear power on the part of the public and the Congress followed by a coherent program to encourage its development.

To accomplish this, ERDA should:

- (1) Support extension of the Price-Anderson Act to ensure a willingness on the part of industry to undertake the necessary risks of constructing, owning, and operating nuclear plants.
- (2) Support various public information efforts designed to present facts to the public concerning the safety of light water nuclear power plants.
- (3) Support efforts to amend the Clean Air Act and the Clean Water Act to remove unduly restrictive provisions which cause unwarranted delay.
- (4) Encourage government cooperation with private industry rather than direct government responsibility for power production itself.

GILBERT ASSOCIATES

The other major ERDA steps that would lead to a utilization of fission energy would be those necessary to re-establish a nuclear fuel cycle and clear-cut definition of energy source plans through the first decade of the next century. Reestablishment of the fuel cycle, including breeders of several types for efficient plutonium/thorium utilization is necessary to demonstrate fuel source stability to potential nuclear buyers. The long-term energy plan is necessary to decouple long-term decisions from current political fads.

COMBUSTION ENGINEERING

Assurance must be given of a viable fuel cycle over the lives of plants already committed plus those to be built in coming years. This means assuring adequate supplies of uranium, enrichment capacity, reprocessing capacity, disposal of radioactive waste, and making use of the plutonium produced. All of these are currently in states of uncertainty. That uncertainty is not only exploited by the opponents of nuclear power but acts as a deterrent to responsible utility executives. Without a long-range energy plan there can be no rational decisions as to developmental directions, and commercial decisions on the commitment of capital are inhibited. It is essential that such a plan remain firm in the face of temporary technological setbacks and incidental cost overruns.

SARGENT & LUNDY

Any effort that the Energy Research and Development Administration could take which aids in the resolution of the licensing issues and the need for nuclear power, as it relates to the overall energy situation of the United States, would be most desirable. Certainly the need for continued development of all of our viable energy resources is a subject of great import to the nation. Regretfully, it seems that the messages being received by the public suggest alternatives which we, at Sargent & Lundy, do not believe are technologically sound at this time. Therefore, some concentrated program for implementation and publication of a clearly defined national energy policy would seem to be in order.

UNITED ILLUMINATING

In the final analysis if the nuclear program is to proceed in an orderly manner the utility industry requires the support of regulatory bodies and of the financial community. Assistance from ERDA and FEA in these areas of course, would be most welcomed and indeed potentially very fruitful. Programs demonstrating to the public the importance of nuclear and coal in meeting our national goals in the short-term are required if we are to receive the necessary support. The use of other forms of energy such as solar, tidal etc. though of potential significance in the long-term do not represent answers to our immediate needs. This should be clearly communicated to the public. Such programs would be most effective if sponsored and supported by the federal government.

BABCOCK & WILCOX

We urge ERDA and other federal energy agencies to implement studies to accurately determine the total industry capability to construct and fuel the number of coal-fired and nuclear electrical generating stations necessary to reduce the use of oil and natural gas for power generation to an absolute minimum.

Programs to develop and publish factual, objective information and data on relative costs of fossil, solar, geothermal and nuclear power sources to permit industry to plan on the most realistic basis possible.

5.2 ERDA POLICY

5.2.1 POLICY CLARIFICATION

CONSUMERS POWER

With the split of the NRC into a regulatory arm and a research and development arm, I am concerned that no one will assume the "expediting" function for speeding the construction of nuclear plants. The United States Atomic Energy Commission in cooperation with the nuclear industry has previously issued two "Action Plans" with associated follow-up "Progress Reports." These action plans and progress reports were aimed at the identification and resolution of critical problems in the construction and operation of nuclear power plants. There is a need within the nuclear industry for this to continue. It is important for some agency to assume this function. In expansion of this concept, I believe that a system should be set up to get input and provide feedback on a continuing or periodic basis from appropriate representatives of industry; that is, it should be a cooperative, ongoing process.

EEI

ERDA also should assume responsibility for the Construction Action Plan established by the Atomic Energy Commission. Implementation of this scheme can shorten construction time. The action plan can be improved by providing some mechanism to interact with the utility industry on a continuous basis. The Institute's Construction Task Force would be pleased to work with ERDA in this area.

BALTIMORE GAS & ELECTRIC

ERDA will play a major role in future large-scale development efforts related to electric power, as well as other energy technologies. We, therefore, urge that the ERDA program be maximally coordinated with other programs in order that the cumulative efforts will continue to be directed toward improved, viable methods and techniques for electric power supply.

BABCOCK & WILCOX

The majority of the needs can only be met by government involvement as they require input and analysis by many segments of the industry and government agencies.

Close cooperation will be required between government and industry as the best information possible must be obtained.

Consideration should be given to the formation of ERDA-Industry advisory committees for the purposes of gaining the best possible advice.

We do not believe extensive cost-sharing arrangements would be beneficial in the present business environment as it could have the effect of denying participation to smaller firms who have considerable to contribute.

NAT'L RURAL ELECTRIC CO-OP

In my opinion, where research, development or any other commitment is required that appears to be of substantial potential benefit to the American people, and where private industry is unwilling or unable to risk research dollars or will otherwise be in violation of the antitrust laws of the U.S., the Federal government should become an active participant in the nuclear business.

In response to your question on potential benefits of nuclear power in terms of reduced power costs to the consumer, a recent AIF survey shows that of 56 operable nuclear power plants in 1974 an average of 6.5 mills per Kwh was saved over the cost of electricity generated by fossil fueled plants. Net savings to the American people amounted to \$810 million on some 125 billion Kwh of nuclear generated energy.

Generally, we urge that the R&D effort be aimed at short-term results working directly with prime contractors, manufacturers, and architectural engineering firms experienced in the design, operation and construction of nuclear power plants.

NORTHERN STATES POWER

Concerning attention which ERDA might direct toward operating light-water nuclear power plants, we submit that the owners of these plants, and the equipment suppliers with which they are associated, already have such great financial incentives to maximize production from existing plants that it would not be especially helpful for ERDA to become involved in new studies of component reliability, fuel performance, inspection and monitoring techniques, or the like. Indeed, if additional ERDA involvement in such studies required expenditures of time and effort by utility personnel to develop additional detailed reports and explanations of operating data, the ERDA involvement could be counter-productive, because the operating personnel already have high priority demands on their time.

DUQUESNE LIGHT

The continued use of the national laboratories for jointly funded research work in the areas of material performance and loss of coolant flow mock-up test and accident analysis would contribute information of a non-proprietary nature which vendors as well as users could share and avoid duplication of research efforts. This would serve to support with actual performance data the mathematical models used to predict reactor fuel temperature transients.

BURNS & ROE

I believe there is an economic advantage for the U.S. utility industry to plan their nuclear programs jointly on a regional basis using the facilities of the national laboratories for their technical capabilities and data assembly, as well as research into new technology. Utilities, by working on a regional basis, will have greater flexibility in siting of nuclear plants not only out of their territory, but also within their state or within their region. The regionalization will also permit utilities to jointly plan their needs for enrichment, reprocessing, and waste storage facilities that would serve the utilities in the region. The national laboratories in each region can serve as the computer data bank and also undertake research in various nuclear technologies for the utilities under ERDA and EPRI funding. The national laboratories can also undertake environmental surveys for the region as a help to utilities in their overall planning.

5.2.2 ACTION THROUGH EPRI

CONSOLIDATED EDISON

We believe that Government-Industry involvement in cooperative R&D ventures should be through industry-wide organizations and should be encouraged wherever possible. The Electric Power Research Institute provides a good vehicle for coordinating such ventures. In our view, Federal Government R&D funding should generally be directed towards basic research, first-of-a-kind engineering prototype work by national laboratories and technical support for demonstration operation.

Industry-wide utility support through EPRI should generally be aimed toward the mid-spectrum of research and development where benefits accrue to the utility industry on a broad basis. Owner support should cover end hardware and those costs of related services that uniquely benefit the owner. Actual sharing of costs should be determined on a case-by-case basis.

UNITED ILLUMINATING

In regard to suggested R&D activities a review of the programs presently being pursued by the Electric Power Research Institute, would represent a good overview of those areas in which we have strong interests. In a four month period preceding February 1975 EPRI started 48 new nuclear related R&D projects and received approval for 18 additional projects. ERDA/FEA efforts should be consolidated with those of EPRI so as to move these programs along in as expeditious a manner as possible. EPRI's objectives are to:

1. Increase assurance of safety
2. Increase reliability and availability
3. Develop new options
4. Address technical issues of fuel, waste and the environment

We strongly recommend discussions with EPRI to determine how resources available from ERDA, FEA and EPRI can be coordinated to move present programs to completion as quickly and effectively as possible.

PORTLAND GENERAL ELECTRIC

We appreciate your efforts to increase the near-term generation of the light water reactors and feel that the Electric Power Research Institute is in a much better position than our Company to give you ideas as to how this can be best accomplished.

ARKANSAS POWER & LIGHT

ERDA should coordinate this effort with EPRI, which already has activities under way, or proposed, to improve component reliability, fuel performance demonstration and modeling improved on-line monitoring and inspection methods and improved water chemistry, and related materials technology. We do not mean to say that EPRI is doing everything that is required, but rather to say that it is the one central organization in the utility industry which receives input from all organizations. In a lot of cases, it may be that EPRI has long-range programs which can only be implemented in the near term with additional funding.

BALTIMORE GAS & ELECTRIC

We are pleased to offer some brief comments on the recent ERDA letter concerning the proposed joint study with the Federal Energy Administration to identify possible actions in cooperation with industry to increase near-term electrical energy generation from light water nuclear reactors. As you know, the Electric Power Research Institute is developing a broad based research program in the nuclear area, as well as in many other areas. While this program will be rather extensive, its ultimate scope will be limited by available funding. We believe that maximum benefits in the subject area may be obtained through maintenance of close liaison and cooperation between ERDA and EPRI, the groundwork for which has been established.

PUBLIC SERVICE OF COLORADO

We believe that an important mechanism in the identification of short term R & D goals for nuclear power is the Memorandum of Understanding between ERDA and EPRI for joint planning and selection of complementary programs and we urge a continued strengthening of this joint effort. One of the mechanisms by which the R & D preferences of the electric utility industry are most effectively conveyed is through the EPRI structure and we recommend that the efforts of ERDA and EPRI should be further coordinated in order to cooperatively maximize the benefits of the R & D dollar.

NORTHEAST UTILITIES

With respect to R&D activities that would increase the energy availability of nuclear plants, we would direct your attention to the EPRI Nuclear Power Division programs. We have been working with the EPRI staff in developing programs in the areas you enumerated in your letter as well as others along with priorities of each subprogram. Discussions should be had with EPRI to insure full implementation of the proposed programs in the areas of water reactor safety, plant reliability and availability, and fuel performance.

EEI

Since all of these areas of investigation concern plant operations, the Institute urges ERDA to coordinate its activities with the Electric Power Research Institute so as to avoid duplication and to make maximum use of the electric utility research expertise represented by EPRI. In addition, electric utility participation should be given paramount consideration. An operating environment and not controlled laboratory conditions must be utilized to assure solutions which will result in practical applications.

PIONEER SERVICE & ENGINEERING

In all these efforts, we would urge ERDA to work closely with EPRI to insure common goal orientation and to avoid unnecessary duplication. Publication of comprehensive statements of objectives and schedules in nuclear energy R & D would provide a framework for public discussion about realistic assessment of risks. In our judgment, public confidence will be enhanced if there is a clear statement of purpose to expeditiously gain more knowledge in areas causing reservations about today's decisions.

DALLAS POWER & LIGHT

Expand the present program of cooperation with EPRI and other industry related organizations in order that new problems can be investigated and resolved in a shorter time frame.

DETROIT EDISON

At the outset, I would suggest that the role of ERDA, separate and distinct from NRC as defined by Congress, be one of strongly advocating the utilization of nuclear power. However, it is difficult to conceive of development projects that could be of major technical benefit in the short term which I assume to be three to five years.

There are certainly longer-term projects of benefit, and their timely initiation may well have a short-term positive psychological effect.

5.3 ALSO SELECTED SHORT SUBJECTS

5.3.1 STOCKPILING

COMBUSTION ENGINEERING

Material Supply: Enlargement of Capacity of Steel Manufacturers

The manufacturing time for the major components of the nuclear steam supply system is a critical element in the overall time schedule for the construction of a nuclear plant. The labor content in the pressure vessel, for example, is determined in part by the size (weight) of the plate and forgings which are available to the manufacturer. Significant savings in shop labor of all types (setup, machining, welding, and inspection) would be realized if the steel industry could provide larger heavy plate sections in thicknesses (up to 12" thick) and larger forgings.

It is proposed that ERDA sponsor with the steel industry the development of processes for production of larger plates and forgings. Since current production represents the largest shapes which can be processed, a cooperative program with steel suppliers to develop necessary new ingot, rolling, and heat treating capacity is indicated. At the present time, there is only one domestic steel supplier in the U.S. who is producing for the manufacturers of the major NSSS components. Expansion of this capacity both in total tonnage and in tonnage of individual pieces processed would constitute a significant step toward increasing nuclear energy generation in the future. It must be recognized, however, that a substantial amount of time will be involved in providing the capital equipment and developing the production processes.

Stockpiling of Critical, Long-Delivery Material

Procurement of heavy plate and large forgings for the major NSSS components from domestic suppliers now introduces a time span of approximately three years (from material order to delivery) in the overall schedule of the construction of a large nuclear power plant. Once the critical material is on hand, manufacturing time (assuming shop capacity is available) for a major component is typically 3 to 4 years. From the time that major NSSS components are delivered to the site, construction contractors allow 2-1/2 to 4 years to commercial operation.

Many utilities have either deferred or cancelled orders for nuclear power plants. Projections of future demands for electric power suggest that there will have to be a rescheduling of the deferred capacity nearer the original dates. Such rescheduling will point to the need for overall plant licensing-construction times of less than the currently-quoted span of 10 years. Achieving shorter schedules will be aided by having the critical raw and semi-finished material on hand at the time new commitments are made by the utilities.

It is proposed that ERDA support stockpiling of critical, long-delivery materials. Ordering of heavy plate and forgings should be at a level which will insure that all the available domestic capacity will be used to the fullest. In this effort it is believed that a small commitment in dollars will have a far reaching effect; that is to say, through this stockpiling Government funds will provide the maximum "leverage" toward increasing near-term nuclear energy generation.

BABCOCK & WILCOX

Implement program to predict capacity requirements for large steel forgings, stainless steel castings and/or critical long delivery components. Recommend special tax or depreciation allowances to promote capital investment in critical component manufacturing facilities.

Survey present manufacturing capabilities of major reactor vendors and component suppliers to assess total capability of country to manufacture and construct nuclear power plants.

YANKEE ATOMIC

- Possible legislative incentives to encourage prompt industry response to commodity and production shortages, such as reinforcing steel, steel plate, large size seamless tube, valves, uranium, etc.

5.3.2 OTHER CYCLES

TVA

One particularly troublesome area to us lies with the commercial uncertainties of the high-temperature gas-cooled reactor. We, and possibly other utilities, find several unresolved situations such as the lack of a guaranteed commercial fuel reprocessing capability, lack of large-plant licensing experience, very little operating experience, and other questions which tend to inhibit commercial orders. There is little the individual utility can do to alleviate this situation--the most frequent solution is to take a conservative approach and to steer clear of such problems. Nationally there would be many benefits of a large-scale HTGR industry such as higher thermal efficiencies, extension of our uranium resources by utilizing thorium, and environmental advantages. Although we recognize that there are institutional and philosophical problems associated with the Government sponsoring programs which might benefit a one-company reactor concept, we believe it is in the national interest for ERDA to foster this reactor concept with the objective that the HTGR would be a viable commercial competitor as soon as is reasonably feasible.

GENERAL PUBLIC UTILITIES

We strongly recommend that ERDA move ahead aggressively and with conviction toward the development and commercialization of the breeder. In our judgment, the breeder is essential to open up a significant new block of indigenous energy that will be mandatory as the world supply of oil is depleted. The country must have a plan which is capable of delivering a known block of energy. We cannot be diverted by a recitation of all of the unknowns of the future. We cannot rely on some bountiful but as yet unidentified energy source or technology. The apparent slowdown in growth of energy consumption may have delayed the date when a mature breeder program is absolutely required. However, we do not agree this justifies a slowdown in the developmental program; even now we may well find we have insufficient time to uncover and solve all the problems awaiting us in the development and commercialization of the breeder technology.

OHIO EDISON

Finally, in connection with R&D, I would suggest that ERDA support increased activity for breeder technology, gas-cooled technology and fusion technology, even though none of these, with the possible exception of gas-cooled technology, hold any promise for increasing nuclear-electric output in the next ten years.

PUERTO RICO WATER RESOURCES AUTH.

ERDA should enter a cooperative demonstration program on a high temperature Gas Cooled Reactor - Gas Turbine System for Central Station. This concept may result extremely beneficial to the nation.

DURUESNE LIGHT

In addition, we feel that results from the Light Water Breeder Program at Shippingport might provide a near-term benefit to relieve uranium supply constraints and somewhat reduce the requirements for fuel enrichment capacity. We encourage your efforts to obtain continued Federal budget appropriations for this project.

Get on with the breeder program.

Get on with the fusion program.

IDAHO O O

A second high priority series of activities could be in increasing the overall efficiency of a given plant or plant grouping by combining LWR production with other energy sources such as coupling a modest temperature geothermal source with an LWR and/or utilizing tertiary power production such as the use of a low boiling point organic heated by an intermediate temperature stream in the conventional LWR steam cycle.

Evaluation of the use of geothermal preheat to improve plant efficiency. This would include study of the siting limitations and electrical transmission tradeoffs involved.

evaluations and applied research of the following: 1) plutonium-thorium; 2) plutonium recycle as mixed oxides with uranium; and 3) seed and blanket concepts using either or both of Items 1 and 2.

2.3
Evaluation of tertiary system working fluids. Although systems using fluids supplementing the steam cycle showed disadvantages in early tradeoff studies, the improved thermal efficiencies possible and the resulting better resource utilization, could make these supplementary working fluids more desirable.

IDAHO 0 0 (CON'T)

Development of the heat pipe concept for core heat removal. This concept would allow removal of fission heat from the reactor core without a circulating primary coolant within the core. It would also allow larger heat transfer areas and higher secondary temperatures. The design problems associated with the use of this concept make this a longer-term research and development item.

Development of thermionic conversion, either integral with the fuel pins or in conjunction with the heat pipe concept, to increase the overall plant efficiency. Most thermionic development to date has been for higher temperatures than those available in light water reactors. However, future development of higher-temperature fuel capabilities and alternate heat transmission methods could make thermionic conversion a desirable means for increasing plant efficiency.

PIONEER SERVICE & ENGINEERING

Studies to comprehensively examine the merits and potential impact of geothermal, solar, tidal and other such forms of energy on the total near term and long term energy requirements of the United States.

WASHINGTON PUBLIC POWER

Although the following comment does not fall into either of the two categories for which comments were requested, it is nevertheless offered because it has the potential for reducing somewhat our national consumption of oil: We support continued operation of the Hanford N Reactor and supply of steam to the WPPSS Hanford Generating Project for at least five years (to October 1982), with steam payments to make plutonium produced in N Reactor competitive with that from other ERDA sources. In the period from 1977 through 1982, the Pacific Northwest will have a potential energy deficit in that during a critical water period, firm energy demand would exceed available resources. Extended operation of the ERDA's N Reactor during this time would reduce by roughly one third the anticipated deficit. During those years when streamflow is adequate to meet anticipated energy demand without N Reactor's contribution, continued transfer of power from the Northwest to California could reduce the latter's dependence on oil for electrical generation. Naturally, the cost to the Northwest of such energy is an important factor in its utility. The Supply System, itself a "public" agency, generally supports a "full cost recovery" approach in which steam payments are used to offset the apparent economic disadvantage of producing nuclear material in N Reactor rather than in some other ERDA facility, such as the Savannah River complex.