NUREG/CP-0003

Conference Proceedings for

STATE WORKSHOPS FOR REVIEW OF THE NUCLEAR REGULATORY COMMISSION'S DECOMMISSIONING POLICY

September 18-30, 1978

Philadelphia, PA; Atlanta, GA; Albuquerque, NM

Office of
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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

December 15. 1978

Note to workshop participants and observers:

The Nuclear Regulatory Commission is committed to cooperating with the States in carrying out its regulatory authority. At the initiation of our major effort on improving the NRC decommissioning posture we wanted to make sure that State views were heard and given proper weight and consideration. Many of you came to the September workshops with a willingness to contribute to that decisionmaking process.

You have contributed in a substantial way to the decision process. A revision to the reevaluation of NRC's current decommissioning policy has been published (NUREG-0436/Rev. 1).

For your willingness to help please accept our thanks. We will return to you for more of the same in September 1979.

Sincerely,

Robert M. Bernero
Assistant Director
for Material Safety Standards
Office of Standards Development

Sheldon A. Schwartz
Assistant Director
for Program Development
Office of State Programs

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Preface

The Nuclear Regulatory Commission (NRC) is developing a more explicit overall policy for nuclear facility decommissioning and amending current regulations 10 CFR, Parts 20, 40, 50, and 70. The proposed plan for developing the new policy was presented in NUREG-0436; "Plan for Re-evaluation of NRC Policy on Decommissioning of Nuclear Facilities," March 1978.

To provide for State comment, the NRC Offices of Standards Development and State Programs conducted three workshops in Philadelphia, Pennsylvania; Atlanta, Georgia; and Albuquerque, New Mexico between September 18 and September 30, 1978. In addition to discussing the proposed Plan, summaries of the first two decommissioning reports, "Technology, Safety, and Costs of Decommissioning a Reference Nuclear Fuel Reprocessing Plant" (NUREG-0278) and "Technology, Safety, and Costs of Decommissioning a Reference Pressure Water Reactor" (NUREG-CR-0130) were presented and relevant comments and/or questions solicited. Attendees included representatives of State executive departments, legislative leaders, and public utility chairmen or their representatives. Representatives from the Environmental Protection Agency (EPA), Federal Energy Regulatory Commission (FERC), and the Nuclear Regulatory Commission (NRC) were available to answer inquiries. A large number of observers, predominantly from industry, were also present. Background data were provided to attending officials prior to the workshops.

In each workshop, participants were divided into heterogeneous groups to facilitate discussion of the presentations. A list of 14 questions was given to each group to provide guidance for discussions. At the close of discussion, group chairmen prepared a report of their group's conclusions. These reports were then reviewed and edited by the groups at large and the final versions were presented to the workshop by the chairmen. Prepared statements were then accepted for presentation.

This report contains the workshop proceedings as edited by the NRC and SCS Engineers, Reston, Virginia.

QUESTIONS ADDRESSED BY WORKSHOP PARTICIPANTS

1. Do the States have an acceptable role in the plan?

2. Are the technical reports adequate in covering the right facilities, in considering the real alternatives?

3. Should the plan be modified? How?

4. Should detailed decommissioning plans be required prior to the issuance of license?

5. Is delay in decommissioning justified to save money? -- to reduce radiation exposure?

6. Is permanent entombment of nuclear facilities an acceptable method of decommissioning?

7. Should decommissioning criteria extend to buildings, structures and components which are not contaminated with radioactive materials?

8. Can cleanup criteria be developed by the Federal Government with State advice so that all can endorse and follow them?

9. Is a maximum dose rate of 1 mrem/yr to any individual after cleanup an acceptable basis for site release? What other basis would you recommend?

10. Who should pay for decommissioning?

11. Should financial responsibility requirements be imposed by Federal or by State authorities?

    - When?

12. Should funds be set aside in advance or accumulated during facility life to pay for decommissioning?

13. Who should hold the funds if they are accumulated?

14. How can uncertainties in cost or contingencies be covered?

    - By extra money in accrual for each facility?

    - By extra money into a general fund?

    - State or Federal?

PHILADELPHIA - Green Group - Miriam Butterworth, Chairman

Questions

1. "Do the States have an acceptable role in 'the plan'?"

   Suggestion - more State officers should be contacted to urge participation.

The group indicated that all other answers to the remaining thirteen questions implied that the States would have an acceptable role in "the plan" if recommendations below were followed.

2. "Are the technical reports adequate in covering the right facilities, in considering the real alternatives?"

3. "Should the plan be modified? How?"

   The group dealt with questions 2 and 3 together.

   Suggestion - We feel that research should be done on the further life of these plants as opposed to automatic decommissioning.

The majority of the group did not feel competent to evaluate the reports. Some thought the reports were not adequate because they were not site-specific. The group did feel, however, that the right facilities were studied as far as reactors were concerned.

The group stated that other technologies (i.e., fusion, breeders) should be studied. Also, other agencies (EPA, DOE, etc.) should be involved in the technical aspects of the reports.

4. "Should detailed decommissioning plans be required prior to the issuance of license?"

The group separated this question into two questions:

(a) Should NRC set guidelines for decommissioning and see that these guidelines are implemented?

The majority of the group answered "yes" with the minority stating that the State should be the primary party responsible for development and implementation.

(b) Should NRC demand site-specific plans for decommissioning at the time of licensing?

The majority of the group answered "yes" for construction licensing with a minority stating that generic plans should be utilized.

Note: After the decommissioning guidelines have been issued by NRC, operating plants that do not yet have a site-specific decommissioning plan should be required to submit a plan to the NRC for approval within a reasonable time period.

5. "Is delay in decommissioning justified to save money? -- to reduce radiation exposure?"

The group thought it did not have sufficient information to make a decision based on health aspects. Furthermore, if dismantlement is preferred, it should be accomplished within 30 years unless financial mechanisms are inadequate for the long term, in which case it should be done immediately.

6. "Is permanent entombment of nuclear facilities an acceptable method of decommissioning?"

The group did not support permanent entombment. Further technical information on this subject is needed.

7. "Should decommissioning criteria extend to buildings, structures

and components which are not contaminated with radioactive materials?"

The group decided that NRC should have no responsibility in this area.

8. "Can cleanup criteria be developed by the Federal government with State advice so that all can endorse and follow them?"

The question, as stated, was not clearly presented. However, the group did agree that the Federal government could develop cleanup criteria with the State participating in the decisions; but would they be worth it?

9. "Is a maximum dose rate of 1 mrem/yr to any individual after cleanup an acceptable basis for site release? What other basis would you recommend?"

The changing definition of the effect of a maximum dose rate of 1 mrem/yr caused the group to question this basis. The group thought that the acceptable basis for site release after cleanup should be related to a risk assessment. Among other areas of investigation, NRC should consider the [illegible] New York study of this issue and studies made by other agencies with respect to West Valley.

10. "Who should pay for decommissioning?"

The group supported the concept that those who benefit (the users) should pay the cost of decommissioning. However, when decommissioning costs have not yet been collected for a facility which has already operated for a substantial part of its useful life, it was felt by some that it is not equitable to charge present or future users over the remaining life of the plant for all of the previously uncollected portion of the costs. The Federal government might consider picking up part of these costs under certain circumstances.

11. "Should financial responsibility requirements be imposed by Federal or by State authorities? When?"

The group supported the concept of the State imposing the financial responsibility requirements under Federal guidelines. These requirements should be imposed when all new nuclear plants are brought on line and for all old plants prorated over the remaining life of the plant. However, on second thought, the group expressed concern that given this decision, there is no real requirement that any financial plan be implemented. Therefore further discussion is necessary on how early collection of funds for decommissioning can be achieved.

12. "Should funds be set aside in advance or accumulated during facility life to pay for decommissioning?"

The group decided that the safest method was to have the funds collected in advance, although accumulation during facility life is the more practical. A combination of the two methods may be the best alternative.

13. "Who should hold the funds if they are accumulated?"

A predominant view was that funds should be held by the State. The group offered the following options:

- irrevocable trust
- security bonds
- controller
- independent commission
- depreciation account within the utility

Note: If States do hold funds, what about interstate cases? States can't regulate interstate commerce. This problem requires a solution; Federal authority may be the answer.

Further concern about treatment by IRS of collected funds was discussed by the group.

14. "How can uncertainties in cost or contingencies be covered?

- By extra money in accrual for each facility?
- By extra money into a general fund?
- State or Federal?"

In response to uncertainties in cost or contingencies, the group suggested frequent evaluation (approximately every 5 years) of the technical decommissioning plan required by NRC and a periodic reevaluation of the financial plan performed by the responsible government entities.

The group answered "no" to parts (a) and (b) of the question, and thought the State should have the authority under Federal guidelines.

Note: Some uncertainties could be covered by a contingency fund that would have to be participated in more widely than by a single utility or State.

Additional questions raised by the Group

(1) Who should handle the nonregulated nuclear areas, and in particular, who should deal with financial responsibility? Possible consideration may be given to the question in the licensing and funding of these facilities.

(2) What if an accident closes the facility prematurely? Would insurance compensation be applicable and sufficient to cover increased costs? Contingency fund of some sort on a regional or Federal basis might be possible.

(3) What if the plant is shut down after 10 years but funds for decommissioning were planned to be collected for 30 years? Do future customers pay the cost even though they get no benefits?

David Bauer, Rapporteur

PHILADELPHIA - Yellow Group - Sherwood Davies, Chairman

Preface

In order to reply to the questions posed by the NRC plan for decommissioning, a number of assumptions or restrictions were developed. The replies to the questions deal only with nuclear power generating and reprocessing facilities. Further, they are directed toward plants not yet in operation. The question was posed as to whether the decommissioning funding and cleanup criteria should be applicable to existing licensed facilities. The group felt that in this case the criteria should be applied by the States on a site-specific basis and that present considerations need to be examined in each case.

Another major question concerned the form that the developed criteria would take. Here we specifically request that the NRC decide whether it is more appropriate to specify acceptable methods of decommissioning in a regulation or a regulatory guide.

Inasmuch as the complete dismantlement of nuclear facilities is contingent upon waste disposal (both high- and low-level), it was a group consensus that this issue be resolved and further, it is suggested that NRC hold similar workshops on the issue of high- and low-level waste disposal.

Questions

1. "Do the States have an acceptable role in the plan?"

The group consensus was that States do have a signifcant role in the plan presented by NRC. It should be understood that the group did not acquiesce nor pass upon the appropriateness of NRC's position in its consideration of those matters set forth in the plan. There was a feeling that further delineations of the legal responsibilities of Federal, State and local agencies was needed. The conclusion was that States should have a continuing role in development of a decommissioning plan and particular recognition should be given to municipal and local concerns.

2. "Are the technical reports adequate in covering the right facilities, in considering the real alternatives?"

In relation to the technical reports presented, questions arose as to whether the reported figures were realistic. The group felt that a range of costs should be identified and the assumptions used in determining costs should be clearly set forth, including variables associated with specific sites. It was also pointed out that the cost of decommissioning should be identified as a factor in the overall financial profile of the plant.

3. "Should the plan be modified? How?"

In formulation of a decommissioning plan, it was felt that NRC should act as a coordinating body incorporating appropriate guidance from all Federal agencies having a jurisdictional role in decommissioning.

4. "Should detailed decommissioning plans be required prior to the issuance of license?"

It was the group's consensus that decommissioning plans be required prior to the issuance of a license. The detailed plans should assure coverage of costs for the various modes of decommissioning assuming best available technology and include periodic review and update to include technological advance.

5. "Is delay in decommissioning justified to save money? -- to reduce radiation exposure?"

The delay in decommissioning of a facility to save money should be a consideration of the appropriate State regulatory agency. Further, costs hinge on site-specific considerations and for this reason, generic rule-making procedures may not be applicable.

A delay in decommissioning in order to reduce radiation exposure may be justified providing the cost per person-rem is not disproportionate to the acceptable norm.

6. "Is permanent entombment of nuclear facilities an acceptable method of decommissioning?"

Based upon present technology, the group felt that the permanent entombment of nuclear facilities is an unacceptable method of decommissioning. Entombment is considered inferior to temporary safe storage procedure under present technology.

7. "Should decommissioning criteria extend to buildings, structures and components which are not contaminated with radioactive materials?"

The group was not able to reach consensus on the extension of decommissioning criteria to non-radioactively contaminated structures and materials. Two opposing views were expressed. The first being that inasmuch as the U.S. NRC evaluates all aspects of the facility for licensing purposes that they should accordingly establish criteria for this decommissioning. The other view, which appeared to be the majority view, was that these criteria should be the responsibility of the State or regulatory agency.

8. "Can cleanup criteria be developed by the Federal government with State advice so that all can endorse and follow them?"

It was the group consensus that criteria can be developed by the Federal government in cooperation with State governments so that they will be mutually acceptable.

9. "Is a maximum dose rate of 1 mrem/yr to any individual after cleanup an acceptable basis for site release? What other basis would you recommend?"

If a maximum dose rate of 1 mrem/yr, above background, to an individual following cleanup is achievable on a cost-effective basis for site release providing that the 1 mrem/yr not be exceeded under any land use conditions, then the group felt that this is an acceptable limit.

10. "Who should pay for decommissioning?"

It was a group consensus that decommissioning costs be borne by the consumer as reflected by rates charged by the operating utility.

11. "Should financial responsibility requirements be imposed by Federal or by State authorities? When?"

Financial responsibility requirements should be imposed by State authorities with minimum technical standards and guidelines for decommissioning provided by NRC.

12. "Should funds be set aside in advance or accumulated during facility life to pay for decommissioning?"

The majority opinion was that funds should be accumulated during the life of the facility. Furthermore there should be some innovative approaches to decommissioning funding such as: including decommissioning costs as a normal capital expenditure in building the plant, utility pooling of funds, and pool insurance. A minority opinion was expressed that funds for decommissioning be set aside prior to the start-up of any new facility.

13. "Who should hold the funds if they are accumulated?"

14. "How can uncertainties in cost or contingencies be covered?"

In response to the issues raised in questions 13 and 14, the group felt that they could not adequately cover all the ramifications that these questions impose; rather the alternatives should be considered by the State at the time the plants are put into operation.

Nancy Nicholas, Rapporteur

PHILADELPHIA - Blue Group - Hon. Steven V. Sklar, Chairman

The members of the Blue Group would like to commend the NRC for their foresight and initiative in actively soliciting input from State personnel during their review of the NRC's policies on decommissioning. Their interest confirms the current State view that the NRC is genuinely concerned with obtaining outside opinions when formulating regulatory decisions.

Summary

In general the Blue Group would like to see an overall data base containing information on financial alternatives, decommissioning methods, minimum standards costs, etc. developed by NRC for use by the States in making their decisions. The group felt strongly that the NRC adopt regulations based entirely on health, safety and technical considerations with the States held responsible for decisions involving financial, political and social considerations.

Questions

1. "Do the States have an acceptable role in the plan?"
3. "Should the plan be modified? How?"

The Blue Group agreed that the NRC plan was acceptable from a procedural point of view in that it allowed sufficient opportunity for outside input, appeared to follow a reasonable schedule and included nearly all relevant topics.

However, the group did not agree that the plan provides sufficient jurisdictional direction in defining the States' roles in the decommissioning process, or in defining those points where Federal/State and concurrent jurisdiction overlap or how jurisdictions are distributed between the State and Federal governments.

The group recommends that the NRC identify, for further discussion: those junctures in decommissioning plans that will have Federal, State and concurrent jurisdiction implications, what areas of jurisdiction overlap, and who will be responsible for standards establishment.

2. "Are the technical reports adequate in covering the right facilities, in considering the real alternatives?"

The group generally accepted the technical reports from Battelle, but did question the reliability and validity of the data used, the sources of information consulted, the assumptions formulated and the generic applicability of the data presented. The group agreed that the NRC should develop cost data that is applicable to current designs.

4. "Should detailed decommissioning plans be required prior to the issuance of license?"

The group felt that detailed decommissioning plans developed prior to licensing would become outdated before a plant nears the end of its operating life. The group recommends that no prelicensing detailed decommissioning plan be required.

However, the group does recommend that NRC develop accurate generic cost estimates for acceptable methods (to NRC) of decommissioning to be used in the plant design and license preparation stages.

The group also recommends that the States and utility be responsible for choosing a mode of decommissioning from alternatives acceptable to NRC and be responsible for choosing financial alternatives and arrangements.

5. "Is delay in decommissioning justified to save money? -- to reduce radiation exposure?"

Delaying decommissioning may be justified; however, the ultimate decision should be made by the utility and the State on a case-by-case basis taking into consideration reduction in radiation, land-use problems, and the public health and safety. The delays should also be limited to a specified period of time.

6. "Is permanent entombment of nuclear facilities an acceptable method of decommissioning?"

Although a consensus could not be reached on whether or not to totally ban permanent entombment, the group did decide to recommend that NRC develop guidelines for acceptable decommissioning methods based entirely on technical and safety considerations. Questions regarding financial, social and political acceptability should be left up to the State using data provided by NRC.

7. "Should decommissioning criteria extend to building, structures and components which are not contaminated with radioactive materials?"

NRC should look at nuclear facilities from a radiation health and safety viewpoint and not concern itself with non-contaminated facilities.

8. "Can cleanup criteria be developed by the Federal government with State advice so that all can endorse and follow them?"

The group reworded the question to read, "How can standards be developed by the Federal government so that all States can endorse and follow them?", and made the following recommendations:

- State radiation control officers, environmental protection agencies and other relevant State personnel supply input to the decision making process.
- NRC develop minimum standards for releasing a site for unrestricted use but allow the States the flexibility to make stricter standards.

- Input from the States be encouraged well before development of initial draft documents.

9. "Is a maximum dose rate of 1 mrem/yr to any individual after cleanup an acceptable basis for site release? What other basis would you recommend?"

The group recognizes the fact that this standard should be set by the EPA, not the NRC, but in any event recommends that a strong rationale for choosing any standard be developed. The group agreed that 1 mrem/yr is sufficiently restrictive and may be too restrictive.

10. "Who should pay for decommissioning?"

11. "Should financial responsibility requirements be imposed by Federal or by State authorities? When?"

12. "Should funds be set aside in advance or accumulated during facility life to pay for decommissioning?"

13. "Who should hold the funds if they are accumulated?"

14. "How can uncertainties in cost or contingencies be covered?"

The Blue group treated questions 10-14 as one subject area and made the following recommendations:

- The current NRC practice of requiring demonstration of the financial capability of the applicant before issuance of an operating license should be applied to all power plant and fuel cycle facilities.
- Current users should pay the costs of decommissioning a nuclear reactor with States determining the collection method.

- Operators should pay the costs of decommissioning a fuel cycle facility with funds collected from customers.
- States should have general jurisdiction over nuclear reactors and material licensees that are in Agreement States; otherwise, NRC should have jurisdiction.
- NRC should have jurisdiction over fuel cycle facilities and require operators to have surety arrangements to pay the costs of decommissioning should the operators default.
- The Federal government should exempt States from liability for decommissioning fuel cycle facilities.
- The Federal government should be financially responsible as a last resort in decommissioning a fuel cycle facility.

Peter J. Kendrick, Rapporteur

ATLANTA - Green Group - Hon. Bill Tauzin, Chairman

Preface

The views expressed in this report, with one exception, represent the personal views of the participants, and not necessarily those of the entities they represent.

The Green Group suggests that these comments be passed by NRC on to the U.S. Congress.

The Green Group also commends its Chairman for his leadership and for the efficient and expeditious manner with which he conducted the meeting.

Questions

1. "Do the States have an acceptable role in the plan?"

The States do have a good forum for commenting on the decommissioning plan, but follow-up is needed in writing to NRC from the State participants. Many attendees at this meeting did not have enough time to prepare; in the future all participants in the same State should be notified of others involved so all can discuss the issues together before attending the workshops.

2. "Are the technical reports adequate in covering the right facilities, in considering the real alternatives?"

The technical reports are adequate in technical areas covered; however, reports on entombment and mothballing should also be considered and additional studies on other and varied sites (including multiple reactor sites) should be conducted and considered in updating the workshop results. Nevertheless, a decommissioning plan should be developed as soon as practical subject to updating as new information is made available. The group did not feel that the reports were adequate in the financial area, particularly in the non-power cases and express reservations about answering financial questions.

3. "Should the plan be modified? How?"

Regarding a modification to the plan, it would be a good idea to have a preliminary meeting in each State before coming to NRC meetings. It is desirable to have written comments submitted before the June 1979 meeting, probably in January. The NRC liaison officer in each State could be used to coordinate pre-workshop discussions.

Additionally, it may be helpful to devote a portion of the workshop to meetings, each consisting of the participants in the following three areas: technical, legal, and political. This should not preclude other meetings of the participants grouped as they were for this workshop.

3a. The Green Group added the following consideration:
Once the Federal Health and Safety criteria are established, the States should have authority to decide which mode of decommissioning of facilities within that State should be used consistent with those criteria.

4. "Should detailed decommissioning plans be required prior to the issuance of license?"

Detailed plans are impractical, but some plans are needed in order to establish financial responsibility. States ought to review the plans, with concurrence by the Federal government, to establish the financial capability of the applicant.

5. "Is delay in decommissioning justified to save money? -- to reduce radiation exposure?"

There is not enough information to determine if a delay in decommissioning is justified to save money. It ought to be examined on a case-by-case basis.

A delay may be justified to reduce radiation exposure.

Since there are no approved disposal plans, there may be no other alternatives to delay.

6. "Is permanent entombment of nuclear facilities an acceptable method of decommissioning?"

Permanent entombment of nuclear facilities should be kept as a viable alternative as long as it meets local and national health and safety standards.

7. "Should decommissioning criteria extend to buildings, structures and components which are not contaminated with radioactive materials?"

Buildings, structures and components which are not contaminated should be of no concern to the NRC. Appropriate State and local authorities should be left to deal with these structures in accordance with their own laws and policies. In many cases it is expected that these structures may see alternate valuable uses once the facility is released.

8. "Can cleanup criteria be developed by the Federal government with State advice so that all can endorse and follow them?"

Federal cleanup criteria are needed and should be developed and followed. Standards within those criteria should be somewhat flexible. It is assumed that no criteria will be endorsed by all.

9. "Is a maximum dose rate of 1 mrem/yr to any individual after cleanup an acceptable basis for site release? What other basis would you recommend?"

A maximum dose rate of 1 mrem/yr to any individual is unrealistically insignificant. A nationally acceptable and reasonable maximum dose rate should, however, be established with the States' right to require a stricter standard. A minority of two took the position that the maximum dose rate should be set on a site-by-site basis considering all the specifics of the given site, including preexisting background radiation levels.

10. "Who should pay for decommissioning?"

For power companies, decommissioning costs should be paid by the rate payers who benefit from the facility, all as set by the appropriate utility rate regulators. For non-power companies, decommissioning costs should be paid by the facility owner (who, it is assumed, would pass this cost on to his customers). In both cases, periodic adjustments should be made to meet the realities of the economics and new or developing technology.

11. "Should financial responsibility requirements be imposed by Federal or by State authorities? When?"

For power companies, the utility rate regulators should impose the financial responsibility requirements at the time the rates are set to permit collection from rate payers. For non-power facilities, the licensing authority should impose those requirements at the time of the licensing.

12. "Should funds be set aside in advance or accumulated during facility life to pay for decommissioning?"

For power companies, the rate payers should pay over the life of the facility and annual set asides or accountings should be made by the utility company. For non-power facilities, advance bond or surety or some advance deposit with periodic payments should be required with emphasis on flexibility, keeping capital dollars in circulation and with care to avoid disincentives to investment and anti-competitive treatment.

13. "Who should hold the funds if they are accumulated?"

For power companies, the company should be permitted to invest its decommission accumulations under the periodic monitoring supervision of the utility rate regulatory agency. For non-power companies the licensing authority should prescribe the method of investment and supervision, with emphasis again on flexibility.

Caveat

The IRS regulations which treat decommissioning accumulations and associated interest as taxable income should be changed.

14. "How can uncertainties in cost or contingencies be covered?

- By extra money in accrual for each facility?
- By extra money into a general fund?
- State or Federal?"

For power companies the periodic review by the utility rate regulatory agencies should be sufficient. For non-power companies, the State or Federal government should consider the establishment of risk pools over and above accumulated decommissioning funds, or face the option of meeting these contingencies from their own general funds.

Peter Cannon, Rapporteur

ATLANTA - Yellow Group - Charles Hardin, Chairman

Preface

The Yellow workshop discussed all fourteen questions posed by the NRC. In addition to these fourteen, two additional questions were considered. These additional questions were:

1. What are acceptable contamination limits, especially in soil?
2. What are acceptable limits for unrestricted release to the public?

These two additional questions were considered, but they were not discussed in detail since it was decided that there wasn't sufficient information available at this meeting to make a decision on limits.

The following are the recommendations of the Yellow workshop for each of the fourteen questions discussed. Where there were minority opinions that differ from the recommendations, they are identified. If no differing opinions are identified, the recommendation represents the consensus of the group.

Questions

1. "Do the States have an acceptable role in the plan?"

The group felt that to accurately answer this question that NRC should have identified the role of States in the plan. Then States could discuss the acceptability of their role in the plan. However, the group thought that if States do have a role, it is in the following areas:

a. The group strongly felt that the States should be involved with the NRC and the licensee at the very beginning when decisions are being made on decommissioning a facility.
b. At the point when fuel assemblies have been removed from a nuclear power plant, and it, therefore, is no longer a production facility, the State, if an Agreement State, and if the State chooses, may

have a role of licensing and regulating the possession of residual radioactive materials in the decommissioning phase.

c. Due to various statutory requirements of States, such as siting, identification of aquifers, environmental limits, etc., the States have a role in decommissioning to assure that these statutes are being followed.

d. The State must have a role in the inspection and monitoring of the facility prior to release for unrestricted release to assure public health and safety.

2. "Are the technical reports adequate in covering the right facilities, in considering the real alternatives?"

The group felt a need for a total master plan for decommissioning, with qualified assumptions, which is tied in with a high- and low-level waste disposal study and a transportation study. Furthermore, the group thought a study of the possibilities to convert the decommissioned facility to another type of facility was needed.

3. "Should the plan be modified? How?"

The group decided its answers and comments to questions 1 and 2 indicate some areas of modification. The group noted in the background paper submitted to the participants for this meeting had the term "urgency" with respect to the need for a decommissioning policy; however, this urgency is not reflected in the plan nor the technical reports. Due to identified need of nuclear power plants and the question of financial responsibility in the early process of licensing, the group supports the urgency of establishing a national decommissioning policy as part of an overall nuclear policy.

4. "Should detailed decommissioning plans be required prior to the issuance of license?"

The group felt that a general decommissioning plan be identified and required prior to issuance of a license and that the general plan use as a reference the generic plans being developed by NRC for decommissioning. The group also thought the general plan should not relate to the financial plan. A financial plan should be a detailed plan identifying financial responsibility for decommissioning by the licensee.

5. "Is delay in decommissioning justified to save money? -- to reduce radiation exposure?"

The group decided that to answer this question, the word "decommissioning" should be changed to "dismantling or permanent status." Based on these new words, the group felt that there was not sufficient data relating to the cost vs. dose reduction over several years of postulated delay for application of the ALARA principal, and therefore could not make a decision on the value of delay vs. no delay.

The group did, however, identify that early dismantlement not only would be a financial savings, but would also relieve the emotional strain on the public of leaving a contaminated facility for several years in their vicinity.

6. "Is permanent entombment of nuclear facilities an acceptable method of decommissioning?"

The group answered this question by discussing the risk associated with entombment and felt that if the entombment would outlive the public health risk from the radioactive residual, then permanent entombment was an acceptable method. However, if the public health risk would outlive the entombment then permanent entombment is not an acceptable method.

7. "Should decommissioning criteria extend to buildings, structures and components which are not contaminated with radioactive materials?"

The group did not feel that the NRC had the authority or responsibility to be involved with non-radiological matters, and that decommissioning criteria should not be extended to buildings, structures and components which are not contaminated with radioactive materials, but that the States and local authorities should regulate this type activity. In addition, some of the group requested that NRC submit data on the level of contamination or negative findings of these buildings to insure they are "clean."

8. "Can cleanup criteria be developed by the Federal government with State advice so that all can endorse and follow them?"

The workshop supports the concept of uniformity in criteria (standards) but feels that the practicality of these criteria being reached by fifty or more entities without one dissenting vote, would be difficult.

9. "Is a maximum dose rate of 1 mrem/yr to any individual after cleanup an acceptable basis for site release? What other basis would you recommend?"

The group is willing to accept the maximum dose rate of 1 mrem/yr as an acceptable standard but feels a range is more appropriate. The 1 mrem/yr is a difficult level to measure; therefore, the group suggests that a range be considered with a minimum dose rate of 1 mrem/yr and 5 mrem/yr the maximum dose rate. If this range is adopted, every effort should be made to achieve the 1 mrem/yr (The ALARA concept).

10. "Who should pay for decommissioning?"

The group felt the beneficiaries of the service of that facility should pay for decommissioning.

11. "Should financial responsibility requirements be imposed by Federal or by State authorities? When?"

The consensus of the group is that the appropriate State agency, in addition to the Federal government, should have responsibility to require and impose financial responsibility on the facility. This financial responsibility should be in evidence prior to receipt of whatever license or permit the facility must receive from the licensing State agency where appropriate.

12. "Should funds be set aside in advance or accumulated during facility life to pay for decommissioning?"

For facilities with substantial financial base and where financial status is evaluated annually; e.g., nuclear power facilities, assurance of responsibility is adequate to obtain an operating license. However, the accumulation of funds for decommissioning should occur during the facility's life.

For other facilities, with a less substantial financial base and whose financial status is not evaluated annually, the licensee should be required to set aside funds for decommissioning in advance, either through a bond or by other methods.

13. "Who should hold the funds if they are accumulated?"

It was the consensus of the group that State agencies should hold funds in trust. Further, the group felt that the funds should be earmarked by the appropriate agency for specific expenditures associated with decommissioning the specific facility that generated the fund.

Minority Position to Yellow Group's Response to Question 13: The position of the Yellow Group concerning the escrowing of funds accumulated for decommissioning of nuclear facilities does not consider the financial impact on the consumers who are receiving the benefit of the facility. In the case of a public utility, this position will result in a larger revenue requirement from customers since the funds accumulated in escrow will be "after tax" dollars and any earnings on the escrowed funds will also be taxed.

The appropriate State agency should review each licensee on a case-by-case basis and based on the financial integrity of the licensee, determine the appropriate method of assuring the financial ability to carry out decommissioning which results in the best utilization of accumulated funds and lowest possible revenue requirement to the consumers.

14 "How can uncertainties in cost or contingencies be covered?

- By extra money in accrual for each facility?
- By extra money into a general fund?
- State or Federal?"

The consensus of the group was that the uncertainties in cost or contingencies be covered by accrual by the facility with frequent (possibly annual) evaluation by the regulatory agency of the adequacy of the contingency funds.

Donald Shilesky, ScD, Rapporteur

ATLANTA - Blue Group - Heyward Shealy, Chairman

Questions

1. "Do the States have an acceptable role in the plan?"

The format of these workshops is a good approach to getting State input. State role in the Plan (NUREG - 0436) appears adequate. Participants reserved judgment on the adequacy of the outcome of the Plan pending further progress.

2. "Are the technical reports adequate in covering the right facilities, in considering the real alternatives?"

In the future, materials to be discussed should be provided in advance to allow for more complete study. Group consensus was that the two reports discussed generally "appeared" technically adequate based on limited review in the time available. However, reservations were expressed concerning the adequacy of the cost estimates, particularly in considering sensitivity to various factors (i.e., labor rates, inflation, etc.) and tax consequences of available mechanisms for collecting the money required for decommissioning.

3. "Should the plan be modified? How?"

Answers to questions 1 and 2 apply. In particular, cost sensitivity, tax consequences and energy costs need further consideration.

4. "Should detailed decommissioning plans be required prior to the issuance of license?"

No. Generically applicable technical plans should be sufficient for the two types of facilities studied to date, and probably for all other licensees as well. Such plans should be required prior to licensing.

5. "Is delay in decommissioning justified to save money? To reduce radiation exposure?"

Consensus was reached that other issues would probably control the decision on what type of decommissioning was appropriate and when it should be implemented. In any case, the group had no objection to delaying dismantling or permanent entombment to reduce cost and/or exposure.

6. "Is permanent entombment of nuclear facilities an acceptable method of decommissioning?"

Consensus was reached that this should be a State decision, and that entombment might be acceptable in some situations. To the question: "Should permanent entombment be excluded as an option?", the group answered NO.

7. "Should decommissioning criteria extend to buildings, structures and components which are not contaminated with radioactive materials?"

No. The NRC should not be involved, and they probably don't have the jurisdiction to extend criteria to uncontaminated facilities.

8. "Can cleanup criteria be developed by the Federal government with State advice so that all can endorse and follow them?"

Theoretically, yes, but some States would likely develop their own criteria.

9. "Is a maximum dose rate of 1 mrem/yr to any individual after cleanup an acceptable basis for site release? What other basis would you recommend?"

The group felt they lacked the expertise required to suggest a specific maximum dose rate criteria, but felt that some maximum dose rate was a reasonable basis for site release. It was noted that perhaps different values might be appropriate for different types of facilities.

It was suggested that a range might be appropriate, with a decision on where in the range the dose rate should be for a specific facility based cost-effectiveness analysis.

10. "Who should pay for decommissioning?"

It was a group consensus that those who benefit (the users) should pay the decommissioning costs.

11. "Should financial responsibility requirements be imposed by Federal or by State authorities? When?"

All States should be responsible for imposing financial (e.g., cost recovery) requirements on power reactor licensees (except municipal and Federally-owned facilities). Agreement States should also be responsible for all other facilities. In non-agreement States, Federal authorities should be responsible for such facilities. Obviously, there are many jurisdictional questions. For example, it is conceivable that wholesale and retail customers would be handled differently under present conditions. The desirability of Federal authority in such instances to remove inconsistencies needs to be considered.

12. "Should funds be set aside in advance or accumulated during facility life to pay for decommissioning?"

This should be a State decision. The group's opinion is that for regulated utility power plants, accumulation of funds over the life of the facility was preferred to advance payment. For other types of facilities, advanced payment (or bonding) is the more appropriate method to set funds aside for decommissioning.

13. "Who should hold the funds if they are accumulated?"

This should be a State decision. The decision may vary depending on the type of facility. If a funded reserve is accumulated, consideration should be given to revising applicable IRS tax regulations.

14. "How can uncertainties in cost or contingencies be covered?

- By extra money in accrual for each facility?
- By extra money into a general fund?
- State or Federal?"

For power reactors, periodic review and rate adjustments by the PUC should generally be sufficient to compensate for uncertainties in the initial cost estimates. For other types of facilities, front-end bonding to cover decommissioning costs in the event of premature shutdown was recommended in conjunction with gradual accumulation of decommissioning funds.

For contingencies required in case an accident or other event significantly changes (increases) decommissioning costs for any facilities, other than power reactors, Federal or State authorities should probably provide insurance or a general fund (contributed to by licensees) to absorb the costs.

David Bauer, Rapporteur

ATLANTA - Red Group - Maurice Van Nostrand, Chairman

Questions

1. "Do the States have an acceptable role in the plan?"

The role that the NRC is assigning the States now in the development of a decommissioning program is acceptable and appreciated. There may, however, be some jurisdictional questions in the area of public health and safety. The group felt that such gray areas surrounding State/Federal jurisdiction do need to be resolved so that the respective responsibilities are more clearly defined.

2. "Are the technical reports adequate in covering the right facilities, in considering the real alternatives?"

The group felt the technical reports were adequate and developed in a professional manner. Further reports, however, such as that on multi-reactor sites, would be helpful.

3. "Should the plan be modified? How?"

In addition to development of decommissioning plans for other types of nuclear utilization facilities, recognition must be given to the great uncertainties that will remain until high- and low-level waste disposal sites are established and the States' responsibility for them is clearly determined.

4. "Should detailed decommissioning plans be required prior to the issuance of license?"

The group felt that detailed decommissioning plans should not be required prior to the issuance of license. Rather, the NRC should develop guidelines based on today's technology that would, with updating, be acceptable to State regulatory agencies and would serve as the basis for developing cost figures. Reasonable guarantees of financial responsibility would, of course, be required.

5. "Is delay in decommissioning justified to save money? To reduce radiation exposure?"

No delay in decommissioning was seen as justified either to save money or reduce radiation exposure. The group generally agreed that the public would be unlikely to accept delay absent a showing of benefit.

6. "Is permanent entombment of nuclear facilities an acceptable method of decommissioning?"

Permanent entombment does not presently appear to be an acceptable option, from an economic or social perspective, but should not be totally excluded from consideration. Continued usage of a site for electric generation, with a portion becoming an alternative to a new low-level waste disposal site may make entombment desirable.

7. "Should decommissioning criteria extend to buildings, structures and components which are not contaminated with radioactive materials?"

The group did not feel that decommissioning criteria should extend to non-radioactively contaminated structures.

8. "Can cleanup criteria be developed by the Federal government with State advice so that all can endorse and follow them?"

The group feels that criteria can be developed so that most--probably not all--can endorse and follow them.

9. "Is a maximum does rate of 1 mrem/yr to any individual after cleanup an acceptable basis for site release? What other basis would you recommend."

Assuming the Battelle reports are accurate--that there is no substantial cost difference in attaining 1 mrem/yr as opposed to some higher level such as 25 mrem/yr, and recognizing that 1 mrem/yr is calculable, with difficulty, by indirect methods--that basis is acceptable. Caution is urged in applying this level to non-production and utilization facilities. The group felt strongly that exposure levels should be reasonably achievable.

10. "Who should pay for decommissioning?"

It was group consensus that those who receive the benefits of nuclear facilities should bear the costs of decommissioning those facilities.

11. "Should financial responsibility requirements be imposed by Federal or by State authorities? When?"

For regulated utilities, administration of this requirement should be the responsibility of the proper rate making body.

For non-regulated utilities, NRC should require that a procedure for recovering decommissioning costs from rate payers be developed and applied.

For other nonregulated facilities, NRC must be satisfied, through the showing of financial responsibility or surety arrangements, that decommissioning can be accomplished. States that have indicated a willingness and an ability to do so can exercise this authority.

"When?"

As soon as cost is identified and generally accepted, this should be retroactively implemented for existing facilities and serve as a prerequisite to licensing of new facilities.

12. "Should funds be set aside in advance or accumulated during facility life to pay for decommissioning?"

The group felt that in no case should funds be set aside in advance. In the case of a utility, accumulation is imperative to assure proper allocation of decommissioning costs. In regard to other licensees, the requirement would be satisfied by a showing, to the proper State or Federal agency, of financial strength or a surety arrangement to guarantee decommissioning would be accomplished.

13. "Who should hold the funds if they are accumulated?"

Accumulation of funds should be required only for utilities. These funds should be held by the utility, with review being given by the appropriate State or Federal agency to the handling of such funds.

14. "How can uncertainties in cost or contingencies be covered?

- By extra money in accrual for each facility?
- By extra money into a general fund?
- State or Federal?"

Given the provisions of continuing surveillance, the group could see no uncertainties or contingencies in the case of a utility that would require extraordinary measures. In the case of non-utilities, the proper State or Federal agency should require a periodic showing of financial strength or surety arrangements to guarantee that decommissioning will be accomplished.

Nancy Nicholas, Rapporteur

ALBUQUERQUE - Green Group - Ted Wolff, Chairman

Questions

1. "Do the States have an acceptable role in the Plan?"

The group decided the question should be reworded to read: "Do States have an opportunity to play a role in the Plan?"

Some of the group felt that the States had an opportunity to play a role in the Plan, but others thought there is a lack of internal communication within the States for coordination of a role in reviewing the regulations and other decommissioning materials.

Suggestion: NRC should try to follow-up with the States as to who reviewed and commented on the materials related to this workshop to insure the appropriate persons knowledgeable in financing, health effects and procedures of decommissioning have had an opportunity to review the materials. Furthermore, the NRC should continue to keep all branches of the State governments (legislative, radiation health, environmental, and public service utility commissions) cognizant of the progress they are making on decommissioning policies.

2. "Are the technical reports adequate in covering the right facilities, in considering the real alternatives."

The group thought the reports were adequate, but should be extended to large manufacturing facilities (e.g., nuclear pharmacy). However, the group did not feel it could consider all the alternatives at this time because the group did not have all the information.

3. "Should the Plan be modified? How?"

The question was modified to read: "Should the Plan and technical reports be modified?"

The group felt that the Plan should include nuclear facilities outside the fuel cycle which require licensing. Furthermore, the Plan should be modified to consider in more detail the refurbishment or conversion of old facilities to other nuclear or non-nuclear facilities.

The reports on PWR and reprocessing facility decommissioning were considered inadequate in that uncertainties in dose calculations, cost and procedures were not thoroughly addressed. On estimates of cost, in particular, the sensitivity of cost estimates to site factors, regulatory assumptions, technology, etc. should be explored. Full and complete calculations and sufficient data to permit independent verification of cost and dose calculations should be included. Lastly, financing possibilities and the effect of tax policy on the cost of implementing these alternatives should be included.

The group also felt States need to increase their participation in the Plan, especially in the non-fuel cycle facilities.

4. "Should detailed decommissioning Plans be required prior to the issuance of license?"

The group desired that a decommissioning Plan of the procedures and tasks to be employed be required, in sufficient detail, to make a thorough and detailed estimate of the cost prior to issuance of a license. This Plan should include all aspects up through and including complete dismantling for facilities, such as reactors, containing long-lived radionuclides. For facilities containing only short-lived radioisotopes, the Plan should cover at least mothballing and should also cover entombment where this is an option.

5. "Is delay in decommissioning justified to save money? -- to reduce radiation exposure?"

Immediate decommissioning is most desirable. In addition, the group felt that facilities which only have surface contamination should be decommissioned immediately. For facilities with induced radiation, immediate decommissioning is preferable; however, a delay of up to 30 years may be justified on the basis of a savings in cost or exposure or multiple units on one site. Permission for such a delay would be determined by the licensing agency.

6. "Is permanent entombment of nuclear facilities an acceptable method of decommissioning?"

The group thought that permanent entombment was not an acceptable method of decommissioning for those facilities containing material with a long radioactive life and a long-term potential for hazards or impact on the environment. However, the group did consider entombment an acceptable method for facilities contaminated with short-lived nuclides.

7. "Should decommissioning criteria extend to buildings, structures and components which are not contaminated with radioactive materials?"

The group decided that decommissioning criteria should not apply to structures and components which are not contaminated with radioactive materials. Furthermore, the NRC has jurisdiction only in the radioactive constituents of the site and local authorities have jurisdiction over non-contaminated structures.

8. "Can cleanup criteria be developed by the Federal government with State advice so that all can endorse and follow them?"

The group changed the question to read: "Can cleanup criteria <u>and standards</u> be developed by the Federal . . . ?"

The purpose of this change was to reflect the group's opinion that movement toward quantifiable standards was desirable. The majority of this workshop thought the Federal government should set criteria and minimum standards which the States should adopt and make an effort to follow. However, under special circumstances, the States should have the right to set standards which exceed Federal standards.

9. "Is a maximum dose rate of 1 mrem/yr to any individual after clean-up an acceptable basis for site release? What other basis would you recommend?"

The group felt it didn't have enough information to evaluate the question and recommended that the dose rate be further studied at a national level by qualified experts. However, the group listed a number of concerns related to this question. Some of these are:

1. Concern with problem of defining background including any changes over the life of the facility;
2. Concern with enforceability because so close to background;
3. Concern with the size and type of the population which would be affected;
4. Concern that the standard should reflect the duration of the exposure;
5. Concern with the relation of the maximum dose rate to a health effect.

10. "Who should pay for decommissioning?"

The group felt that two categories of nuclear facilities should be addressed by this question. One the public utility and the other the owner/operators of all non-reactor fuel cycle facilities and State-licensed facilities.

For public utilities, the group decided the rate payers should pay for decommissioning during the life of the plant. In considering the owner/operators, the group decided the owner/operators should bear the burden themselves.

of a surety bond and an escrow account. The financial assurance (surety bond and/or escrow account) should always be equal to the current estimate of the financial risk involved.

13. "Who should hold the funds if they are accumulated?"

The group decided that any funds accumulated should be invested outside the utility. The funds should not be idle. A number of possible avenues where these funds might be placed were discussed (e.g., banks, trusts, a special State authority for decommissioning, an existing State agency). However, the group did realize that there could be a potential tax problem associated with this approach.

The group requested NRC exploration of financing mechanisms utilizing parties other than utilities holding the accumulated funds and investing these funds in non-utility assets. Also included should be the manner in which present tax policies would affect the cost of implementing such financing methods and the changes required in tax policy to minimize impact on implementation costs.

14. "How can uncertainties in cost or contingencies be covered? By extra money in accrual for each facility? By extra money into a general fund? State or Federal?"

The group added the two considerations to the question of premature shutdown and utility insolvency. The group thought that uncertainties in cost for decommissioning of reactors could be handled by periodically reevaluating the anticipated costs and adjust the rate of funds accumulation accordingly. One method for doing this would be to obtain a detailed cost estimate at the time of initial licensing and for the utility or regulatory agency to maintain an economic computer model which would review annually the contingencies of decommissioning costs. These would be used to generate an updated cost estimate with a more complete review of costs by the regulatory agency every 3 to 5 years.

11. "Should financial responsibility requirements be imposed by Federal or by State authorities?"

The group decided that different categories of nuclear facilities required different authorities to impose financial responsibility requirements. Basically, the Federal government should set general criteria (minimum guidelines) for acceptable financial responsibilities and leave the States some latitude in the specific form of funding required and to implement whatever financial requirements are selected. If a State chose not to impose and implement these financial requirements, the complete authority would revert to the Federal government. The States have the right to require more stringent standards of financial responsibility than those required by Federal authorities as a minimum.

The group desired that the financial responsibility requirements be imposed prior to initial issuance of the license. Therefore, the appropriate State agency should involve itself in this aspect of licensing.

12. "Should funds be set aside in advance or accumulated during facility life to pay for decommissioning?"

The group decided three different types of facilities should be addressed by this question. For regulated public utilities, the group decided that funds for decommissioning should be accumulated over the life of the facility. In the case of unregulated power facilities, the group decided that where Federal regulation or a change in regulations at the State level could assure that all necessary funds would be accumulated over the plant life, that this is desirable. If funds cannot be collected over facility life, then the funds for decommissioning should be assured in advance of licensure by providing some combination of cash, a surety bond, or fully funded trust.

When considering all non-power facilities, the group decided that decommissioning costs should be up front in the form of a surety bond or a combination

Also, the group felt that uncertainties could be controlled through the State rate setting process and the licensing process. Furthermore, to avoid the possibility that in the event of premature reactor shutdown, the accumulated monies would be insufficient to cover the total costs at that time, a surety bond could be required in addition to cover any shortfall.

Note: The following two questions were also discussed by the group:

15. "To what extent do recent cost estimates for decommissioning reflect actual cost incurred in the past and to what extent are they site-specific?"

The group expressed concern for more site-specific cost estimates to give a better handle on the uncertainties in cost.

16. "How extensive is decommissioning experience? What are the uncertainties?"

The group recommended the NRC should be cognizant of ongoing or upcoming decommissioning situations and avail themselves to this experience.

Donald Shilesky, ScD, Rapporteur

ALBUQUERQUE - Yellow Group - Ernest Garfield, Chairman

Preface

The Yellow Group discussed all fourteen questions posed by NRC. Some questions were rephrased.

Questions

1. "Do the States have an acceptable role in the Plan?"

We are pleased with the opportunity to participate and would like to participate further. But, we do not have enough information to endorse the present Plan.

2. "Are the technical reports adequate in covering the right facilities, in considering the real alternatives?"

At this point, the Plan is not considered complete. Therefore, the reports cannot be adequately assessed.

3. "Should the Plan be modified? How?"

The Plan will have to be modified (e.g., NRC should attempt to gain control through licensing of tailings).

4. "Should detailed decommissioning Plans be required prior to the issuance of license?"

Detailed Plans and cost estimates should be made prior to issuance of license. (Group is split as to whether NRC has any responsibility regarding cost recovery, and whether the States should have this responsibility.)

Question 5 is rephrased:

5a. "Is delay in decommissioning justified if a money savings can be shown (as long as health and safety are not jeopardized)?"

Yes.

5b. "Whose role is it?"

A determination of whether a cost savings is justified to defer decommissioning should be given to the States (as long as health and safety are not jeopardized). NRC should provide the technical support and guidelines to the States to make the determination.

Question 6 is rephrased:

6. "Should permanent entombment in place or part thereof (reactors, reprocessing plants) be precluded as a viable decommissioning method at this time?"

No, until further detailed studies occur.

7. "Should decommissioning criteria extend to buildings, structures and components which are not contaminated with radioactive materials?"

No.

Question 8 is rephrased:

8. "Should NRC develop decontamination criteria as related to health and safety with State advice so Federal and State agencies can endorse and follow them?"

Yes.

Question 9 is rephrased:

9. "Should NRC be requested to establish (with State technical advice) a standard maximum dose rate for an individual for cleanup (decommissioning) which will be an acceptable basis for site release?"

Yes.

Questions 10-14 are all answered in four categories: Regulated Utilities, Unregulated Utilities, Fuel Cycle and Material License.

10. "Who should pay for decommissioning?"

Regulated Utilities: The costs should be borne by the utility customer (rate payers) as prescribed by State regulatory authorities.
Unregulated Utilities: The costs should be borne by the utility customer (rate payers) as prescribed by State and local authorities.
Fuel Cycle: The costs should be borne by the company as a cost of business.
Materials License: The costs should be borne by the company or individual involved as a cost of business.

11. "Should financial responsibility requirements be imposed by Federal or by State authorities?"

Regulated Utilities: NRC should set minimal standards. And where feasible the States may impose regulations more stringent or equal to Federal regulations.
Unregulated Utilities: Same as Regulated Utilities.
Fuel Cycle: Same as Regulated Utilities.
Materials License: Same as Regulated Utilities.

12. "Should funds be set aside in advance or accumulated during facility life to pay for decommissioning?"

Regulated Utilities: States should impose conditions for financing. This is not in the scope of NRC licensing procedures.
Unregulated Utilities: States should impose conditions for financing. This is not in the scope of NRC licensing procedures.
Fuel Cycle: Funding procedures should be required prior to licensing.
Materials License: Funding procedures should be required prior to licensing. Group expressed dissatisfaction in IRS imposing income tax on reserve and sinking funds. The minority of the group believes it is not NRC's function to intervene with IRS in behalf of utilities.

13. "Who should hold the funds if they are accumulated?"

The appropriate State authorities should determine conditions for financing.

14. "How can uncertainities in cost or contingencies be covered?

- By extra money in accrual for each facility?
- By extra money into a general fund?
- State or Federal?"

Regulated Utilities: State should impose conditions for financing.

Unregulated Utilities: State should impose conditions for financing.

Fuel Cycle: NRC and/or State should require bonding prior to licensing.

Materials License: NRC and/or State should require bonding prior to licensing.

William Lyon, PhD, Rapporteur

ALBUQUERQUE - Blue Group - David K. Lacker, Chairman

Questions

1. "Do the States have an acceptable role in the Plan?"

The general opinion of the group was that there was a lack of State involvement in the Plan. It was felt that States do not have a role in setting up rules and regulations and that they should have the opportunity to participate in the draft stage, especially in areas that will specifically affect their State. It was also suggested that the question be restated to ask if the Federal agencies have an acceptable role, emphasizing the feeling that the States should have the primary role.

2. "Are the technical reports adequate in covering the right facilities, in considering the real alternatives?"

The technical reports were seen as well done for the facilities that they covered, but it was noted that similar studies, which are planned by NRC, covering other licensed facilities are needed.

The alternatives covered were apropo for the facilities studied, but for those types of facilities to be studied, alternatives other than those presented here will need to be considered.

3. "Should the Plan be modified? How?"

Modification of the Plan is needed to allow for more input from States, as well as input from national State organizations. The group felt it would be a great help to seek input from organizations such as: The National Governors Association, the National Conference of State Legislatures, the National Conference of Radiation Control Directors, and the National Association of Regulatory Utility Commissioners in the areas of their specific expertise.

4. "Should detailed decommissioning plans be required prior to the issuance of license?"

Detailed plans for decommissioning should not be required, but the future requirement for a decommissioning plan should be considered. Some criteria such as financial responsibility and possible modes of decommissioning should be considered. A plan should be flexible enough to incorporate technological advance, and the amount of detail to the plan will vary in accordance with the type of facility under consideration.

5. "Is delay in decommissioning justified to save money" -- to reduce radiation exposure?"

The group felt, in some cases, delays in the completion of decommissioning may be justified to save money when balanced against radiation risk, but there should be a site-specific determination as to the timing and final disposition.

6. "Is permanent entombment of nuclear facilities an acceptable method of decommissioning?"

Permanent entombment cannot be totally ruled out as a viable decommissioning option, but the decision depends upon the degree of entombment and the site-specific situations.

7. "Should decommissioning criteria extend to buildings, structures, and components which are not contaminated with radioactive materials?"

The group was opposed to the extension of decommissioning criteria to non-radioactive contaminated structures. Further, they questioned the NRC's authority to do such, as well as feeling that it would be unjust to burden the rate payer with the additional expense of dismantling a "safe" and possibly useful structure.

8. "Can cleanup criteria be developed by the Federal government with State advice so that all can endorse and follow them?"

The group felt that this question should be restated to ask: "Should cleanup criteria be developed by the Federal government with State advice?" The answer to this was "no," rather, Federal advice should be used, but criteria should be developed in accordance with the needs of the State. At the very least, the development of criteria should be a joint State/Federal effort.

9. "Is a maximum dose rate of 1 mrem/yr to any individual after cleanup an acceptable basis for site release? What other basis would you recommend?"

One mrem/yr was seen by the group as an unrealistic number and, on that basis, unacceptable. In determining a more reasonable number for use, options such as a percentage of background, a sliding percentage (10 CFR 50, Appendix I), or use of levels presently set for exposure in operating reactors should be investigated. In setting a specific level, current criteria must be taken into account, but the flexibility to alter the level as technological changes occur must be incorporated.

10. "Who should pay for decommissioning?"

The consumer who reaps the benefit from any facility should bear the cost of decommissioning.

Questions 11-14 were answered by dividing licensed facilities into two groups: Regulated Facilities and Other Non-Production and Utilization Facilities. In the case of Regulated Facilities, the questions asked in 11-14 were addressed by the following scheme:

For Regulated Facilities, funds should not be set aside in advance nor accumulated during the facility's life. The regulating body concerned with the financial responsibility to assure that decommissioning funds are available should allow the operator the use of negative salvage in the company's depreciation, with a deferral of the tax advantage of the decommissioning to the time they may take it for tax purposes. Negative salvage will permit use of these funds during their accumulation and will enable a well-regulated utility to have the funds required when needed.

The following answers to Questions 11-14 are meant to apply to Other Non-Production and Utilization Facilities.

11. "Should financial responsibility requirements be imposed by Federal or by State authorities? When?"

In Agreement States, the regulating body licensing the facility should set the financial responsibility requirements. In non-agreement States, the Federal government, as the licensing agent, would have to set these requirements. In both cases, these requirements should be set prior to the issuance of license.

12. "Should funds be set aside in advance or accumulated during facility life to pay for decommissioning?"

Funds should either be set aside in advance or the regulating body should be assured of their availability at the time of need.

13. "Who should hold the funds if they are accumulated?"

Accumulated funds should be held by the appropriate State agency. It should be the responsibility of the NRC to see that the mechanism exists in the absence of an appropriate State agency, such as in non-agreement States.

14. "How can uncertainties in cost or contingencies be covered? By extra money in accrual for each facility? By extra money into a general fund? State or Federal?

Uncertainties in cost or contingencies should be covered through a periodic review in terms of current cost, technology and requirements, by the licensing agency, and appropriate update at the time of review to incorporate any necessary changes.

Nancy Nicholas, Rapporteur

ALBUQUERQUE - Red Group - Sen. Ted Bottiger, Chairman

Preface

The responses to the questions below apply to power reactors and represent group concerns unless otherwise indicated.

The group expressed significant concern that waste disposal facilities are not currently available for waste from decommissioning and urged NRC to resolve this issue.

Questions

1. "Do the States have an acceptable role in the Plan?"

The Plan is procedurally acceptable. However, the Plan should be expanded since it does not adequately address how authority and responsibility for existing facilities will be considered. In addition, the majority believes that the States cannot have an acceptable role in plans dealing with the end of the nuclear fuel cycle (i.e., decommissioning) while they have been precluded from an appropriate role at earlier points. Therefore, the majority would require NRC support of legislation to remove the pre-emptive clause from the Atomic Energy Act which would then allow State regulation of all facets of the atomic energy cycle so as to allow States to set stricter standards. This is not meant to preclude setting of Federal minimum standards; the provision of technical assistance to the States; or to conflict with Federal control of interstate commerce.

2. "Are the technical reports adequate in covering the right facilities, in considering the real alternatives?"

A minority of one said that the reports were adequate in covering the right facilities and the real alternatives. Other members of the group cited the following topic areas which required further study to make the reports adequate:

- the feasibility and costs associated with recommissioning or conversion of a reactor facility;
- sensitivity to site-specificity, labor productivity and disposal cost variability;
- validity of extrapolating technology from a small facility (Elk River) to large facilities;
- ranges of cost and technical options;
- the viability and cost of sub-optimal alternatives, such as storage of spent fuel off-site in combination with entombment or mothballing;
- more detailed financial analysis with investigation of tax issues and related concerns; and
- reliability of the presumption that deep geological disposal facilities will be available.

3. "Should the Plan be modified? How?"

Yes, as indicated in the responses above to Questions 1 and 2.

4. "Should detailed decommissioning Plans be required prior to the issuance of license?"

Technical decommissioning Plans with sufficient detail to permit development of cost estimates and evaluation of design options should be developed before a license is granted (a construction license in the case of power reactors). It was also suggested that public comment on the Plan be solicited and that updates of the Plan be conducted periodically. Detailed Plans as opposed to generic Plans are required due to sensitivity to site-specific conditions.

5. "Is delay in decommissioning justified to save money? -- to reduce radiation exposure?"

As a general rule, yes. But site-specific conditions require case-by-case determination. For example, a reactor shut down because it is discovered to be on a fault zone should be decommissioned (dismantled) immediately, while delay may be appropriate in other cases.

It is generally desirable to reduce exposure, but costs and political implications will also affect the timing of decommissioning selected.

6. "Is permanent entombment of nuclear facilities an acceptable method of decommissioning?"

Permanent entombment (above the ground) is not acceptable if it is assumed that adequate off-site waste disposal facilities are available. Current lack of adequate waste disposal facilities makes permanent entombment worth considering in more detail than presented in the PWR study. Options such as off-site disposal of high-level waste with on-site entombment (below ground or above) or low-level waste should also be considered.

7. "Should decommissioning criteria extend to buildings, structures, and components which are not contaminated with radioactive materials?"

No. These are State and/or local issues.

8. "Can cleanup criteria be developed by the Federal government with State advice so that all can endorse and follow them?"

Minimum cleanup criteria can be developed by the Federal government with State participation, reserving to the State the right to impose more stringent criteria.

9. "Is a maximum dose rate of 1 mrem/yr to any individual after cleanup an acceptable basis for site release? What other basis would you recommend?"

No. A majority felt that 1 mrem/yr is an unrealistically low basis for site release. The group felt it lacked the expertise necessary to recommend a specific basis for site release. The group did suggest that health effects (death and illness risk) be considered as a method of defining an acceptable level for site release. It was also noted that any basis for site release needed to be well documented and not arbitrary. The group also expressed their curiosity as to why a maximum dose level less than that for an operating reactor was even considered.

10. "Who should pay for decommissioning?"

This should be a State decision. The group felt that in their States, the licensee should pay, with the cost to be assigned by State authority. The Federal government should pay for decommissioning reactors built as part of the Federal R&D effort.

The cost of decommissioning should be included as a cost of electricity generation. A minority of one indicated that decommissioning is a social issue.

11. "Should financial responsibility requirements be imposed by Federal or by State authorities? When?"

Financial responsibility requirements for decommissioning should be imposed by State authorities at the time of issuance of the certificate of public convenience and necessity or a land use permit. Technical assistance should be provided by the Federal government. A minority of one indicated that minimum standards should also be developed by the Federal government. State approval of a financing plan should be a condition of NRC license approval.

12. "Should funds be set aside in advance or accumulated during facility life to pay for decommissioning?"

This should be a State decision. The group felt that in their States, funds should be accumulated during the facility life (either over the entire projected life of the facility or a portion of the useful life, such as the last 10 years), with some other mechanism developed to cover costs in the event of premature shutdown.

13. "Who should hold the funds if they are accumulated?"

This should be a State decision. A majority of the group felt that their States should hold the funds. A minority of one said either the State or the utility (within State rules) should hold the funds.

14. "How can uncertainties in cost of contingencies be covered? By extra money in accrual for each facility? By extra money into a general fund? State or Federal?"

The group suggested the following options of providing for uncertainties in cost and contingencies:

- insurance pool to distribute risk;
- tax on uranium;
- periodic review of cost with rate adjustment;
- electricity generation tax;
- partial bonding (perhaps by the Federal government);
- combinations of the above;
- stratified system depending upon the dollar amount involved, with small costs borne by the utility and very large costs (i.e., a major accident) absorbed by the Federal government.

David Bauer, Rapporteur

APPENDIX A

ALBUQUERQUE

AGENDA

STATE WORKSHOPS FOR REVIEW OF NRC DECOMMISSIONING POLICY

> **Editor's Note**
> A similar agenda was followed at Philadelphia and Atlanta

First Day (PM)

5:00	Registration	
6:30 - 9:00	Opening Plenary Welcome (Rio Grande Room)	Sheldon A. Schwartz Assistant Director for Program Development Office of State Programs U.S. Nuclear Regulatory Commission
	Policy Issues Summary of Comments on Decommissioning Policy	Robert Bernero Assistant Director for Material Safety Standards Office of Standards Development U.S. Nuclear Regulatory Commission
	Questions	
9:00 - 9:30	Divide into Four Groups	Red - Turquoise Yellow - Mercado 18 Blue - Kachina Green - Rio Grande
9:30	Cash Bar	

Second Day (AM)

8:00 - 10:00	Plenary	
	Results of Decommissioning Reports	Richard I. Smith Associate Manager Safety Analysis Section Battelle, Pacific Northwest Laboratory
		E. Smith Murphy Study Leader Safety Analysis Section Battelle, Pacific Northwest Laboratory
10:00 - 10:30	Coffee Break	
10:30 - 12:00	Working Groups	Red - Mercado 24 Yellow - Mercado 18 Blue - Kachina Green - Potters

Second Day
(PM)

1:00 -	Working Groups	Discussion (continued)
5:30 - 7:00	Dinner	
7:00	Working Groups	Reports, discussion (continued) (if necessary)

Third Day
(AM)

8:30 - 9:30	Working Groups	Review reports Red - Turquoise Yellow - Mercado 18 Blue - Kachina Green - Rio Grande
9:30	Coffee Break	
9:45 - 12 (noon)	Closing Plenary	Chairmen Present Reports

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APPENDIX B

P R O C E E D I N G S

MR. SCHWARTZ: Ladies and Gentlemen, can I have your attention, please. Welcome to Philadelphia, the City of brotherly love.

I want to welcome you all here, we appreciate your giving us your time, your knowledge and your experience to discuss with us the issues relating to decommissioning of nuclear facilities. They are important issues, to not only the Federal Government, but also the States in their regulatory programs. This is the principal reason we have structured a meeting like this for State input to our decommissioning policy.

What we are about here, at the workshops, is to hear from you, the States. How you view what you have seen so far, NUREG 0436 and some of the contract reports.

Through these workshops we are going to be seeking your comments on the clarification of jurisdiction between State and Federal Governments, on the financial assurance aspects, that there will be money available to decommission the facilities, and to the extent of decommissioning required. By the extent of decommissioning, we mean mothballing, entombment, or dismantling. You will be hearing more about this from Bob Bernero later.

We will be conducting identical regional workshops with other States in Atlanta, Georgia and Albuquerque, New Mexico next week. If you are accurately registered, each of you will receive copies of the deliberation of the States in these meetings and also any documents coming out of the Nuclear Regulatory Commission relating to the decommissioning of nuclear facilities.

In June of 1979 we expect to be back to you, through another set of work-shops hopefully involving all of you again. At that workshop we will present the NRC Staff views and hopefully it will reflect what we have learned at these workshops with the States.

I would like to go through the agenda now and make sure everybody understands how we are planning to conduct the workshop.

At the close of the Plenary at 9:00, we will divide into working groups. What I expect to happen tonight is that you will review the questions for issues to assure yourself that what we generate on the banks of the Potomac are things that you feel are important. If they are not important to you, recommend to your workshop chairman that this is something you are not interested in.

If there are issues that you think are not dealt with, raise them and get them on the agenda for your discussions tomorrow. I think it is very important that you review the questions, not in the light of the individual questions themselves, but the issues that they raise whether you think they are important to demonstrate.

Let me take this opportunity to introduce to you the working group chairmen. The Chairman of the Blue group is the Honorable Steven Sklar, a Delegate from the Maryland House of Delegates.

(Applause.)

The Chairman of the Green group is the Honorable Miriam Butterworth, Chairman of the Connecticut Public Utilities Control Authority.

(Applause.)

And the Chairman of the Yellow Group is Sherwood Davies, Director of the Bureau of Radiological Health, New York State Department of Health.

(Applause.)

If I forget to, I want to thank you all right now for accepting the challenge of chairing these groups. I feel very fortunate to have your involvement.

There are other representatives from the Federal Government here, I know of two from other agencies, and I would like to introduce them so they can identify themselves. They will be available during the working group deliberations to provide to you the impact of their agency decision making on any decisions or recommendations you come up with in the next few days.

From the EPA Office of Radiation Programs, Mr. Bill Crofford.

And from the Federal Energy Regulatory Commission, Mr. Ben Kitishima. Are there any others from other Federal agencies who would like to be identified here to the audience?

(No response.)

For those who wish to make a statement for the record, I would ask that it be a written statement so that it can be included in the record. And, if they would like to make an oral statement that you see me sometime during the meeting to put you on the agenda for the Plenary session on Wednesday. We have a very full agenda, and I would like to hold it for that time.

I would like to note also that the Nuclear Regulatory Commission is holding a public meeting on the issue we are dealing with here on October 18th in

Washington, D.C. for all those that feel they were not heard here or would like to be heard again.

Let me just close with one other remark, all of us are busy; all of us attend a lot of meetings, sometimes too many. For that reason we are holding a night session and a day session so we don't take too much of your time. But at too many of these meetings, issues are not raised by the individuals, for a number of reasons, until the very end of the time that it's available for discussion. I would appreciate it if each and every one of you is conscious of that and be on the record early.

I think the products of the workshop will benefit from that, and I think you will benefit also by hearing it early and having enough time to discuss the issues.

With that, I would like to introduce Bob Bernero who is Assistant Director of Material Safety Standards, Office of Standards Development, Nuclear Regulatory Commission, who will discuss with you the technical and policy issues and summarize the comments on decommissioning policy.

Thank you very much.

(Slide 1)

MR. BERNERO: Good evening, I have a rather lengthy pile of vugraphs. I will go through all of them. I am open to interruption for questioning if you see fit. However, it might work better if I can get through the vugraphs and cover all of this material in a more or less straight shot and we can have a free flowing discussion afterwards. (Slides are at the end of the presentation.)

You have copies of every one of the vugraphs I am using so that there is no need for you to take notes. You might even find it convenient to flip through as I go through the material.

Shelly Schwartz told you what we are doing here.

(Slide 2)

NRC can't do this alone. We feel at NRC that in order to do reevaluation of our decommissioning policy we have to share with the States the questions, the policy considerations, the matters at hand because we share jurisdiction with you.

Many of the licenses that we have are also issued by the states. There are many instances where the States have programs with us for licensing, so what I would like to do tonight is go through the subject of decommissioning.

First of all what we are talking about, what nuclear facilities are, what sort of activities are associated with decommissioning, and then I'll give you a brief overview of some of the history of reactor decommissioning which is of most interest to most people, then a brief summary of the present requirements for decommissioning.

There is an NRC decommissioning policy. Many of us don't like it, we want to improve it, but I would like to explain to ~~you~~ what the present requirements are under which facilities are licensed. And last I will get into what we are doing about it, what this plan is, where we are going from here.

(Slide 3)

First of all, let's get into some terminology and see if we can't agree for clear discussion of this issue to use the same words.

Decommissioning is removal from active service, or removal from service. And along with that there must be a need to dispose of radioactive residue.

Now many types of decommissioning are not complete. And there is a great deal of confusion in discussing this matter because people will frequently say a plant is decommissioned when in reality it is only temporarily decommissioned. It isn't finished. It's in some form of safe storage. Someone padlocked it, or put some guards around it. It's in custody, you can't walk away from it, you can't release it. It is only partially decommissioned.

Final decommissioning, it has been done. There is dismantling with removal of residue, a release of the place. You don't need to have guards, you don't need to have padlocks after it's properly dismantled.

There have been cases of what is called entombment. Where the radioactive residue is in effect buried. Sealed up with concrete, typically. So that this residue is isolated from the biosphere. People can't get at it.

But I didn't use unrestricted release there. There is the real question in my mind, and in the mind of many other people, whether it's legitimate, whether it's acceptable to take very long lived radioactivity and seal it up in concrete on the surface.

King Tut's tomb was looted only a few hundred years after he died and even we who have totally removed all the contents came by only about 2000, or 2500 years after he died. So if we are looking to entombment to hold radioactivity that is at a high level for 20,000 years, I don't think it's a legitimate use, I don't think it's a legitimate method.

Now I'm speaking here of how to handle the radioactive parts. There are non-radioactive parts of a nuclear facility and particularly a power plant where the turbine generator may be eminently usable with another boiler. Another fuel form could be used to feed the boiler. And in that instance one speaks of conversion.

A nuclear facility might be converted to another form of nuclear facility or into a non-nuclear facility. And we should be careful in discussing decommissioning to remember that the primary interest is on the disposition of the radioactive material.

(Slide 4)

Now, the scope of this whole effort is to cover the entire range of licensees that NRC is responsible for. That ranges from the largest power reactor down to a radioactive materials licensee like the doctor who handles radioactive drugs for use in diagnosis.

There is a question of decommissioning with all of these licensees because all nuclear activities have associated with them some residues. We are anxious to look at all of the alternatives of such decommissioning.

However, in this program we cannot look at the overall waste management program. In order to sort out our problems and approach them in a timely fashion we are not tying the decommissioning evaluation to the high level waste repository, even though I will mention the possibility of some of the decommissioning waste going to that repository.

Similarly, the low level waste program, low level burial grounds. We have a problem in the country today, but we would merely confuse issues and not accomplish very much if we confuse the two programs and try to deal with the low level waste program in the decommissioning evaluation. Well, if we do this, if e separate those problems we have to be careful because we will have soft spots. We will have a vulnerability to error, and that's why I indicated on the vugraph we will have uncertainties about the form, the acceptable form of waste shipments. How can waste be packaged, where can it go, how far will it have to go, what will it cost to ship it?

And residual activity standards, which are related to the waste management programs, this is how clean is clean. What can you leave on the ground, what can you leave on the surface in terms of radioactivity. Uncertainty there can give us uncertainty in clean up costs. But as a practical matter I ask you, this is not the forum for high level waste repository, and how the States can participate in the development of it.

So please let's try to confine the discussion to decommissioning.

(Slide 5)

Well, what are the facilities that we are concerned about decommissioning?

This map -- many of you have seen this before -- is a map of the power reactors of the United States. 66 of them, I believe, are operating right now. Another 80 or so under construction. We are talking about a very large number of large facilities distributed throughout the United States. Heavily in the Eastern half as you can see.

And these facilities tend to dominate much of the discussion of decommissioning for two reasons.

There are so many of them distributed around the country, and they are so large, they do constitute a major decommissioning cost. And they are, of course, a complex decommissioning job.

They are supported by a fuel cycle. In order to have a set of reactors operating, there have to be uranium mills, there are uranium mills in the fuel cycle in the United States.

(Slide 6)

About 23 mills right now operating. Most of those are in the Western States, in Wyoming, Colorado, New Mexico, some in Texas. About half of the uranium mills are licensed by states and half of them by the Federal Government. It depends on the NRC's Agreement States Program whereby certain states, right now about half of them, enter into agreements with the NRC to license certain facilities and material operations.

There are few fabrication and conversion plants. I lump them all together. About 15 facilities.

If you briefly reflect on the fuel cycle for a power reactor, the uranium mill produces uranium oxide, U_3O_8, sometimes called yellowcake. That is converted typically in a factory that merely changes the chemical form from uranium oxide to uranium hexafluoride.

There are right now only two such facilities for the civil power reactors: one in Oklahoma, the other in Southern Illinois.

After being converted to uranium hexafluoride, the uranium is enriched in Federal plants. There are three Federal enrichment plants: Oak Ridge, Tennessee; Paducah, Kentucky; Portsmouth, Ohio. Those are Federally owned and operated and the owners of the uranium pay the Federal Government a fee in order to have the isotope ratio in the uranium changed.

After the uranium is enriched it is shipped to a fuel fabrication plant where it is converted back to the oxide form and then treated chemically and thermally to make little hard pellets of uranium oxide. These ceramic pellets are then assembled into bundles.

There are a number of major fuel fabrication facilities. They generally run along the Eastern Seaboard. The Westinghouse factory for fuel is in Columbia, South Carolina. The General Electric fuel fabrication plant is in Wilmington, North Carolina. Babcock and Wilcox has their main plant in Lynchburg, Virginia. Combustion Engineering Corporation has their plant in Connecticut. And then you go way out to the West Coast to find in Richland, Washington, the Exxon Nuclear Plant and near San Diego the General Atomic Plant.

Now I didn't name 15 plants there. There are a number of small research and development type fuel fabrication facilities scattered about the country.

Those, though not so terribly important in the economics of the fuel cycle, are facilities that we must be concerned about for decommissioning.

Low level burial grounds exist now. There is a shortage in the United States of useful low level waste burial facilities. Right now there are only three such burial grounds in operation. There is the burial ground at Barnwell, South Carolina. There is one at Beatty, Nevada, and another in Richland, Washington. Other burial grounds, the other six of them are not operating right now. Sheffield, Illinois, Maxey Flats, Kentucky and NFS-West Valley, New York.

We have one more class of license listed here, and it is a very large one and it ranges in size over a very great range.

What I call material licensees. These are licensees who are authorized to hold or to do something with source material that is something like uranium or thorium, byproduct material, that's material that was made radioactive by a reactor, or special nuclear material. That would be something like plutonium, or fissile uranium.

These material licensees are mostly licensed by the States. I think the best number we have right now is 21,000 licensees, and about 9,000 of them are NRC licenses and the others are state licenses.

The best estimate we have is that 40 percent are medical or academic licenses and the rest are industrial. Things like x-rays sources for checking pipe welds, well logging sources for the exploration of oil, and things like that.

These licenses, as I say, cover a great range of size and they can be a problem. We are concerned about financial responsibility for these as well, so that if a material licensee goes bankrupt, and this is not a high visibility operation where the State Public Utility Commission is looking at it and has all sorts of other scrutiny, we want to be sure that if one of these licensees goes out of business, there isn't either an undue risk of contamination getting all over the place, nor an unnecessary expense to the State or to the Federal Government for cleaning it up.

(Slide 7)

Let's look at a nuclear facility and talk a little bit about what is decommissioning. This facility is not far from the meeting room where we sit. This is on the Susquehanna River about 90 miles west of us here. Just outside of Harrisburg, Pennsylvania. This is the Three-Mile Island Nuclear Station. It has two pressurized water reactors. This is Unit 1, this is Unit 2.

The station is on Three-Mile Island. The water you see on both sides is the Susquehanna River whose flow is not enough to give adequate once-through cooling without undue thermal effects on the river, so each one of the reactors has a pair of cooling towers to provide power plant cooling with minimal effect on the river.

Now when people speak of a nuclear power plant being decommissioned there is usually an impression of the whole being radioactive. You really have to look at the thing closely to see where the radioactivity is concentrated.

Now what I would like to do is go into this plant, go right into one of the reactor buildings where we have the reactor and its core and work our way out and see what we have.

(Slide 8)

If you go right down into the bowels of that big cylindrical building you will find a pressurized water reactor.

Now the pressurized water reactor is the more common type found in the United States. This is the reactor vessel itself and the core. And this is for a typical large plant in use today.

The core is about twelve feet tall and about twelve feet across. And each one of these bundles, they are square bundles, is a bundle of tubes about as big around as your finger. Each tube is filled with a very long stack of ceramic uranium pellets. When bundled together and controlled in a certain way, the nuclear reaction, the fission, takes place there and a great deal of radiation is generated.

The fission reaction causes the uranium to break up, producing fission products in the fuel. That's where the bulk of the radioactivity is produced. But the radiation field will actually make the steel here, these steel structures that are holding the core together, that radiation field will make them radioactive themselves. They become irradiated, not contaminated. You can't wipe it off, it is right into the nuclear structure of the steel itself. The radiation has converted it so these metals are now inherently radioactive and two nuclides in particular are of interest to us, Nickel 59 and Niobium 94, because they have very long half lives. They become radioactive and they don't decay very rapidly. We are talking about a half life of 20,000 years for Niobium 94.

Now the water that cools the reactor comes in here, comes down the outside of the vessel, flows up through the core and out to boilers where it will -- it is very hot water, and it will cause other water to boil making steam to drive a turbine. That water will contain radioactivity of a different type. It's called an activation product.

There is a very small amount of corrosion going on in that reactor coolant system, and these corrosion products, they are metals, are floating in that core and they are becoming radioactive. They are becoming radioactive cobalt, radioactive manganese, radioactive iron, the various constituents of stainless steel.

Now what happens is they go out into the pipes and gradually they plate out and they form a highly radioactive layer out there, but it is principally cobalt 60 which has a 5.3 year half life.

(Slide 9)

Let's look at the rest of the reactor coolant system, here we see a human figure by the way for scale. Here is the reactor vessel again. Here is where the hot water comes out, goes through the tall pipe into a boiler. The boiler is merely a heat exchanger so that one can keep the reactor water on one side, never boiling, and the turbine generator water on the other side, allowed to boil so that it can be piped off to the turbines.

The reactor water is returned by these large pumps for reheating.

Now that Cobalt 60 I mentioned is going to distribute itself around in the boilers in these pipes, and in these pumps so that as part of decommissioning one will have to deal with high levels of radioactivity there as well.

Now that system. this is called a nuclear steam supply, or the reactor coolant system by some --

(Slide 10)

that's embedded in that large concrete containment building. For operational safety reasons the reactor vessel and the boiler loops are encased in heavy concrete, usually referred to as the biological shield. It provides two things: one is that it shields radiation, it stops radiation during the fission reaction. And secondly, it's there in the event of an accident. If a pipe breaks it acts as a mechanical shield.

Now that structure of concrete in the area around the reactor can also become somewhat radioactive. Right up close to the reactor vessel there are a few elements in the concrete that can become radioactive. So that if one is going to decommission one has to dig out the reactor, its core, and this structure with care because of the radioactivity contained therein.

Now during ordinary operation of the plant there isn't an awful lot of radioactivity in this building's atmosphere. You can move around in there, it's the controlled zone. You can move around, there will be some leakage or spillage, but this building has a steel lining typically, so that in decommissioning one is going to clean the steel and then in essence have what amounts to a non-radioactive outer building.

The main building itself is not likely to have any residual activity except on the liner or on a few of the pipes going through it.

Now one of the major passages going through it is a duct for spent fuel. All reactors have spent fuel stored there until it can be shipped away.

(Slide 11)

I apologize, this is not a reactor spent fuel pool, but it is close enough. This is a separate spent fuel storage pool. The only difference here is that it is larger.

Spent fuel, those bundles you see are those dark colored rectangles that stick up out of the stainless steel pipes. A spent fuel bundle turns black. Typically, it is a very satin black when it comes out of a pressurized water reactor. It's a sort of a reddish black when it comes out of a boiling water reactor. These are the activation products on it, the corrosion products.

The fuel is stored in a large swimming pool type storage basin. There is relatively little radioactivity coming off of it now. There is radiation.

That water is primarily for shielding, for biological shielding. And to some extent for cooling. But there is very little material coming off.

The water in most pools is clean, but in order to decommission a plant one has to dispose of the spent fuel and then clean this pool, the walls and the sumps and the pipes that served it.

(Slide 12)

That pool is usually in the auxiliary building, so let's look at that plant again and ask ourselves, where is or was the radioactivity?

The reactor vessel is in here, the reactor coolant system, the biological shield, the spent fuel pool in this particular plant is in the building over here. There are other systems.

But the radioactive waste treatment system, storage tanks, you see these tanks out here, outside the building, those tanks there do get radioactive to a fairly mild degree.

The basic thing then is that one finds that the nuclear power plant is highly radioactive right around this building. But is progressively less radioactive and becomes virtually non-radioactive when you get away from the reactor building. So that there is a great deal of the plant which is not decommissionable for reasons of radiological health and safety.

If I were to come in at the end of useful life and say that I'll tear down that cooling tower, I would not be doing that for reasons of radiological health and safety. I might be doing it for site restoration, for cosmetic reasons, for some environmental property reasons, but not for radiological health and safety.

And one of the very important things in our mind is, we authorize the construction of this whole thing. And by we, I mean the NRC. Should we be concerned about the destruction of the whole thing, or should we confine our attention to the radioactivity? This is one of the questions we are anxious to discuss with the States.

(Slide 13)

Let's turn to some history.

The number of reactors that have been decommissioned is larger than this. There is a goodly number of small reactors, little research swimming pool type reactors, but they don't really teach us very much about decommissioning a large reactor because they are so simple. They are a little bit more complicated than that spent fuel pool you saw, but they really aren't teaching us a whole lot about the major job of decommissioning.

These reactors are ones that have been decommissioned from the first generation of reactors and they are all fairly small, in megawatts thermal ranging from even a fraction to 256 megawatts. For perspective, a major power reactor today is 3,000 or more megawatts thermal. So it's way above this range.

Now we don't have experience on decommissioning a major power reactor because we don't have any to be decommissioned yet. They are all fairly new and they are all very valuable to their owners.

Now these were decommissioned, but notice something, mothballed, mothballed, mothballed. You see that throughout. That is a temporary form of decommissioning. Tomorrow in the detailed discussion of a reactor decommissioning analysis you will hear terms defined more specifically, but in a nut shell, mothballing is just temporary storage. It is to remove the fuel and the easily removable radioactivity and then padlock the door and guard it.

Well, what you will find is many of these reactors are on sites with other reactors. Here is one that is not far from us also, Peach Bottom. Peach Bottom 1 is mothballed, and it can be practically mothballed and guarded and provided with proper health physics surveillance for almost no cost because it is on a site with Peach Bottom 2, and Peach Bottom 3 which are very large power reactors in operation. So every third sample that the health physicist runs is on that little one that's in mothballs. And the net cost of that is very, very small.

So if we look to these for precedent, for examples of what useful experience we have, we don't see too many.

Here's a dismantled one, but it's very small.

Here are some that are entombed, where the radioactivity is cast in some sort of concrete mausoleum and left there forever, indefinitely. And there is one place in Elk River, Minnesota, that's north of Minneapolis-St. Paul that was dismantled. And this one gets a great deal of attention and is perhaps one of the more useful pieces of experience from this whole set of reactors.

(Slide 14)

Just looking at that example briefly, the Elk River reactor is a small boiling water reactor, it was set up as part of the power reactor demonstration program with a contract whereby the Federal Government in essence said, look, if you operate that thing we'd give you a lot of financial assistance and we'll cut a deal with you. We'll own it until it has gone through the check out period and some reasonable period of operation. And then if you like it you can buy it from the Federal Government or if you don't we'll take it away. And the owner said, I don't like it, it is not efficient, it's not what I want, take it away.

So the reactor only operated from 1962 to 1968 and it was decommissioned in the years 1972 to '74. Now, when I say here that the method of decommissioning was dismantling, I am referring to the reactor itself, to the nuclear steam supply as you will see in a few pictures in a moment.

The power plant, what we usually think of as the power plant, that's the turbine generator that generates the electricity, was almost brand new. And they converted it to operate on a coal boiler and to continue operation as a power plant which it does today.

In early 1972, the program made a detailed estimate of what it would cost to dismantle that little reactor and they estimated 5.1 million dollars, documented it, and about two and a half years later, when they were done, it came out to be 5.7 million dollars which was not bad, about a 15 percent over run in that short span of time. It is sort of a clue on what sort of uncertainty one might have, or certainty in cost.

(Slide 15)

A few pictures of the Elk River. This is the installation of the plasma torch manipulator. In order to cut up that reactor you can't go near the thing. You can't get in there bare walled, you have to do it under water, and it's a thing like an acetylene torch, a plasma torch, and it goes right down into the reactor vessel and cuts through the steel.

Now you can see here, if you look at this, this is not a very large reactor.

The inside diameter of that was, I think, only about 6 or 7 feet. Not very large compared to today's reactors, in the relatively thin reacotr vessel, about 3 inches thick whereas some of the big pressurized water reactors today run 8 to 9 inches.

(Slide 16)

Now here is the reactor building. This is the containment building. Some of them have a flatter top, some of them have a domed top. And after having cut up the reactor vessel, the building was cut open somewhat and the internal parts of the building were being hauled away. Notice in the background there is a big building here, and that's where the turbine is. And that strange looking catwalk like structure is an elevator for hauling coal and you will see more of that later.

So the reactor building was gutted and then stripped.

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And then the last section of subgrade steel, this is where the reactor used to be and they dug the pieces out of the ground and there you see now the coal plant in the background.

(Slide 18)

And then when Elk River was done they had a parking lot, they had a coal plant with a parking lot. And this is where the reactor had been, right here.

In our calculation, which you will hear more about tomorrow morning, we are taking the whole station down to a parking lot hypothetically, in order that we have a reasonable estimate of all possible costs. We will discuss this with you at great length, and we may come to the joint conclusion that neither one of us cares who knocks down the cooling tower. And if financial assurance for decommissioning is held for the future, it might be confined just to cleaning up the reacotr building. But we want the option to be open.

So we are calculating the entire cost of taking the whole reactor station, reactor buildings, control buildings, warehouses, everything down to this kind of a parking lot status.

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You will get a little bit more about this tomorrow. But here is the comparison, just a quick comparison, of Elk River and Trojan, the reference reactor for our pressurized water reactor study, and you see the differences.

The differences are pretty significant. And the years of operation here, that plant only operated for 6 years and it wasn't even full power operation for all of the 6 years. And we estimate on a major power reactor that more than 30 years, greater than 30 years would be the operating life.

I would like to single out here that there is no exact time to stop operating a reactor or a power plant of any kind. The operational economics are what usually will shut the plant down, when the cost of replacement fuel, maintenance, and all other factors is such that the power company is not getting an efficient operation out of it, and can turn to another machine.
They will do so and the plant will either be put on some sort of a standby for emergency use only or it will be shut down, and in the case of a nuclear plant, decommissioned.

We estimate 30 years life, 35 years life, maybe 40 years life. The NRC licenses these plants for 40 years from the date of construction permit.

Since a typical plant takes about 6 years to build, you would then project 34 years of operation and they don't have to shut off the reactor, but to operate it any further they have to get a license renewal and the thing has to be reevaluated to see if it is still in good shape. So the operating life of a power plant is not that hard and fast a thing.

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Let me just briefly go through our existing criteria for decommissioning.

If you are not familiar with the Code of Federal Regulations and many of you probably are not, we use a shorthand. Title 10 of the Code of Federal Regulations is Energy. CFR standing for Code of Federal Regulations. And then we have parts and sections.

The part 50 of Title 10 is concerned with licensing reactors, enrichment plants (if we ever do license them), and fuel reprocessing plants (if we ever do license them).

We have in that part 50.33, section 50.33 which says that before we can license a facility, a power reactor say, we must be assured that the owner is financially competent, capable, has the resources to hire a good crew, to train it properly, to deal with the spare parts and the emergencies that go with the power plant, that has all of the resources necessary to safely operate it, and to shut down, and that includes decommissioning that nuclear facility.

There is an appendix to part 50, appendix C that spells out in detail the sort of financial information we need to support that finding. But decommissioning is not singled out. Decommissioning is not emphasized in that sort of a consideration. There is another part, 50.82, that says that when a facility is ready for decommissioning, then the owner comes to the NRC and says this is how I would like to decommission it. We review and approve the plan, or have it changed as necessary. But that's at the end of life, that's at the end of the whole thing.

So there is an end of life approach right in the regulations. And the only guidance that exists really is a regulatory guide. That does not have the force of regulation, that is the NRC working Staff speaking to the outside to the regulated industry and saying, if you want a good idea of how we tend to review these things here is what we think are acceptable decommissioning modes. And that regulatory guide says well, one way you can do it is mothballing, another way is entombment, another is dismantling, and another way is conversion.

Well, mothballing, and I said before, is temporary. It's not a solution, not a final solution. Entombment and dismantling are certainly two final choices, and conversion is somewhat -- well, I sometimes say it's irrelevant, but it really isn't, it's a complicating factor if you try to salvage some of the plant for some other purpose.

But if I look at that regulatory guide I say to myself, it's not enough. Right now I think it is appropriate that we have more definitive guidance, and more definitive regulations.

For fuel cycle facilities we have an appendix for that part 50, for fuel reprocessing plants that gets more specific about decommissioning, more basic requirements. But it is somewhat academic, because we are not licensing reprocessing plants.

The other facilities, uranium mills, fuel fabrication plants, and others, there is a little bit of what we have for the reactors as far as financial assurance. But nothing with real teeth, nothing that requires funds to be set aside in any firm fashion. It is more or less just look at, and evaluate, and judge financial competence.

We have some residue limits, both in the reactor reg guide and other guides for clean up. They don't have the force of regulation. They are not highly tested and, what shall I say, force-of-law clean up criteria, but they are not bad ones, they do exist there. And the more we look at them in light of the current evaluations, the more reasonable they do appear to be.

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Well, right now, what do we do to evaluate decommissioning when the reactor license is granted? Well, basically it's done in a very simple fashion, and perhaps too simply.

The licensee, or the person proposing to get a license for the reactor identifies a mode of decommissioning and the cost as a representative number. The NRC Staff considers that cost and when that cost would take place in judging whether that company is financially competent. And then, in the environmental statement, you will find a cost-benefit analysis. How many mils per kilowatt hour does it cost to generate electricity with that plant or an alternative coal plant. And you will find the decommissioning cost buried as a small portion of the mils per kilowatt-hour cost.

Now, when it comes to funding, who is going to set aside the money?

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Who is going to control that money? Who will make that requirement? NRC does not do it.

I put here an example, this is a fairly recent adoption by the State of New York, which we got in a comment in our decommissioning proceedings. And the State of New York Public Utility Commission, acting out of the philosophy that the costs should be borne by the customer served by that plant, in essence has set up a cash sinking fund invested in the utility's own assets. Basically they say the plant is going to depreciate not to zero value, but at the end of its life to a negative value. That value being the cost to decommission it.

You know there is no salvage value there, it's a penalty when you are through, so you write off the plant to a negative salvage value and the utility charges a fraction of that cost as a depreciation expense as they go along.

So each customer pays a pro rata share and the utility puts that money into a reserve fund. And in that reserve fund which is moving around inside company resources, just like short term capital, the utility has to be sure -- I should say, the Public Utility Commission makes sure that the utility will not count that in their rate base, or get liens against, borrow money against it. So that has to be used, those resources are used but they are not owned by the power company.

And since they are in the short term cash flow, they can get a rate of return that's very high, so it is like having a sort of an escrow account for the electricity customer with a 15 percent return, 15 percent interest rate.

Well, there is a drawback to this, and I just got another letter from the State of New York recently, and others have recognized the same problem. When you collect money this way it is apparently judged by the IRS to be a business expense and subject to Federal Income Tax which can, in effect, roughly double the cost, the full Federal Corporate Income Tax. It is suggested by some that if this were an irrevocable trust it could be treated something like a pension plan and if that were done the IRS wouldn't tax it and you would thereby double, or I should say halve the cost to the customer. But I don't know what you would do with the interest yield on an irrevocable trust. It probably would be lower.

So there is some subtlety here. But an interesting point. Who does this, who does the deciding on should it be a blind trust, an irrevocable trust. An open account like this, how does it appear in the rate structure of a regulated public utility? Right now many tell us that we don't have any authority to meddle in that, that the statutes of the United States and the respective states reserve that to the State Regulatory Commissions and the Federal Energy Regulatory Commission under certain circumstances.

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Let me just summarize, what's wrong with the present decommissioning policy?

First of all we don't have recognized criteria that are widely known and widely understood for how clean is clean in soils, on surfaces, and in burial. We need these.

We don't have a clear policy on the permissible modes of decommissioning. We don't even say when in our guidance, there is nothing that says if you mothball a plant you can only leave it in mothballs for 10 years, or 20 years, or 50 years. Everything is quite indefinite. A very bad aspect of the present policy.

There is lack of a clear policy on financial assurance. The NRC sort of touches on it, but really doesn't get into it. We are in a passover mode, we leave it to the states. But it's not clear that we do. We don't have any clear deal to leave it to you. We have never sat down with you and said look you do that and we will do this.

And little is being done to see that plants are being designed to facilitate decommissioning. If we really look at this thoroughly we might find design features that would make it a lot easier, a lot less costly to decommission.

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So what are we doing about it. We are going through a complete reevaluation of our policy on all our activities. We are trying to do a whole body of detailed technical studies, such that we will have enough information to make reasonable judgments about the whole spectrum of the question. And then we will go into a rule making mode. That's the normal procedure whereby the Federal Government says here is a new regulation and we propose it and the public can get in and contest it and the whole public process goes on.

This one is unique because we see we have deep mutual interest with the states. Many of these facilities we are worried about are also licensed by the states. We have related responsibilities because there are facilities that you license and we don't.

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An accelerator which is a frequent tool in industry now, and in research, is a machine. It's not a nuclear reactor; it is a machine that generates radioactivity. It makes things radioactive. Now those are state licensed, NRC has nothing to do with them.

Naturally occurring radioactivity, radium things, there are radium smoke detectors, and radium needles used in medical therapy, these are state licensed. Naturally occurring radioactivity, we don't license, we have no jurisdiction over it.

So we see this work as being potentially useful in State -- in related State work where the problems are similar and where the cost information, the detailed technical analyses may be quite useful.

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So we are looking at this rule making on decommissioning and we are trying to keep certain thoughts in mind. One of them is, and it's not a trivial thought, that the responsibility for decommissioning is what is really urgently needed, not the act of decommissioning.

There are a lot of facilities out there that need to be decommissioned. The classic example, NFS-West Valley, New York, but those facilities are not teetering on the brink of a disaster. They are a mess needing to be cleaned up and what is needed urgently is clear assignment of responsibility.

So that's an important thing in our mind, the assignment of responsibility. Not actually plunging forward to decommission this facility or that. And in our policy and rule making, very strong emphasis to remember, we want to say what is an acceptable method, how far do you have to clean it, when must it be done, and how can we be sure that the money or the resource will be available?

Those are the four key features of the thing. And we see the difficulty of coming to grips with the problem arising in two areas. In residue limits and in surety arrangements because both of these deeply involve the responsibilities of others.

Residue limits deeply involve the Environmental Protection Agency and all of the states in which these facilities are used.

Surety arrangements -- who is going to pay for it and how to clean it up. These also involve us, they involve the Federal Energy Regulatory Commission, and they involve the states. So what we set up as a program is a pattern of information reports.

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These are detailed studies. You will hear an explanation of the results of the first two of these tomorrow.

These are large reactors, a pressurized water reactor, and a boiling water reactor. One each to see what are the costs, what are different ways you can do it, what does it take to do it, is the technology available to do it? And then on fuel cycle facilities and others, a fuel reprocessing plant, a mixed oxide fabrication, a low level burial ground, a uranium mill, a fuel fabrication plant, and a UF6 conversion plant in parallel so as not to waste the fresh minds we are using on those subjects. We are doing studies on what one might do to facilitate decommissioning, both on reactors and fuel cycles.

So you see this information flow. And that is the fiscal year, by the way, Government fiscal year '78, '79 and '80. Our priorities are to get the big reactor studies done first, but we definitely want them separate so that we can learn certain things in doing one, and factor that learning into the conduct of the second.

We have finished this one, we have finished the fuel reprocessing plant, we are almost finished with this mixed oxide one. It's in house for review prior to publication right now.

These are the principal reports. The ones you will hear about tomorrow are the pressurized water reactor and the fuel reprocessing plant.

Now what will we do with these information reports?

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Here is the basic program. If one is to develop a new regulation with the significant environmental impact it should be done by an environmental impact appraisal.

So the core of this whole thing is some technical work leading to an environmental impact statement. We divide the technical work into three basic areas.

One of them is financial assurance. One of them is radioactive residues, and the third, which is important internally to us, is generic applicability.

Now I've said financial assurance is who is going to pay, and how, and when, and who will control it. Radioactive residues is how clean is clean. What is an acceptable level of radioactive contamination that one can walk away from. The generic applicability important to us is that if we study carefully the Trojan Nuclear Power Plant in Oregon, does that information apply to the Three-Mile Island Nuclear Plant here in Pennsylvania, or to the Oconee Plant in South Carolina? It's how generic is this information, how generally applicable is it? We have to be very careful there that we don't miss things.

So we want to think through these issues and develop this environmental impact statement, but we recognize the role of the states. So what we do, as soon as we have started with this plan, we have scheduled this and two other workshops. This diamond here is the State workshops whereby we sit down with you and we are asking you are we doing this intelligently? With the guidance we get from you we go back and put down on paper what we are thinking, which way are we going in the EIS? What are the patterns coming out? What is the set of our mind coming? Then we sit down with you again and discuss the issues with you, what we think are the right procedures or policy so that then when we have come up to the Commission with the policy statement, a proposed rule, and have completed the environmental impact statement, we have had the benefit of your advice twice on how we approached it, and what we are thinking of.

Now there is still a public rule making you know, if you have said, after advising us twice, that we still acted like the most stupid dolt you ever saw, you could still come in to the public rule making and call us that. You lose no rights by coming here, you know. This is gravy for us so we hope it's gravy for you.

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These workshops we are holding are to solicit State views on jurisdiction and residues, so that we can get specific guidance. We are trying to do this before our thoughts are cast in bronze. We are consciously trying to come in here without having made up our minds.

And the first set of workshops, this one, and the other two next week, are to discuss the approach we are using, the questions we are asking and the results of our first two reports.

The next round of workshops in 1979 are to discuss with you how it is coming out. That would be a discussion of policy. And the final results on this thing.

So what can you do to participate?

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You can take an active role, you can speak your state's or your agency with the state's views on all of these key issues. Those of you who have the expertise can critique these technical studies that we are doing. If the Radiation Control Program Directors disagree with some of the radiation control analyses in there, we welcome that kind of peer review.

And then after we are through you can participate in our rule making process as usual. And if you have work of your own, regulation of naturally occurring radioactivity of accelerators and things like that, you can take separate State actions whether that be legislative or executive action to deal with that.

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So let me cover the questions that we have put in your handouts. We started this whole program with a Federal Register notice in which we asked a series of questions in what I consider in retrospect a more stilted way. We are trying to recast them into a more free flowing layman's terminology here, and I divided them into three sections. There are fourteen questions.

And the first -- I would just like to go through these. I would like to say I welcome discussion and questions now, but I don't want to replace the purpose of the workshop which is for you to discuss these questions with yourselves. So tonight let's make sure we are just getting an idea of what are the bounds of the questions. What are the topics, rather than what are your views. I think it would be constructive if you withheld your views for your internal discussion in the workshop groups.

So the first question. Do the states have an acceptable role in the plan? Are we just giving you a ritual pose here or are you in a position to get your views heard, get them heard at the right time, and heard in an effective fashion? Are the technical reports adequate? We've got these great big fancy reports, you have received two of them now. Are we really covering something comprehensively and adequately, or are they just a pile of numbers, a pile of calculations? We are looking for this kind of comment. If we are looking at the right facilities, if we are looking at the right alternatives for those facilities.

Should we modify the plan in some way? Can you suggest any modification to the plan in order to either make your participation more effective, or to have better information?

Now when one gets into decommissioning plans, I will be covering shortly the comments we have received from the public, from you people and the states formally, and from industry, since we have started on this effort. I think it will be useful to you to hear these comments.

Many have suggested the detailed decommissioning plans. That's right -- once you define detail, we usually think of a detailed decommissioning plan as a very exact thing saying exactly how you will knock down the building, package the waste, take it away, where you will send it, all of that.

Some argue that that should be in place before you issue a facility. Others say you are to wait. You know by the end of 40 years life, and maybe 30 years holding, it will be a totally different ball game. It will be a different thing altogether. And you are just wasting your time setting up a plan in advance.

Is delay in decommissioning justified? That is, the facility is at the end of its life, it is just sitting there, is it okay to let it sit for a while to save money, or to save radiation exposure? Is permanent entombment of that facility -- this is the King Tut's tomb approach -- is that an acceptable method of decommissioning? If we do that then we gradually accumulate entombed facilities here and there.

Let's look at another set of questions here.

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This next set of three is related to clean up criteria.

Should the criteria extend to building structures and components that are not contaminated? My favorite example is the cooling tower. Should we care, should we require the demolition of cooling towers or nonradioactive buildings?

Now, a delicate one, can clean up criteria, these are radioactive clean up criteria, can they be developed by the Federal Government in such a way that the states can endorse and follow them?

One of the great problems, as I see it, is that if the Federal Government licenses a facility and then says if you clean it up to my criteria it is acceptable for you to walk away. And if the host state disagrees with my criteria, we have created a nightmare because then I will authorize that fellow to walk away and the state will be very upset and take him to court or whatever has to be done to get the place cleaned up properly. And the real issue is one that the State and the Federal Government ought to get together and have consensus standards of some sort. Can this be done?

Now, what is the basis for such a standard? We are considering here a standard that would be based on the risk to an individual, risk of radiation. And we use the term here that some of you who are not radiation trained might not know. One millirem per year. This is one of the numbers, it's not the proposed standard, it's not the only number we use, but it's one. It's a sample.

One millirem per year is a very low level of radiation.

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For those of you without the background in the field, I included a very simple sheet to give you a perspective on what sort of radiation you receive without fooling around with radioactive facilities. And if you look at radiation exposures that one gets from the world around us, if you fly occasionally you can be getting a radiation exposure from flying of 1, or 2, or 3 millirem per year.

If you are a frequent air traveler you will get a radiation exposure on the order of some 10's of millirem per year. The average person in the United States gets something like 100 millirem per year just living where you live. You get that radiation from the rocks in the soil, from the cosmic rays coming from outer space, from the chemicals in your body, from a variety of sources.

Now if you live out in the Colorado mountains, you know back of Denver, Leadville, places like that, two things are operating there. One is you are a lot closer to heaven so you get a lot more cosmic ray ation. And secondly, you have a lot more big rocks around you giving you more radiation. So that the natural background gets you up around 200 millirem per year.

And there are even peculiar places in the world where the average radiation of millirem per year is very, very large, but these are in parts of the world where the wear and tear of every day life kind of masks anything the radiation might do to you. And most of these are due to Monazite Sands; they are mineral deposits that are radioactive.

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The last set of questions deal with who should pay. And you really ought to sort this out because is it the company that pays, is it the user, or the beneficiary of the facility that pays? And also you might ask in this question here, it will come up, who should guarantee? You know, if the calculation was wrong, or if something occurred, where should contingency assurance come from?

Getting back up to question 11, should financial responsibility requirements be imposed by the Federal Government, and by that if someone is going to require a million dollars a year to be put into an escrow account, and monitor it, and control it, should the Federal Government do it? Should the Public Utility Commission do it, or who?

Should funds be set aside in the advance? You know, cash on the barrel head on day one. Or could it be accumulated in a sinking fund, you know, 2 percent per year, or 10 percent per year. Some sliding scale.

Who should hold these funds as they are accumulated? I mentioned earlier the question of irrevocable trusts, who holds it, the tax picture gets into it. It gets very sticky, very complex.

And then how can you deal with uncertainties? My own view is when you look at the matter, and I urge you to look at the results you will hear about tomorrow, you look at the thing and I think the man hour estimates are reasonably good. How many man hours it takes to knock down a wall, or how many truck loads of concrete rubble it takes to haul it away.

But when you look at the amount of labor in the calculation, how many man hours at what dollar per hour rate. When you look at the uncertainty about what the labor rate would be, and labor productivity on anything that's heavy in labor, and you look at the fact that the event itself, the event of decommissioning can be 40 or 50 or even 75 years in the future, to me the dominant uncertainty is not how many man hours or truck loads of rubble, it's what will inflation do between now and then. What will be the effect of interest yields between now and then? Where could I put money to even be assured that it broke even?

I have some mutual fund stock that I insist on holding that's been awful. For 20 years it hasn't kept up with inflation and I keep believing that next year it will. And how would I feel if the funds set aside for decommissioning were in an escrow like that? That, in my view, is where the uncertainties are.

But that's the thrust of this question. How can we deal with these uncertainties? Would it be appropriate to collect the little extra money in every case where the little extra money would only cover that case, that would be extra money in accrual for each facility just in case, and I don't know what to do with it at the end.

Or how about a general fund? Someone, the State Government or the Federal Government having a contingency fund for this purpose, or third party responsibility. This is the thrust of this question.

Now turning away from the questions, let me just quickly go through the comments we've received.

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We had two publications in the Federal Register on which we received public comments. One was the Federal Register notice that announced this whole reevaluation of decommissioning. The other was related to the Public Interest Research Group petition which was received last year.

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Now just briefly on the Public Interest Research Group petition, the essence of their petition is that we should require bonds held in escrow for every reactor to assure the availability of decommissioning funds and that the operator is going to pay, not future generations. And as is our practice with a petition or a major rule making, we put some information in the Federal Register and solicit outside comments.

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What we did on the PIRG petition was unique to the character of it. We put out a Federal Register notice announcing and asking for comments and we specifically wrote to each Public Utility Commission and said here is something we think involves you or it affects you so we would like to have your comments specifically.

We also met with the Federal Energy Regulatory Commission because of their involvement in rate setting and the like, and we began a lengthy exploration with surety companies in order to explore if we wanted to get a bond, and we picked a number, 50 million dollars, and we wanted to get a 50 million dollar bond, what would you charge, what would be the terms, what would be the conditions?

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Now the comments we received from the Federal Register notice and here this is a pro, or in favor of their petition, many of them said accelerate your research on decommissioning, get the technology to be able to decommission. Update your regulations, and for a reason that is not too clear to us, many of these comments followed a pattern in suggesting they were people in the same group, many of them called for a 13 million dollar escrow bond. And the exact origin of the 13 million dollars is not too clear.

From the numbers you will hear tomorrow, you will see 13 million dollars is not a whole lot of money for a decommissioning, for a prompt dismantling certainly. It would fall far short.

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Now against PIRG, and I might say many of these comments do come from the industry, the public utilities, saying the present requirements are adequate, bonding is uneconomical and inflexible, and you ought to do a systematic evaluation before getting new requirements out. But a very important comment, you don't have the authority under the Atomic Energy Act or the National Environmental Policy Act to do this.

That was a common comment.

And the corollary is that FERC, or the State Public Utility Commission's are the ones that do have that.

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Now when we put out the Federal Register notice on this whole program, we put out six questions in a somewhat more formal fashion on the desirability and form of criteria for cleanup, timing of decommissioning plans, surety arrangements, residue limits, timing of decommissioning -- not the plans but the activity, and lastly, criteria for uncontaminated components. You know, the cooling towers, and pumps and things that are not contaminated.

(Slide 41)

Well, I'll just go through these rather quickly.

Regarding question number one about criteria, many people -- there's a whole chorus of answers, yes, yes, yes, everybody says criteria are urgently needed and you need to define what you mean by decommissioning.

The whole pattern of answers betrays that there is a lack of clarity.

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When we look at the criteria, those that are against them again, feel that everything is fine, you don't need rigid requirements. Stand back and don't fool around with this.

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As far as plans are concerned, some argue you should have very detailed plans, and based on demonstrated techniques. Now one of the patterns you see in this, and it's evident in many discussions I've had on decommissioning, there is an underlying feeling in the minds of many that the technology decommissioning does not exist. That we don't really know how to do it and consequently it's an urgent problem.

This is an extrapolation of the situation at NFS-West Valley. I'd be happy to discuss that case in detail with anyone, it's a fascinating case, but I would just emphasize it is not representative, it is very unique. But it has been extrapolated because that case is such a nightmare that everything else must be like that too.

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And so with plans you see this sort of thing where many members of the public and State Governments feel that you must have detailed plans in order to establish this technology. And many members of the industry said oh, you don't have the problems, stand fast, don't worry.

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As far as funding is concerned, again you can see a polarization. Those argue that funding in advance is required, that there should be some sort of plan, there should be some sort of accrual. A common thread that one has heard is the current users, the beneficiaries should pay for it. You shouldn't wait 75 years and then scrounge around in the coffers of the company to find the 40 million dollars or whatever it has inflated to to do the job.

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The funding, there are a number of comments that pointed out that sureties are undue cost and that they don't necessarily provide present funding.

One of the things you find, if you really look into bonding, surety financing of some kind, there are so many permutations and combinations of that, that what you might have is an insurance policy more than a bond. And you aren't guaranteeing who is paying for it, you are leaving a responsibility that perhaps the company at the time of the activity will pay for it, and all you are doing is providing some guarantee that the company will have the money.

Once again, in the funding, NRC authority is questioned because of the Atomic Energy Act, and the National Environmental Policy Act. The argument is made that the NRC doesn't have the authority to regulate the funds for decommissioning on reactors.

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Now the residual limits, the one I cited in the questions, or 1 millirem per year which is not hard and fast, but is an example, has been suggested as a comment.

I might point out that an industry group, the Atomic Industrial Forum, has published a study recently proposing something like that criterion, one millirem per year for the total body, three millirem per year for an organ, as the clean up criteria. And that's a very conservative value.

I am trying to think of another adjective for it. One could argue for a higher level of tolerance for radioactive contamination, but right now the thing traces ultimately to Environmental Protection Agency standard, and there is no such standard in existence yet.

Others have argued, and for those of you who are Radiation Control Program Directors you can appreciate some of these other arguments, for limits which are higher than one millirem per year, or thereabouts.

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And then as far as timing, and this is timing of the act, when should one decommission? When should one dismantle, or entomb, or whatever you are doing. And there's a broad spectrum of response. No one proposes longer than 100 years. The Environmental Protection Agency has recently proposed a criterion that says you shouldn't count on institutional controls, you know guards and surveillance and stuff like that, for more than a period of about 100 years. And much of the comment we received is consistent with that thinking. Some say let it decay for some time, reduce the dose rate, reduce the cost by letting the radioactivity decay for a few years.

But we got no recommendations of indefinite storage or holding.

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And then the applicability, some say everything should be returned to nature. It's very hard to define what nature is.

Here again, the argument is: what is your authority. The NRC cannot require cooling towers to be knocked down because they have nothing to do with our jurisdiction. So in essence many of the comments here are pointing out that there are other mechanisms such as local zoning restrictions, or potential use of the site, reuse for another purpose, that is a sufficient basis for a decision on what to do once the radioactivity is gone.

With that, I have outlined the comments we have received, for whatever use they are to you. We don't do these things by vote, just getting 26 comments in favor, and 20 comments against doesn't mean in favor is going to win. But it's useful to get the view of the public, the view of the states on these matters.

I will be happy to discuss anything here, or review any of this material you would like. We can go into question and answer right now.

REEVALUATION AND REVISION
OF
NUCLEAR REGULATORY COMMISSION
POLICY ON
DECOMMISSIONING OF NUCLEAR FACILITIES

DECOMMISSIONING OF NUCLEAR FACILITIES

1. WHAT ARE THESE FACILITIES AND WHAT DOES IT MEAN TO DECOMMISSION THEM?

2. HAVE ANY BEEN DECOMMISSIONED?

3. WHAT ARE THE PRESENT REQUIREMENTS FOR DECOMMISSIONING?

4. WHAT IS NRC DOING ABOUT DECOMMISSIONING?

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TERMINOLOGY

<u>DECOMMISSIONING</u>: REMOVAL FROM SERVICE AND DISPOSITION OF RESIDUE

<u>TEMPORARY DECOMMISSIONING</u>

SAFE STORAGE
- VARIOUS BARRIERS
- CONTINUING CARE

<u>FINAL DECOMMISSIONING</u>

DISMANTLING
- REMOVAL OF RESIDUE
- UNRESTRICTED RELEASE

ENTOMBMENT
- SEALING OF RESIDUE

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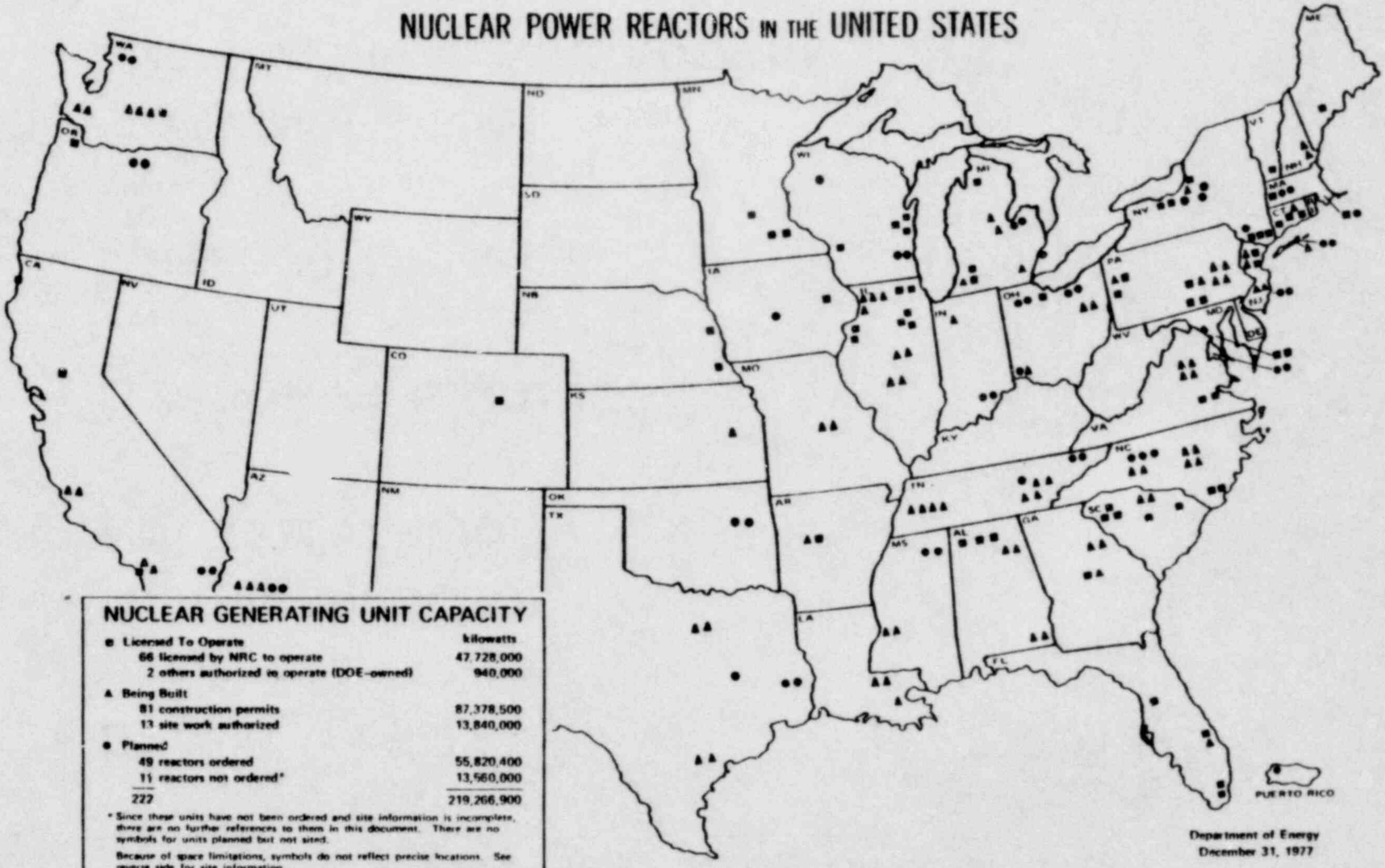
SCOPE

COVERS
- WHOLE RANGE OF LICENSES
- ALL DECOMMISSIONING ALTERNATIVES

DOES NOT COVER
- HIGH LEVEL WASTE PROGRAM
- LOW LEVEL WASTE PROGRAM

SOFT SPOTS
- FORM/DISTANCE/COST FOR WASTE SHIPMENTS
- RESIDUAL ACTIVITY STANDARDS

NUCLEAR POWER REACTORS IN THE UNITED STATES



NUCLEAR GENERATING UNIT CAPACITY

	kilowatts
■ Licensed To Operate	
66 licensed by NRC to operate	47,728,000
2 others authorized to operate (DOE-owned)	940,000
▲ Being Built	
81 construction permits	87,378,500
13 site work authorized	13,840,000
● Planned	
49 reactors ordered	55,820,400
11 reactors not ordered*	13,560,000
222	219,266,900

* Since these units have not been ordered and site information is incomplete, there are no further references to them in this document. There are no symbols for units planned but not sited.

Because of space limitations, symbols do not reflect precise locations. See reverse side for site information.

(over)

Department of Energy
December 31, 1977

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OTHER LICENSES

- URANIUM MILLS 23
- FUEL FABRICATION AND CONVERSION ~15
- LLW BURIAL GROUNDS 6
- MATERIAL LICENSES > 20,000

~60% INDUSTRIAL
~40% MEDICAL & ACADEMIC

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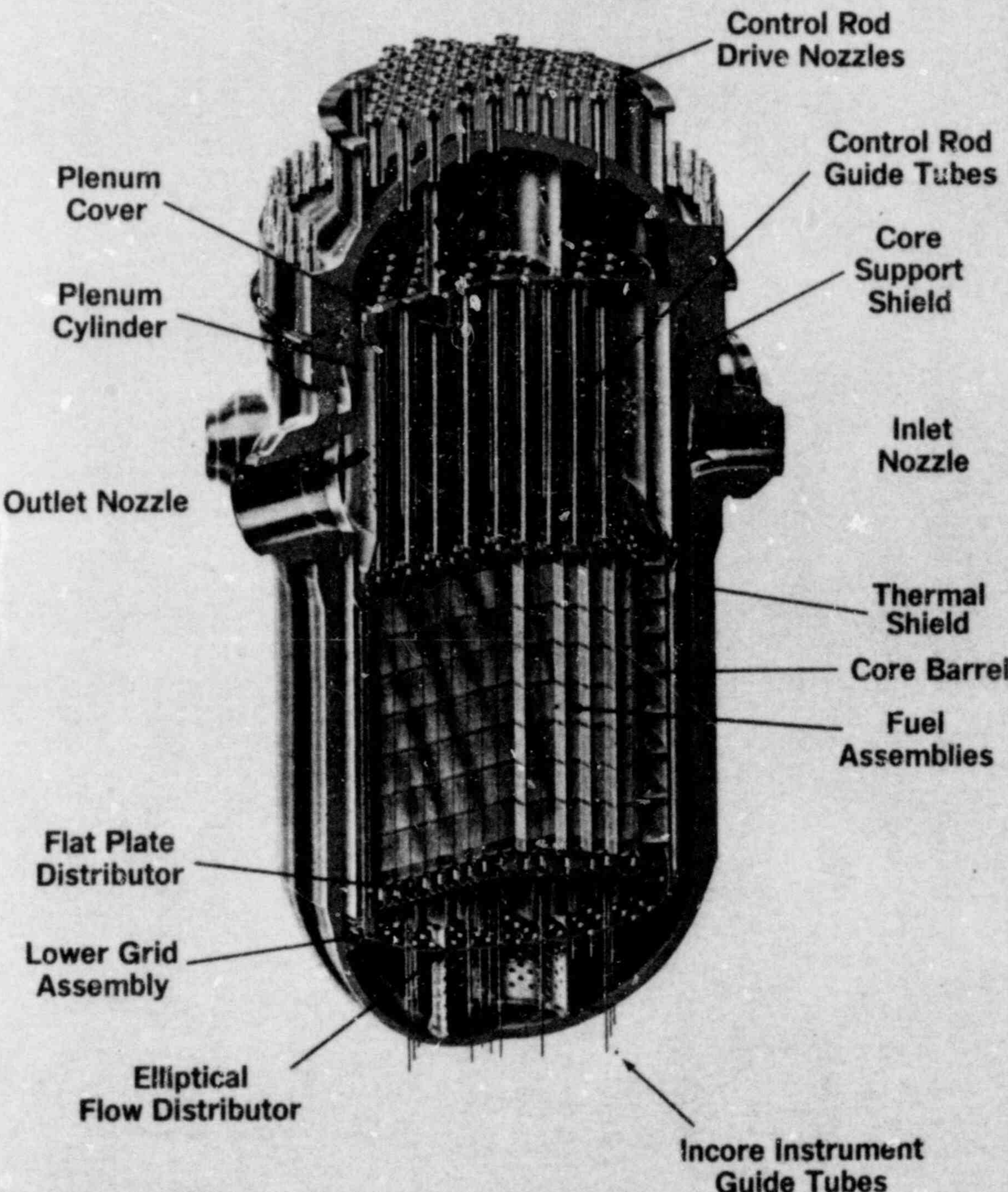
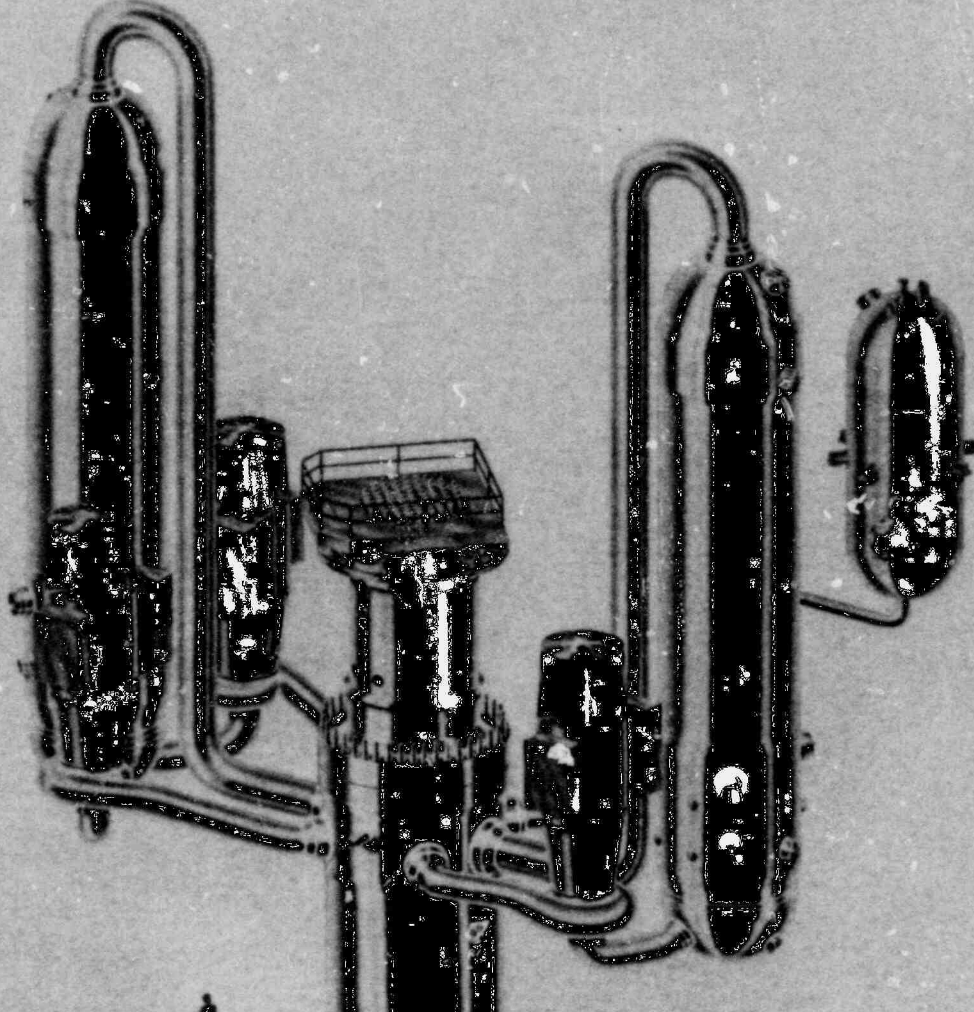


Pressurized Water Reactor

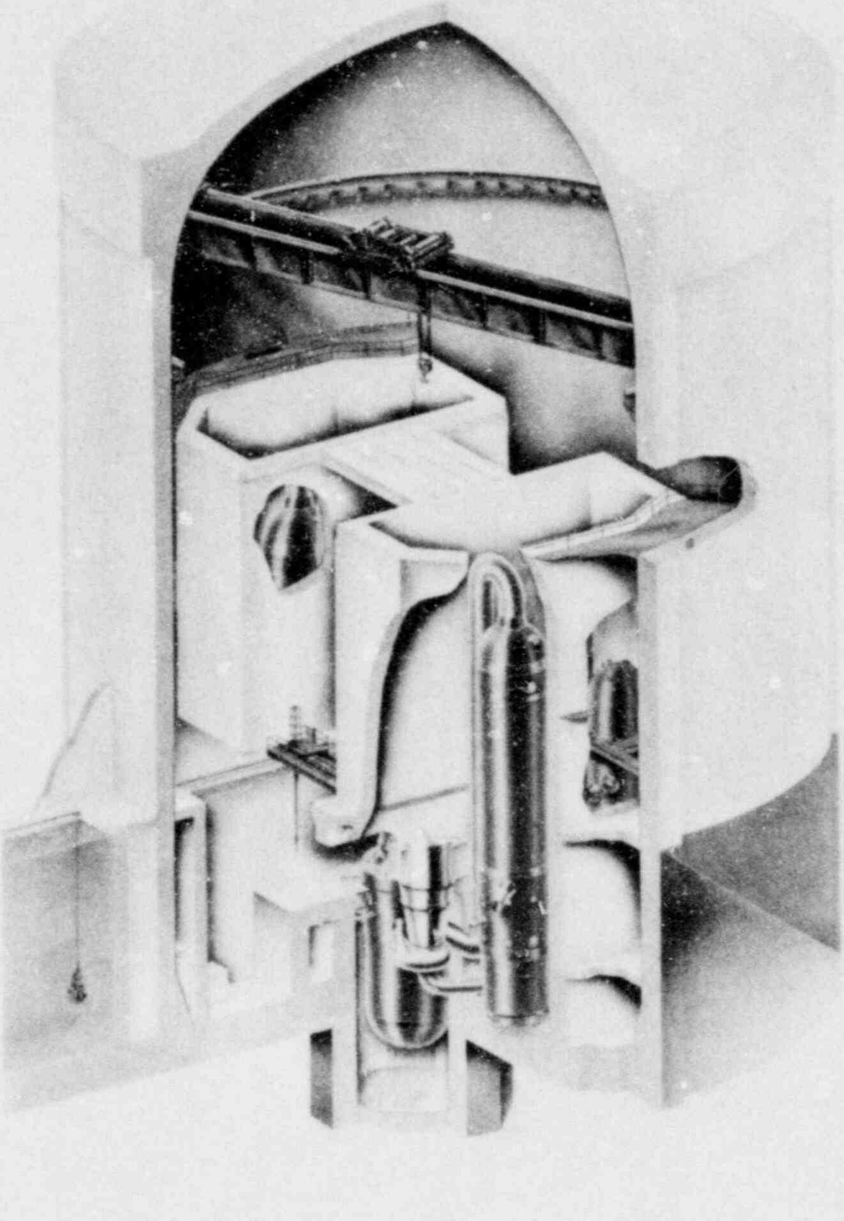
Babcock & Wilcox

Slide 8



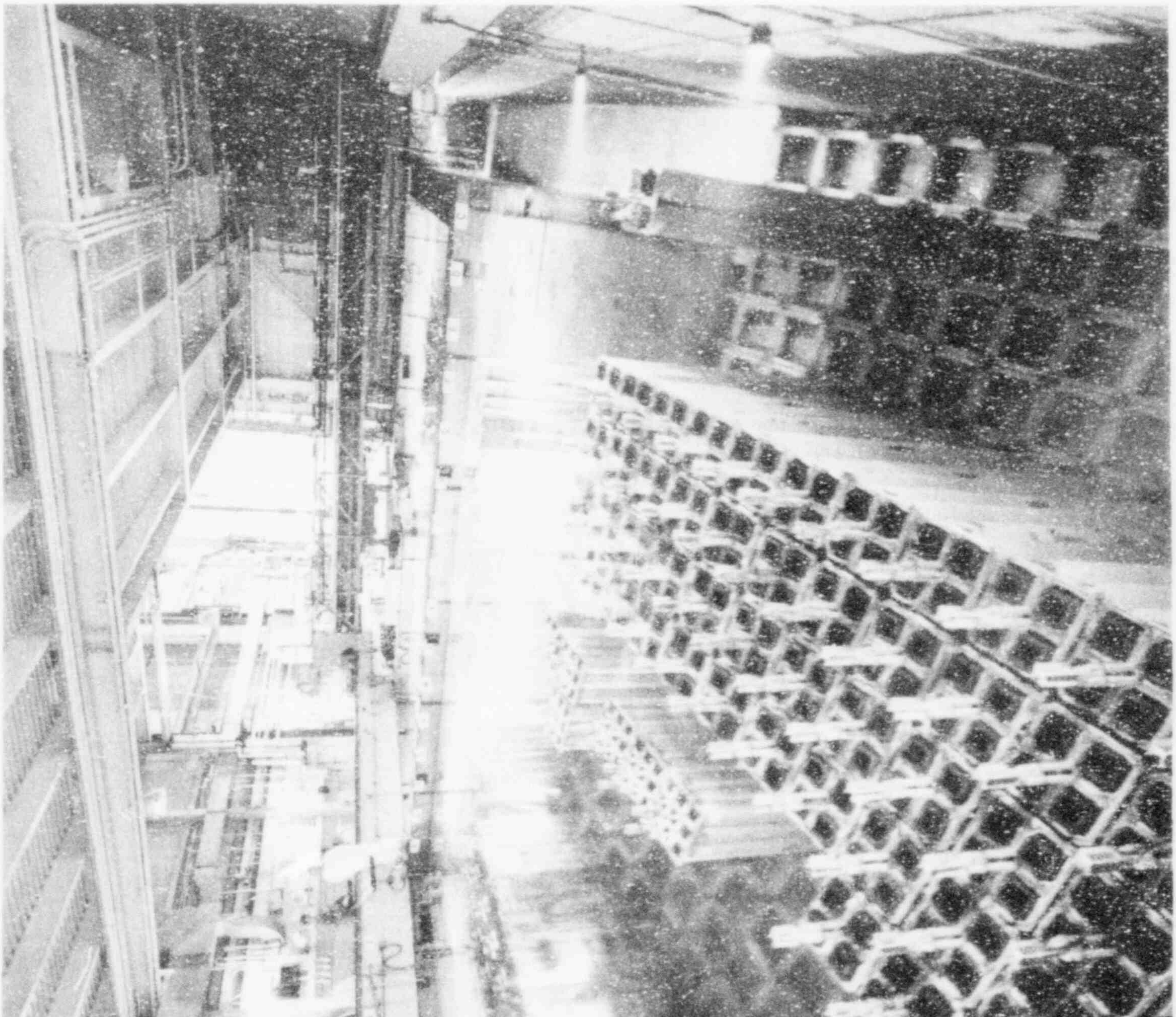
Nuclear Steam System

Babcock & Wilcox



Nuclear Steam System -Typical arrangement in building

Babcock & Wilcox



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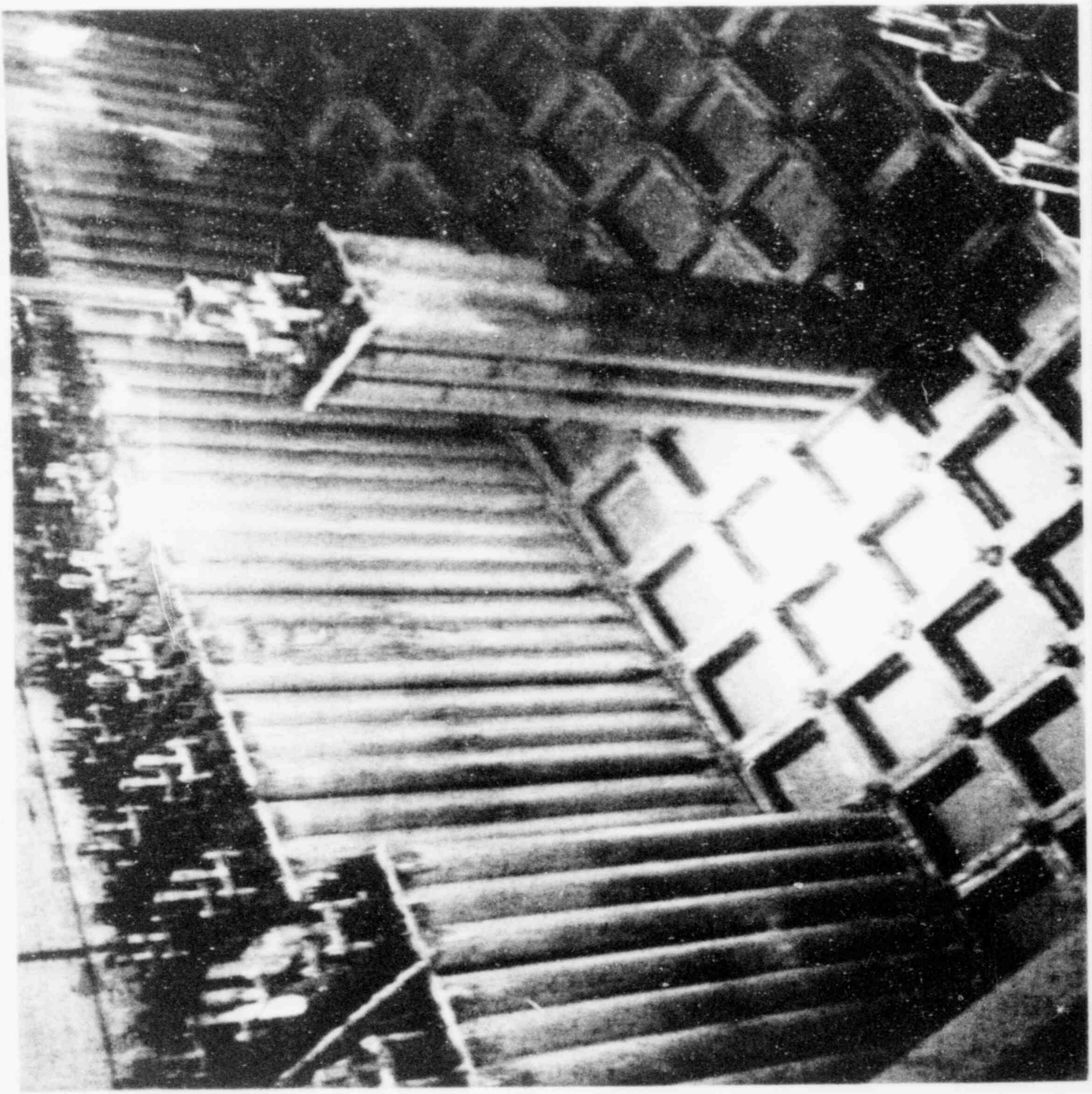

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DECOMMISSIONED POWER, DEMONSTRATION, AND TEST REACTORS

REACTOR	SIZE (MWt)	DECOMMISSIONING MODE SELECTED	LOCATION
SAXTON	23.5	MOTHBALLED	SAXTON, PA.
SEFOR	20	MOTHBALLED	STRICKLER, ARKANSAS
WESTINGHOUSE TEST REACTOR	60	MOTHBALLED	WALTZ MILL, PA.
NASA PLUMBROOK	0.1	MOTHBALLED	SANDUSKY, OHIO
GE EVESR	17	MOTHBALLED	ALAMEDA CO., CA.
B&W	6	DISMANTLED EXCEPT FOR SOME CONCRETE STRUCTURES	LYNCHBURG, VIRGINIA
HALLAM	256	ENTOMBMENT	HALLAM, NE.
PIQUA	45	ENTOMBMENT	PIQUA, OHIO
ELK RIVER	58	DISMANTLED	ELK RIVER, MN.
BONUS	50	ENTOMBMENT	PUERTO RICO
VBWR	50	MOTHBALLED	ALAMEDA CO., CA.
FERMI I	200	MOTHBALLED	MONROE CO., MI.
CVTR	65	MOTHBALLED	SOUTH CAROLINA
PEACH BOTTOM	115	MOTHBALLED	YORK CO., PA.
PATHFINDER	190	CONVERSION AND MOTHBALLING	SIOUX FALLS, SOUTH DAKOTA

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EXAMPLE DECOMMISSIONING

REACTOR	ELK RIVER
REACTOR OUTPUT	58.2 MWth
OPERATED	1962-1968
DECOMMISSIONED	1972-1974
METHOD OF DECOMMISSIONING	DISMANTLING FOR UNRESTRICTED RELEASE
ESTIMATED COST	$5.1M
ACTUAL COST	$5.7M

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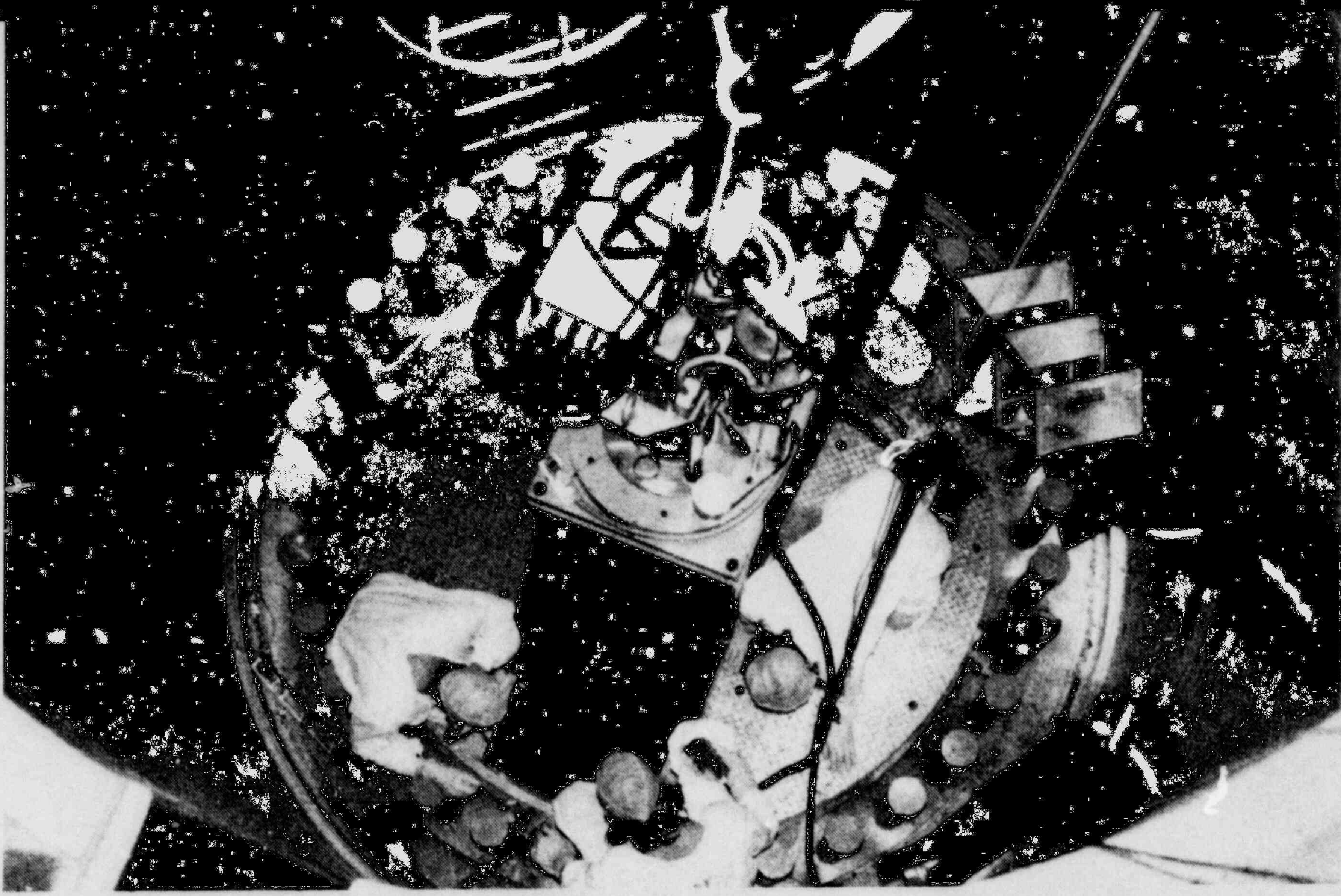
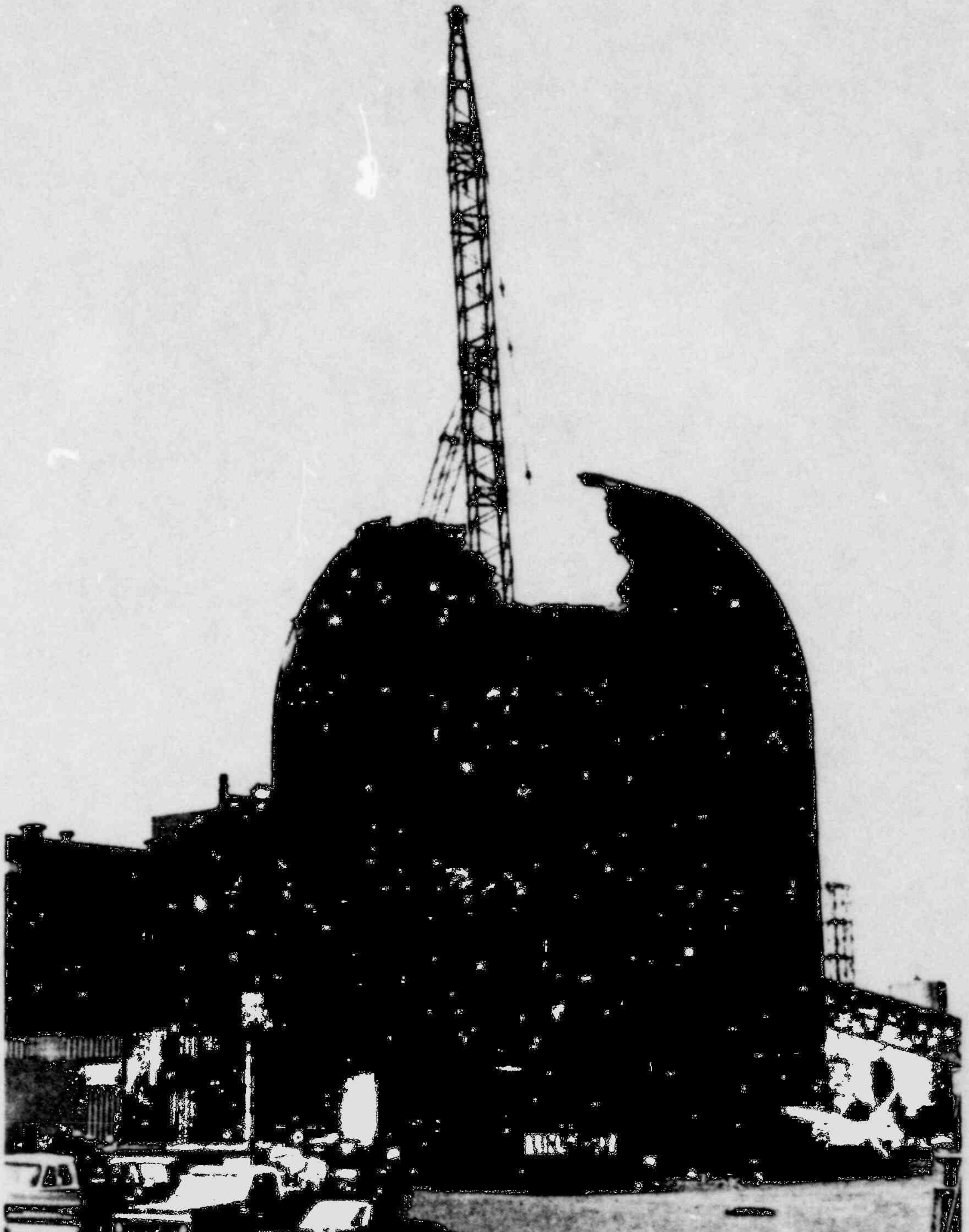


Installation of Plasma Torch Manipulator



Dome of Building Open
for Equipment Removal

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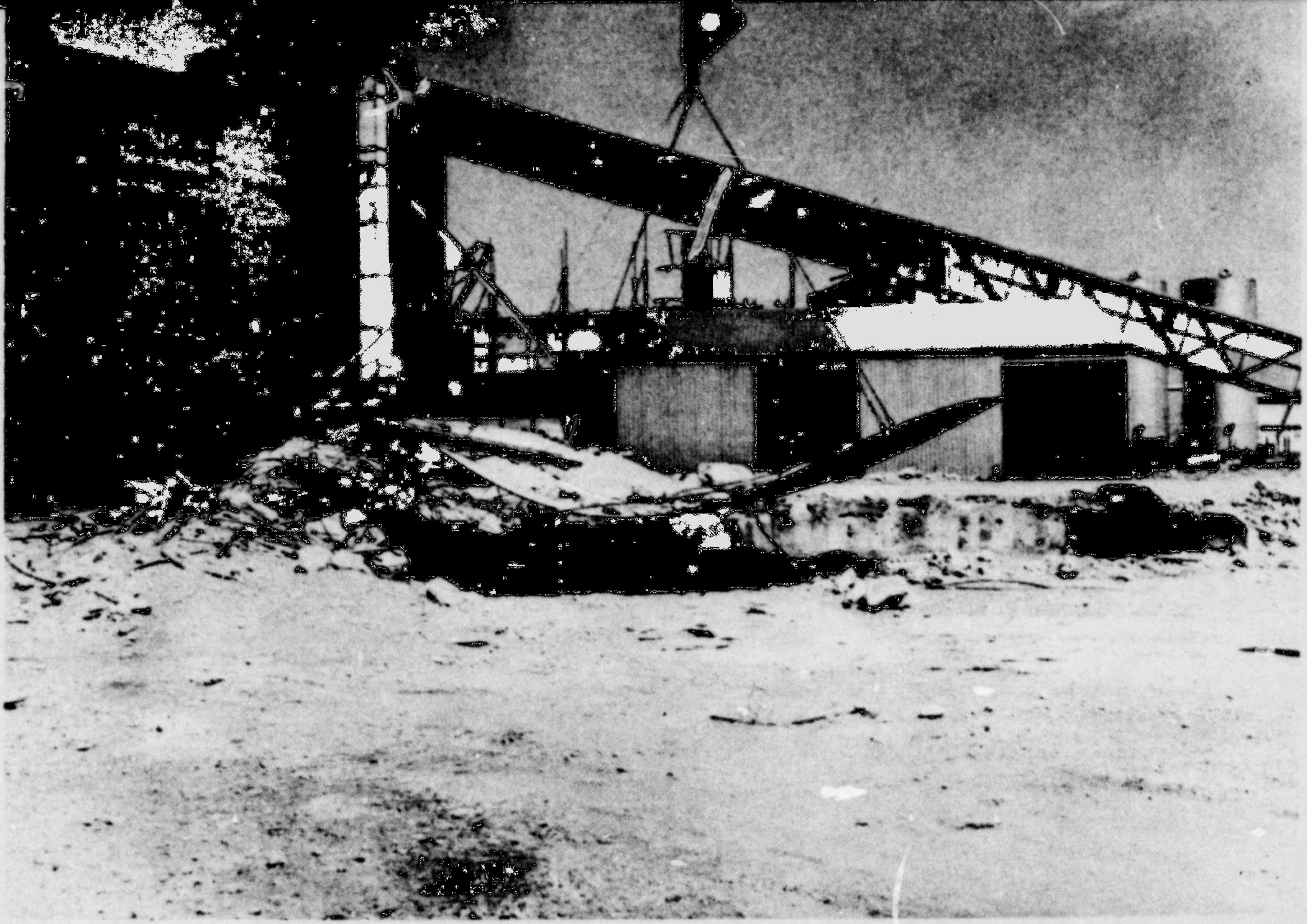
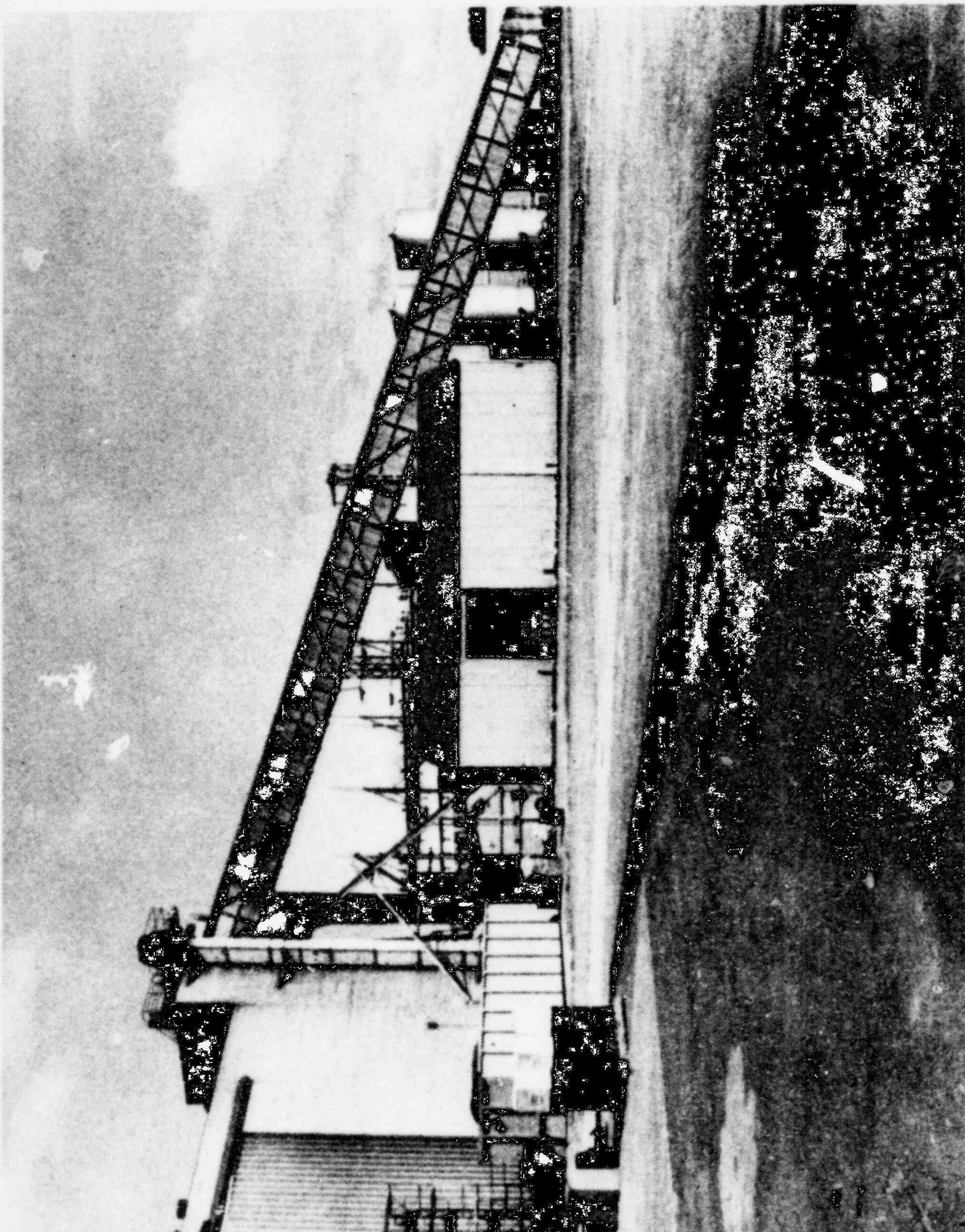


Removing Last Section of
Sub-grade Steel



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EXTRAPOLATION OF EXPERIENCE

	ELK RIVER	TROJAN
REACTOR TYPES	BWR	PWR
REACTOR OUTPUT, MWth	58.2	3500
REACTOR VESSEL WALL THICKNESS; INCHES	3	8.5
YEARS OF OPERATION	6	>30
DISMANTLING COST ($M)	5.7*	42.1**

* DOES NOT INCLUDE STEAM PLANT AND HEAT REJECTION - 1973 DOLLARS

** INCLUDES ALL STATION FACILITIES AND LAST FULL CORE - 1978 DOLLARS

EXISTING CRITERIA FOR DECOMMISSIONING

REACTORS

- 10 CFR 50.33 FOR FINANCIAL QUALIFICATIONS
- 10 CFR 50.82 FOR DECOMMISSIONING PLANS
- R.G. 1.86 FOR DECOMMISSIONING MODES AND RESIDUE LIMITS

FUEL CYCLE AND OTHERS

- 10 CFR 50 APPENDIX "F" FOR REPROCESSING PLANT
- 10 CFR 50.33 AND 10 CFR 70.23 FOR FINANCIAL QUALIFICATIONS
- R.G. 3.5 ETC. FOR CRITERIA
- RESIDUE LIMITS

EVALUATION OF DECOMMISSIONING IN A REACTOR APPLICATION

- LICENSEE IDENTIFIES TENTATIVE MODE AND COST
- STAFF CONSIDERS COST AND TIMING IN 50.33 FINDING
- STAFF CONSIDERS COST IN NEPA COST-BENEFIT ANALYSIS

EXAMPLE FUNDING FOR REACTOR DECOMMISSIONING

- DECOMMISSIONING COSTS BORNE BY CUSTOMERS SERVED

- CASH SINKING FUND INVESTED IN THE UTILITY'S OWN ASSETS
  - UTILITY CHARGES FRACTION OF DECOMMISSIONING COST AS DEPRECIATION EXPENSE AND CREDITS RESERVE FUND
  - RESERVE IS DEDUCTED FROM RATE BASE AND FROM PLANT AGAINST WHICH SECURITIES CAN BE ISSUED

- TYPICAL RATE OF RETURN ON THIS RESERVE ABOUT 15%

WEAKNESSES OF PRESENT POLICY

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- LACK OF RECOGNIZED CRITERIA FOR RADIOACTIVE RESIDUE
  - IN SOILS
  - ON SURFACE
  - IN BURIAL
- LACK OF CLEAR POLICY ON PERMISSIBLE MODES OF DECOMMISSIONING
  - REMOVAL VS. FIXED-IN-PLACE
  - TIMING
- LACK OF CLEAR POLICY ON FINANCIAL ASSURANCE
- LITTLE IS BEING DONE TO SEE THAT PLANTS ARE BEING DESIGNED TO FACILITATE DECOMMISSIONING

WHAT IS NRC DOING?

- COMPLETE REEVALUATION OF POLICY
  - ALL ACTIVITIES LICENSED BY NRC
  - DETAILED TECHNICAL STUDIES
  - RULEMAKING

- CLOSE COORDINATION WITH STATES
  - MUTUAL INTERESTS
  - RELATED RESPONSIBILITIES
  - POTENTIAL TECHNICAL SUPPORT FOR STATE WORK

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FACTORS IN RULEMAKING ON DECOMMISSIONING

- RESPONSIBILITY FOR DECOMMISSIONING IS URGENT DECOMMISSIONING IS NOT

- POLICY AND RULEMAKING SHOULD CONSIDER
  - DECOMMISSIONING MODE
  - RESIDUAL CONTAMINATION LIMITS
  - TIMING OF DECOMMISSIONING
  - FINANCIAL AND/OR SURETY ARRANGEMENTS

- FACTORS CONTROLLING SCHEDULE
  - RESIDUE LIMITS (EPA, STATES)
  - SURETY ARRANGEMENTS (STATES, FERC)

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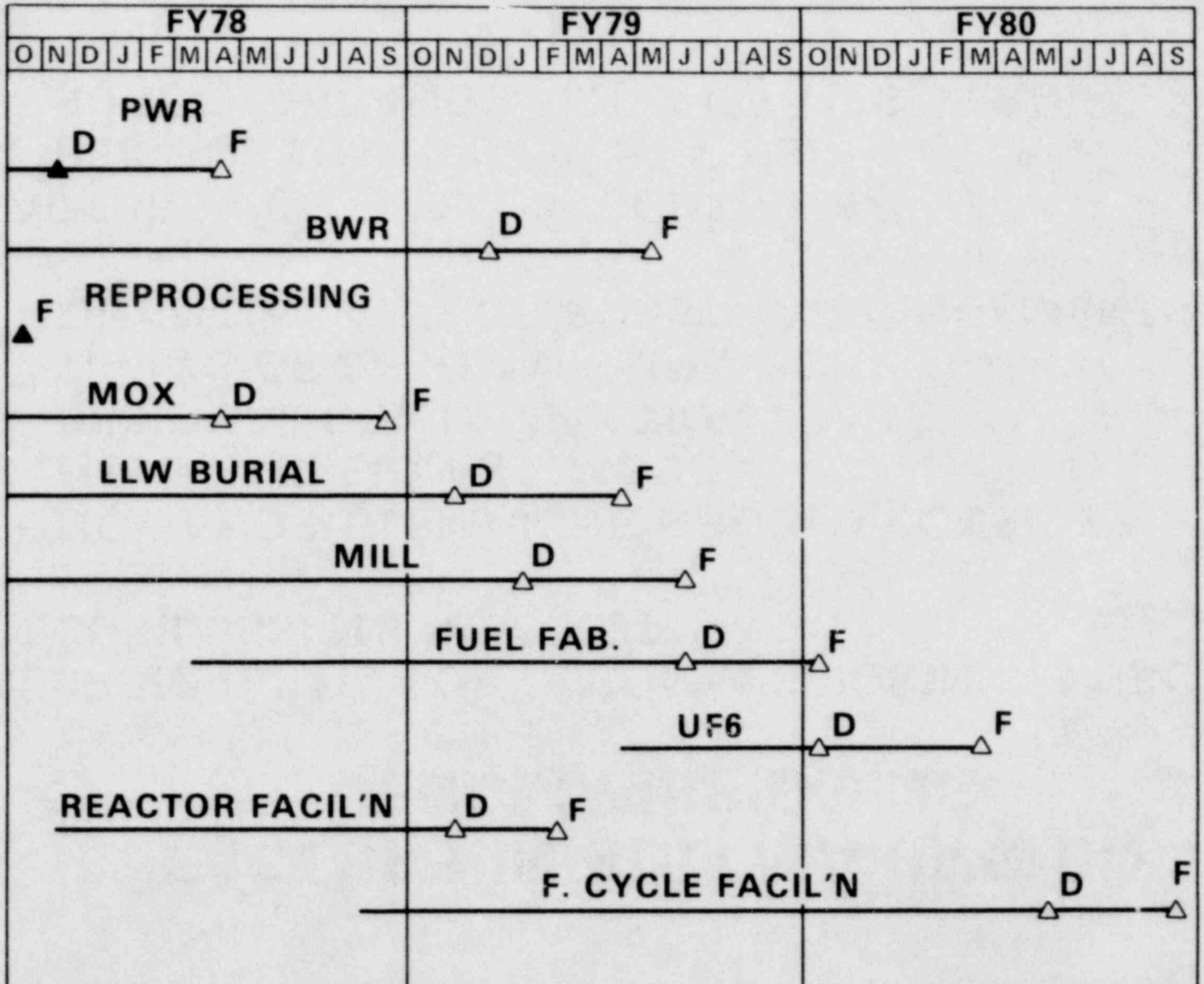
MBO A DEVELOP INFORMATION BASE FOR DECOMMISSIONING



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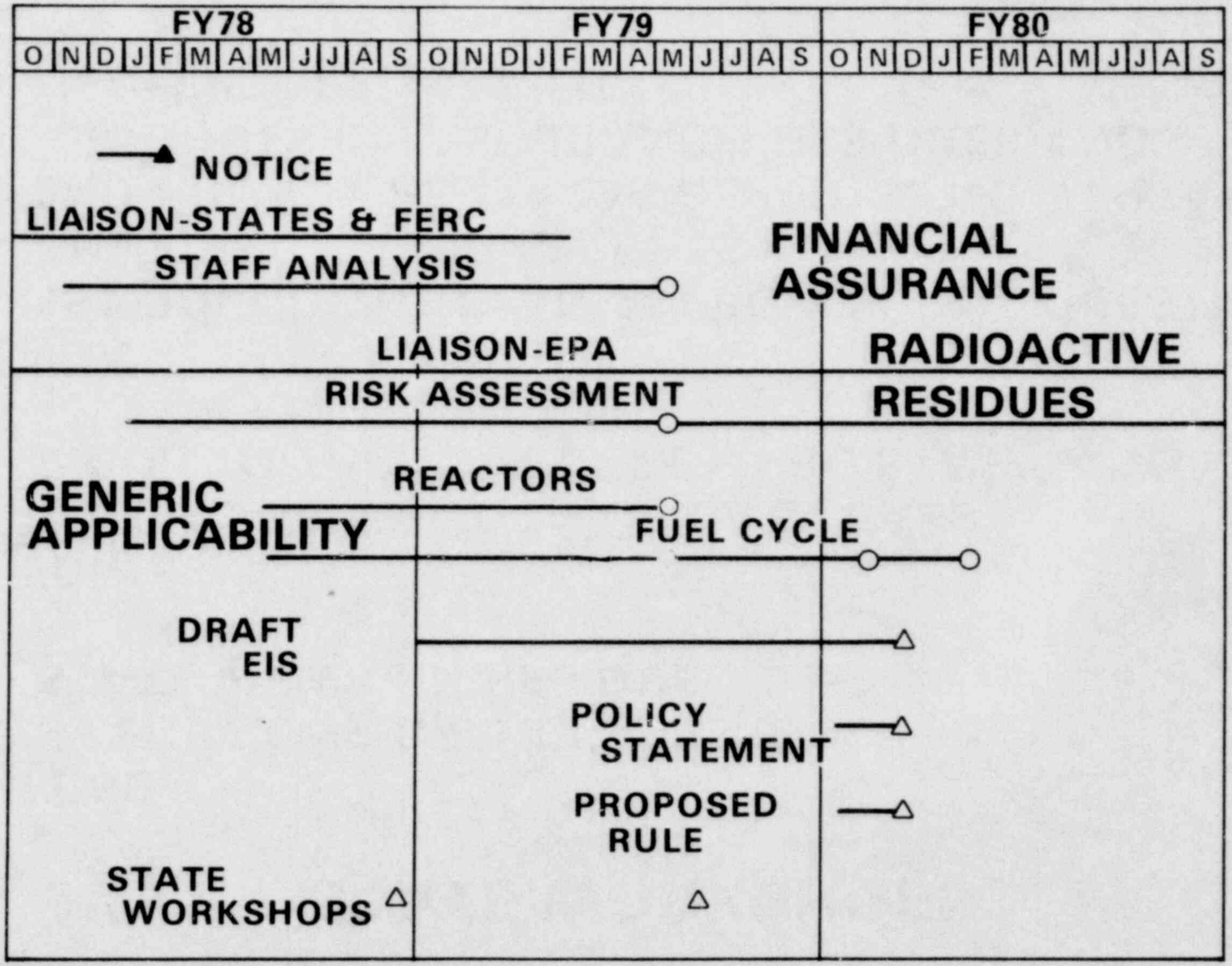
MBO B DEVELOP POLICY AND RULE



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STATE WORKSHOPS

PURPOSE

- STATE VIEWS ON JURISDICTION
- STATE VIEWS ON RESIDUES

SCHEDULE

- DURING GENERATION OF DATA BASE
- PRIOR TO THOUGHT SET BY NRC STAFF

AGENDA

- 1ST ROUND-THE PLAN APPROACH, THE QUESTIONS, THE FIRST MAJOR REPORTS
- 2ND ROUND-THE MAJOR REPORTS, THE TENTATIVE THOUGHTS ON ASSURANCE, RESIDUES AND GENERIC APPLICABILITY

HOW CAN A STATE PARTICIPATE

<u>ACTIVE ROLE IN WORKSHOPS</u>

- CLARIFICATION OF JURISDICTIONS
- FINANCIAL ASSURANCE
- EXTENT OF DECOMMISSIONING REQUIRED
- RESIDUAL ACTIVITY LIMITS

<u>CRITIQUE OF TECHNICAL REPORTS</u>

- VALIDITY OF CALCULATIONS
- MEASURE OF UNCERTAINTY IN COSTS

<u>NRC RULEMAKING PROCESS</u>

- AFTER WORKSHOPS AND REPORTS
- NO REDUCTION IN OPPORTUNITIES BECAUSE OF WORKSHOPS

<u>SEPARATE STATE ACTIONS</u>

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QUESTIONS

1. DO THE STATES HAVE AN ACCEPTABLE ROLE IN THE PLAN?

2. ARE THE TECHNICAL REPORTS ADEQUATE IN COVERING THE RIGHT FACILITIES, IN CONSIDERING THE REAL ALTERNATIVES?

3. SHOULD THE PLAN BE MODIFIED? HOW?

4. SHOULD DETAILED DECOMMISSIONING PLANS BE REQUIRED PRIOR TO THE ISSUANCE OF LICENSE?

5. IS DELAY IN DECOMMISSIONING JUSTIFIED TO SAVE MONEY?—TO REDUCE RADIATION EXPOSURE?

6. IS PERMANENT ENTOMBMENT OF NUCLEAR FACILITIES AN ACCEPTABLE METHOD OF DECOMMISSIONING?

QUESTIONS (Cont'd.)

7. SHOULD DECOMMISSIONING CRITERIA EXTEND TO BUILDINGS, STRUCTURES AND COMPONENTS WHICH ARE NOT CONTAMINATED WITH RADIOACTIVE MATERIALS?

8. CAN CLEANUP CRITERIA BE DEVELOPED BY THE FEDERAL GOVERNMENT WITH STATE ADVICE SO THAT ALL CAN ENDORSE AND FOLLOW THEM?

9. IS A MAXIMUM DOSE RATE OF 1 MREM/YR TO ANY INDIVIDUAL AFTER CLEANUP AN ACCEPTABLE BASIS FOR SITE RELEASE? WHAT OTHER BASIS WOULD YOU RECOMMEND?

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QUESTIONS (CONT.)

10. WHO SHOULD PAY FOR DECOMMISSIONING?

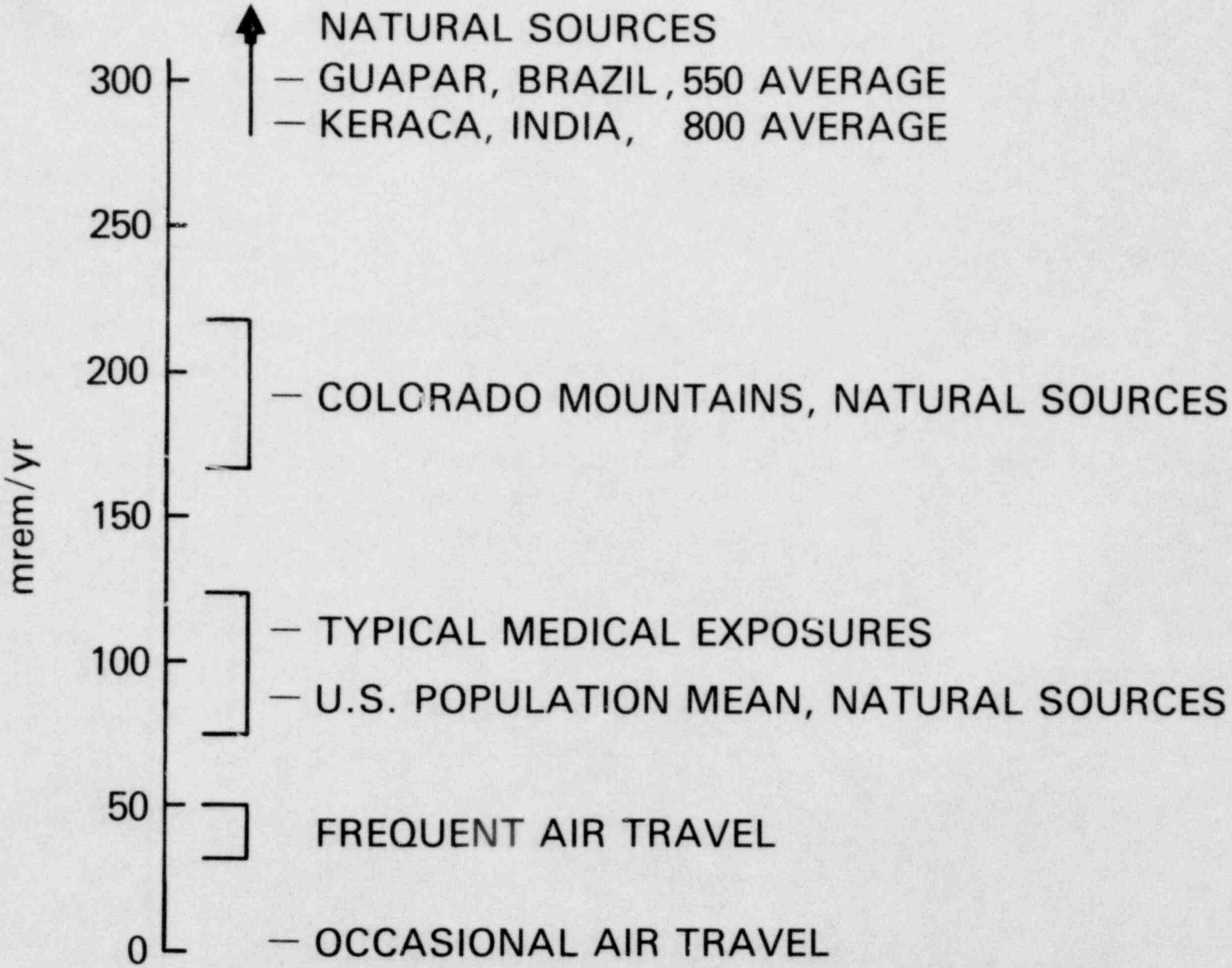
11. SHOULD FINANCIAL RESPONSIBILITY REQUIREMENTS BE IMPOSED BY FEDERAL OR BY STATE AUTHORITIES?
    - WHEN?

12. SHOULD FUNDS BE SET ASIDE IN ADVANCE OR ACCUMULATED DURING FACILITY LIFE TO PAY FOR DECOMMISSIONING?

13. WHO SHOULD HOLD THE FUNDS IF THEY ARE ACCUMULATED?

14. HOW CAN UNCERTAINTIES IN COST OR CONTINGENCIES BE COVERED?
    - BY EXTRA MONEY IN ACCRUAL FOR EACH FACILITY?
    - BY EXTRA MONEY INTO A GENERAL FUND
    - STATE OR FEDERAL?

RADIATION EXPOSURES



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FEDERAL-STATE JURISDICTION

ACTIVITY	FEDERAL	STATE
Reactors and reprocessing plants	Issues CPs and OLs in all States	Issues site certification, etc.
Fuel cycle facilities	Issues licenses in all States except mills and UF_6 plants in Agreement States	Issues licenses for mills and UF_6 plants in Agreement States
Source-Byproduct-and SNM (small quantities)	Issues licenses in non-agreement States	Issues licenses in Agreement States
Naturally occurring and accelerator produced materials	No authority	Regulated by States
X-ray machines	No authority	Regulated by States

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PUBLIC
COMMENTS
ON

FEDERAL REGISTER NOTICE

(3/13/78) AND

PIRG PETITION

(7/5/77)

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PIRG PETITION

BONDS-HELD IN ESCROW-TO ENSURE:

1. Availability Of Decommissioning Funds
2. Paid By Reactor Operator-Not Future Generations

PIRG PETITION

- Federal Register Notice (8/8/77)
- Letter To State PUCs
- Meeting With FERC
- Letter To Surety Companies

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FOR PIRG

ACCELERATE RESEARCH

UPDATE NRC REGULATIONS

REQUIRE $13 MILLION ESCROW BOND

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AGAINST PIRG

- Present Requirements Adequate
- Bonding Is Uneconomical & Inflexible
- New Requirements Should Be Based On Systematic Evaluation Of Alternatives
- No Authority Under AEA Or NEPA
- FERC & State PUCs Are Appropriate Agencies

FEDERAL REGISTER NOTICE
(43 FR 10370)

1. Desirability And Form Of Criteria
2. Timing Of Decommissioning Plans
3. Funding And/Or Surety Arrangements
4. Acceptable Residual Limits
5. Timing Of Decommissioning
6. Criteria For Uncontaminated Components

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QUESTION NO. 1 — IN FAVOR
(CRITERIA)

- Decommissioning Definition Needed
- Criteria Urgently Needed
- Should Include Soil & Induced Limits
- Should Be In Form Of Numerical Limits
- Should Be In Form Of Dose Limits
- Should Be In Form Of Numerical And Dose Limits
- Limits Should Be In Regulations
- Limits Should Be In Regulatory Guide And Be Flexible

QUESTION NO. 1 — OPPOSED
(CRITERIA)

- Present Requirements Adequate
- Further Research Needed
- No Immediate Need
- Rigid Requirements Inappropriate
- Absolutely No Need

QUESTION NO. 2 — IN FAVOR
(PLANS)

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- In Detail For Both Normal And Accident Conditions
- Based On Demonstrated Techniques
- To Include Dismantling
- For Selected Facilities Only
- Policy Statement Or Conceptual Plan Prior To Issuance Of License

QUESTION NO. 2 — OPPOSED
(PLANS)

- Present Practice Sufficient
- Details At End Of Plant Life
- Not Logical Or Sensible
- Serves No Useful Purpose
- Obsolete Before 40 Years Due To Technology Changes

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QUESTION NO. 3 — IN FAVOR
(FUNDING)

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- Should Be Required Prior To Licensing, Including Government Owned
- Should Require Demonstration Of Financial Responsibility Only
- Should Require Preliminary Plans Only
- Should Be Paid By Current Users

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QUESTION NO. 3 — OPPOSED
(FUNDING)

- Present Practices Adequate
- Sureties Are Undue Cost To Utilities
- Sureties Do Not Provide Current Funding For Future Costs
- Costs Are Double Due To IRS
- NRC Authority Questionable—Should Be Left To FERC And State PUCs
- Costs Will Be Spread Over Several Years
- Unnecessary For Regulated Utilities

QUESTION NO. 4
(RESIDUAL LIMITS)

- Present Limits Adequate (i.e., 1.86)
- Should Not Be Lower Than Variations In Normal Background
- No Surveillance 0.03-0.05MREM/Hr
- Unrestricted Release 0-0.01MREM/Hr
- 1MREM/Yr Total Body-3MREM/Yr Organ
- NUREG-0278
- 100 dpm Removable—0.05MREM/Hr
- Should Be Based On Potential Exposures
- No Basis For New Limits—1.86 Limits Are Guesses
- Background

QUESTION NO. 5
(TIMING)

- One Generation
- Best Protection Principle
- Unlimited—As Long As Licensee Can Justify And Safely Maintain
- 50-100 Yrs
- 10-20 Yrs At Least To Allow For Radioactive Decay
- Dismantled Within 10 Years

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QUESTION NO. 6
(APPLICABILITY)

- Everything Returned To Nature
- Absolutely No Basis For Additional Requirements
- No Authority Under NEPA
- Sites Are Owned By Private Companies
- Local Zoning Restrictions Sufficient

PHILADELPHIA - Opening Plenary - Comment and Response Session

Comment

An individual commented on Mr. Bernero's presentation of the results of the PIRG Survey. He mentioned that Mr. Bernero pointed out that the responses against the PIRG were from industry. He questioned whether Mr. Bernero would be as quick to point out that the people in favor of these issues were radical environmental groups. He further stated that Mr. Bernero was being too biased against the industrial interests.

Response

The responses do bear out that those against the PIRG Petition were from industry. Furthermore, the purpose of this meeting is to provide a forum for input from State officials. A subsequent meeting is being held to receive public/industrial input. It is the intent of the NRC to evaluate all opinions presented.

Comment

With regard to radiation limits, unless NRC and EPA can get together, the individual felt that they "may not be playing off the same piece of music."

Response

There is in fact an agreement and EPA representatives are present in these workshops for just that reason.

Comment

Was the 1 mrem level that was mentioned in the presentation added to everyday exposure?

Response

The 1 mrem level was indeed spoken of as an addition to normal exposure.

Comment

Comments were made on a three-year battle that the individual had just completed with EPA over some mistake that they had made. He was not specific. He said that he wanted to laugh at the government's overreaction to the handling of nuclear materials. He stated that the problem was only in the security of the operation and that he was amazed that the Federal government was even involved in the nuts and bolts aspect. He felt that the government should not be involved in this at all. He cited an example in EPA's battle to install scrubbers for cleaning the air and went on to say that there was no point in over-burdening industry by over-regulating them. Instead, the government should set up a system to provide payment upon default. He summarized his point by saying that he felt States needed to stand up and tell the Federal government that they were completely out of place in dealing with issues of this nature.

Response

The purpose of these workshops was to hear opinions of this nature.

Comment

The term "further research" was questioned. The individual said this is a "cop-out." Rather than hearing the term used, he wanted to know specifically what was going to be done by whom, and especially how much it would cost.

Response

One point of further research is to determine if further research is indeed necessary and/or what kind of research.

RICHARD I. SMITH, Associate Manager,
Safety Analysis Section, Battelle,
Pacific Northwest Laboratory

". SMITH MURPHY, Study Leader,
Safety Analysis Section, Battelle,
Pacific Northwest Laboratory

(Copies of the slides used are included in the Discussion Material following this transcript)

MR. SMITH: My presentation today is designed to give you a brief look into the studies that we have been conducting for NRC in the area of decommissioning new facilities.

We will look at two facilities, one being the PWR, and for that study we chose the Trojan plant up in Oregon.

And for the second one, a fuel reprocessing plant, we used the Barnwell plant in South Carolina.

My presentation is divided into essentially three parts. First I am going to give you some of the generic bases that we used in developing these studies. Then I will give you the specific results that we obtained for the PWR, and finally then, my colleague, Dr. Murphy, will follow with the specific results from the fuel reprocessing plant.

(Slides)

Okay. Let's first define what we are talking about here in terms of what is decommissioning.

As we use it, and I think most people up in NRC at least will agree, it is the preparation of a facility for retirement from active service, and placement of that facility in such a condition that future risk to the public is within safe and acceptable bounds.

Now that covers a lot of ground. It covers a wide range of possible approaches that one might use. We will talk about some of the more likely ones here today.

We had certain objectives in these studies. The first one was to determine whether or not the technology was available today, whether we had to have some major scientific breakthroughs or whether or not we could accomplish decommissioning with the tools we have on hand.

Secondly, we were to estimate the kinds of occupational and public radiation exposure that one might get resulting from decommissioning operations.

Thirdly, to make estimates of the manpower and the costs associated with accomplishing the job for a variety of possible approaches to decommissioning.

Now in these studies we looked at several cases. In the reactor case we looked at two particular modes; in the fuel reprocessing plant, we looked at three.

(Slide.)

These are the basic work elements involved in these ' ties.

First of all, we looked through the regulations to see really what is required today. And Bob talked about some of this last night.

We looked at what decommissioning experience there was around the world, and this country in particular. But we didn't neglect the foreign experience either.

For each facility we had to develop a fairly detailed characterization. This involves the physical plant, how big, how high, how wide, how much concrete, what is the equipment in it. But perhaps more importantly in many cases, what is the nature of the residual radioactivity in that plant when you shut it down.

We developed work plans and techniques and schedules for accomplishing the proposed work.

And based on these plans and schedules, we developed the estimated manpower costs and equipment, and disposal costs and so on.

And for safety, we are talking primarily now about radiation safety, although we did look at normal industrial safety utilizing, basically, a statistical point of view.

We did a fair amount of work in the area of what allowable residual radioactivity levels are likely to be. In particular, we developed a methodology for determining what these levels might be. We will talk about the details of this a little later.

And, we looked at what kinds of financing alternatives might be possible in a fairly simple-minded way without dealing with the various complexities of tax laws and all this sort of thing.

Now we looked at several different approaches, as I mentioned.

(Slide.)

These are the bases for the studies.

First of all, we picked a real place to do the detailed analyses. You had to have a real thing to look at so you could determine how big it was, how many miles of pipe you had to handle and all these kinds of things.

We made the assumption that the housekeeping in the place was good during the life of the plant. I think this is a safe assumption because the people have to live there, work there and they have to maintain it. They will have to do a certain amount of housekeeping.

We used a generic site for all of these studies with the exception of the uranium mill and the low level waste burial ground.

We looked at a variety of possible decommissioning modes. The plans that we developed were designed to provide some reasonable balance between costs and safety. One can always go too far one way or the other.

We kept the ALARA principle, as-low-as-reasonably-achievable idea in mind when we were developing the work plans and procedures.

We used only available technology.

We assumed that the workforce was reasonably efficient. Considering that they were working in radiation zones, they had to suit up and unsuit, all the usual things that are required for radiation zones.

An important assumption was that the facility was on a site all by itself. Now this becomes particularly important when you are looking at the protective storage or safe storage mode where you have to provide surveillance and other support for the facility that was standing there.

And finally, the transuranic and other fairly high-level radioactive materials were assumed to be sent to geologic disposal facility, recognizing there isn't any such animal at the moment. We assumed that there would be one available by the time one wants to decommission one of these. The rest of the radioactive material, contaminated et cetera, we would assume to be shipped to a low-level shallow-land burial site.

(Slide.)

Now these are the basic modes of decommissioning we looked at.

Dismantlement is fairly straightforward. That really says you remove all of the radioactivity down to the acceptable residual level and terminate the license.

Now this can mean a variety of things, depending on the timeframe that we are dealing with, whether it is immediately after shutdown. If it is immediately after shutdown, it may mean a lot of radioactive stuff goes out. If you wait long enough, it may mean a relatively small amount of radioactive material has to be disposed of.

The safe storage modes are subdivided into categories depending on the nature of how you are doing it.

The hardened safe storage is essentially a temporary entombment. I want to emphasize the word "temporary" here as opposed to a permanent type thing. Here you are basically cleaning up most of the accessible areas and putting the really hot stuff into a localized area and sealing it up in a fairly secure location, keeping in mind that you are going to have to ultimately come back and remove the very long lived radioactive materials.

The passive safe storage mode is one that we think is the most feasible, I think, for most applications. Here you again do a fairly good cleaning up of accessible areas, seal up some of the hotter areas, and clean it up to the point where you don't need any active protective systems in operation to assure the confinement of the material.

The custodial mode is basically shut the plant down, clean it up a little bit, keep the ventilation system and other associated systems running, just to make sure that nothing gets out.

This is probably the easiest one to accomplish immediately. It turns out to be far and away the most expensive, if you leave it that way for very long because the surveillance and continuing care required are more extensive.

You have to keep in mind that all of these safe storage modes are open-ended. In other words, they are not a terminal mode by themselves. You eventually have to go through a dismantlement of some kind.

Maybe if you leave it in one of these safe storage modes long enough, the dismantlement is as simple as doing a detailed survey to assure yourself the residual levels are sufficiently low.

(Slide.)

We worked pretty hard to develop a method for determining some disposition criteria for these things. The idea is to determine what are the acceptable residual levels for a facility that you can walk away from.

And our approach here is to base it on dose limits to the public. What is the maximum acceptable dose to the public, that might result from this facility just sitting there, after being decommissioned and completely accessible, that is unrestricted release to the public?

We considered all the pathways, not simply external radiation but ingestion, inhalation, food chain, the whole bit.

We wanted to have a method that was applicable to all kinds of nuclear facilities, not tailored to one facility in particular.

And hopefully, that when you got through with this exercise you would end up with results that were in a reasonable agreement with existing criteria, or at least we could justify them.

(Slide.)

So here is basically the technique that we evolved.

First of all you go through the exercise and develop a scenario for the release of the radioactive material as a result of whatever is going on at the site. Consideration is given to the composition and makeup of the material that is there.

Next, you go through the computation of the annual dose to the maximally exposed individual resulting from the material that is there.

And then compare the dosage calculated here. You want to assume certain things here. You have to start with some inventory that you think is probably reasonable for the facility. Calculate these doses, compare this with the allowable annual dose limit, whatever that may be. This dose has not been determined yet as Bob pointed out last night. This number may range anywhere from 1 millirem per year to 100. It has not been determined yet what that should be.

At any rate, if you will pick or assume a number, you can compare the number you calculated from here with the dose limit. And based on that ratio then, recompute the levels that will be allowed back at this point. And it is a sort of an iterative process so that you can arrive at the levels that will be present and still not result in the allowable annual dose.

So this is the technique that we have developed for this thing. It seems to work pretty well independent of the facility, because this part of it takes into account the nature of the radioactivity or the spectrum of radionuclides present, the pathways for these nuclides to get to the individual and so on.

As I said, we looked at financing in a fairly simple-minded way.

(Slide.)

We said, okay, there are really three ways you can do this:

One, is pay for it when you do it. Don't worry about the details, cough up the money at the end.

Another way is to develop a prepaid sinking fund where you deposit some finite amount of money into the kitty to begin with and you start up the plant, supposedly large enough to be able to assure that you will pay for the whole operation when you shut it down.

Or, you can develop a sinking fund by annual payments by collecting the money from the consumers as the plant operates.

(Slide.)

And we didn't take into account taxation variations or any of these good things. We just did the mathematics in the question.

And one of the things that is always asked is, all right, what is the present value of this approach going to be at the start of the reactor life?

So we went through this exercise. This example is based on the decommissioning cost of 44 million in 1978 dollars. And if you assume that you started up the plant in 1978 and you are going to decommission it 40 years hence, it turns out that for the parameters we chose to look at with an interest rate of 8 percent, inflation rate of 6 percent and discount rate of 10 percent, after 40 years you are going to need $452 million to complete the decommissioning.

If you decide to pay a lump sum 40 years later, the present value of that money today is $10 million, approximately.

On the other hand, if you decide to set up a prepaid sinking fund and keep this fund adjusted by refunds to the customer or the utility or whoever is putting the money into it, such that the balance at the end of 40 years is the 452 million, and the present value of that full operation turns out to be 27 million.

Now in the case of the annual payment thing you treat the decommissioning costs as a negative salvage value, the present value of all of these payments over the 40-year life, comes out to be about 15 million.

So the prepaid sinking fund is the present value cost.

The payment of a lump sum when incurred is the least expensive, but may be the least desirable because it is not equitable.

The annual payment sinking fund is probably more equitable to the consumer because they are paying for it over the life of the plant.

Well, there, some discussion on how these funds are collected might be appropriate.

The NRC queried a number of the public service commissions on how they thought it might best be handled.

And the result they got was that most of them felt that it could probably be best collected as part of the plant depreciation schedule by making the decommissioning cost essentially a negative salvage value and tacking it on to the capital cost.

This is shown on this next slide, on which the plant capital cost is this much and the decommissioning cost at the start of plant life is this little bit here.

(Slide.)

A straightline depreciation is shown on the upper curve.

Now we just saw that an inflation rate was predicted. The actual decommissioning costs were really going to be this amount down here, so that one needs to have a depreciation rate that probably looks like this lower curve.

There is one difficulty with that too, though. The straightline approach again tends to penalize the people who are paying up here in the early part, because they are paying their share in less inflated dollars.

So it would seem reasonable that the depreciation curve probably should follow something like this dashed line to be more equitable to the consumers.

Now, keeping in mind the various generalities and assumptions that I pointed out here to begin with, let's take a look at the results from the Pressurized Water Reactor, PWR, plant.

(Slide.)

This is the Trojan plant located outside of Portland, Oregon. It is a Westinghouse 4-loop PWR rated at 1175 megawatts electrical.

The site is really dominated by this tremendous natural draft cooling tower.

The parts of the plant that are particularly of interest to our decommissioning efforts are these buildings over here; the containment building that contains the reactor and the three buildings that surround it. The one immediately below it here is the fuel building. The lower one behind it, which is difficult to see back here, that is the auxiliary building. And the turbine building, which is the large building above it.

The buildings that we were principally concerned with were the containment building, the fuel building and the auxiliary buildings, since they contain by and large almost all of the radioactivity present.

The turbine building is really quite clean.

(Slide.)

These were the approaches we looked at for this particular plant.

We looked at immediate dismantlement; shut the plant down and essentially start taking it apart almost instantly.

We looked at passive safe storage with deferred dismantling occurring at a number of different periods of time, 10, 30, 50, 100 years.

We didn't study custodial safe storage for this plant in detail because it was clear early in the study that the costs of preparation for this particular approach were not very much less than those for the passive safe storage method. Also the continuing care costs for the custodial mode was considerably larger.

It also became clear as a result of some of our early calculations, that permanent entombment was not a particularly viable approach for PWR's, especially if they had operated for 30, 40 years. Also, it really didn't make a great deal of sense to do a temporary entombment if you are going to have to take it apart anyway later to complete the decommissioning.

The permanent entombment business was considered not be be viable for two reasons:

One being the disinclination, if you like, of the public to having a whole series of these monuments containing radioactivity stashed around the country. If we are going to move into perpetual care of this kind of stuff someplace, it is probably better to have a few of them rather than many of them.

But more importantly the permanent entombment, by definition, requires that the radioactivity that you are entombing will decay to inconsequential levels before the building decrepitates, essentially. And, in the case of the PWR we found you really couldn't satisfy that kind of condition, and I'll show you why.

(Slide.)

We did a series of calculations on the times of activation that you will get in the reactor vessel internals. These particular data came from the area in the most radioactive portion of the core, the core shroud immediately surrounding the fuel area.

And here we have the growth rate of these activations as a function of the number of full power years of operation.

You will see some of the fairly short-lived things like iron 55 and cobalt 60 growing fairly rapidly and saturating after 15 or 20 years.

Some of these other things, which have long half lives, grow essentially linearly, like nickel 59, carbon 14, nickel 63 and niobium 94.

Nickel 59 and niobium 94 are giving us the most trouble in terms of entombment. The niobium 94 is the result of an impurity in the stainless steel. It is essentially there and it is very difficult to control. It is there in the order of a few hundred parts per million, no less, and steel companies have a great deal of difficulty removing it.

Carbon 14 results from nitrogen impurities in the steel.

Bob mentioned last night the Elk River reactor as being the only one that had been dismantled so far. To sort of put this in perspective, based on the number of full-power years that Elk River ran, we would be down at this point on the curve, something on the order of a tenth of much of the activities that we have present in the reactor after 30 full-power years.

(Slide.)

This gives you an idea of the kinds of radioactivities we are talking about in the core shroud. The plan for dismantlement is to shut the reactor down without any significant cooling period. The activities are listed in order of increasing half life across the slide. The types of emissions that are given off and the radioactivity in curies, or disintegrations per minute.

And then we calculated the external dose rate. Those are strictly external doses, not assuming any ingestion or inhalation.

Iron 55 has a small contribution of the total dose. It has a lot of radioactivity, but the external dosage produced by it is fairly small.

Cobalt 60 is by and large the key contributor here in short times with a fair amount of activity. And this is 560,000 R per hour, which is a very large amount of radioactivity.

With others like nickel 63 you don't produce any external dose of any significance because of the softness of the radiation emitted.

Molybdenum 93, carbon 14, these are all principally beta emitters, and they don't really give you any significant external dose.

When we get over to the long-lived things like niobium 94, you will see that the surface dose rate from the core shroud is a couple of R per hour. Well, that doesn't sound like very much compared to the 560,000, but when you think about the fact that that is there, has a 20,000 year half life, after 20,000 years it is still turning out 1 R per hour, about 100,000 times natural background.

It is the same way with the nickel 59.

So it is these latter two that essentially limit the entombment mode because I don't know of any man-made structures that you can be sure it will survive the kind of timespan you are talking about and contain the radioactivity.

We essentially took these data and summed them to show you the decay behavior of these radioactivities on the next slide.

(Slide.)

The upper curve is the total radioactivity in curies, and the principal contributor here is the nickel 63. But as I mentioned, it doesn't really contribute to the external dose.

If you look down here at the dose rate, cobalt 60 is the primary contributor for the first 80 years or so. And at that point the niobium takes over and is the dominating radiation from that point on. So you are down to a couple of R per hour at this point for the niobium.

It is still a fairly husky dose rate compared to natural background radiation.

(Slide.)

The sequence of activities that one needs to go through to perform the dismantling activities are shown here.

Obviously, you have to plan the operation. We went through a chemical decontamination for the primary system as one of the early steps.

Then we took out contaminated equipment, piping, et cetera. We mechanically decontaminated the structure. That means we removed concrete surfaces to a depth necessary to get rid of the radioactivity.

All of this radioactive stuff had to be packaged and transported to a disposal site.

Then you had to conduct the final in-depth radiation surveys to assure yourself that you had indeed got them clean.

And then finally we went through the exercise of essentially demolishing the structure down to ground zero or a little below.

As Bob pointed out, this demolition of non-radioactive structures is not required by NRC, and we included it in our analyses just to get a handle on the costs associated with it.

(Slide.)

Let's look at the costs we estimated for doing this job for immediate dismantling. Broken down here in categories:

Staff labor is far and away the biggest item on the list, something about $11 million.

The next biggest item was the disposal of radioactive material. A fairly large volume of material to dispose of here, as I'll show you in a minute.

The demolition job which as I said is not necessarily required, was another fairly large piece, about $8 million.

Perhaps, surprisingly enough we have a fairly large electricity bill. Trojan uses electric-fired boilers to provide their auxiliary steam in the plant so there was a fair amount of electricity used in providing the auxiliary steam in the decontamination or cleanup, and in particular for evaporating the liquids involved, as well as for operating the evaporators and so on.

We included the cost of the shipment of the final core of spent fuel to a repository or reprocessing plant, although this is not necessarily considered a true decommissioning cost.

The various special kinds of equipment and supplies were estimated to be about $3 million.

One has to maintain a nuclear liability insurance while we are doing this operation.

And we assumed we had to bring in certain outside contractors, particularly in the area of waste handling and waste solidification because, first of all the plant facilities are probably not large enough to handle the load. And secondly, as you approach the end of decommissioning, you have also torn out those facilities, and you no longer have them.

Now, all these numbers include a built-in 25 percent contingency on top of the amounts that we originally estimated. The costs of labor and materials are typical of those in the Pacific Northwest the first part of this year.

One thing I should mention, we assumed the staff that was used here in this operation came from the utility with the exception of certain specialists we had to bring in. This meant that a labor force without the highly compartmentalized craft structures that you find on construction sites was utilized.

If we had had to assume the latter kind of a labor force makeup, the labor cost would probably have been at least double.

Let's look at the disposal of radioactive materials.

(Slide.)

This first column is the activated materials.

This column is the packaging, just the packaging costs of containers and so on. Because the stuff is highly activated it requires not only shielded casks for shipment, but that the cask liners be shielded as well. This is a disposable shielded liner and a fairly expensive container which is left behind at the disposal site.

This column is the transportaion costs, the costs of delivering this material from the reactor site to a low level, shallow land burial site some 500 miles away.

And this next little input is the actual charges at the burial site for handling and burying materials.

As an alternate, we did look at the incremental costs of shipping the very worst of this activated material to a geologic disposal site, and that is this piece up here. That amounted to about another $2-1/4 million, if you want to go that route.

The containment -- and this is the rest of the material out of the containment buildings, the contaminated material as opposed to activated.

Again, the packaging, shipping and disposal costs similarly for the fuel and the auxiliary buildings. We have the same items again. Included in here is the activated concrete from the bioshield.

Included over here and some of this, is the contaminated concrete from around the buildings. We assume there is quite a bit of that.

The following, entitled radwaste, is basically combustible waste, ion exchange resins, filter cartridges, and this sort of material that one normally has coming out of a reactor plant but associated with the decommissioning operation.

The whole business added up to something just under 18,000 cubic meters of radioactive material to be disposed of. And the total cost was up in the order of $10-11 million.

(Slide.)

This shows you the time distribution of expenditures during the operation. The first year or so before shutdown now was used for developing the planning and obtaining the equipment, the supplies that we need.

This is the reactor shut down at this point and the shipping out of the fuel over the first two years.

This is radioactive material disposal.

The fuschia color is the demolition of the plant.

Electric power.

This one is the nuclear insurance, and the bottom little strip here is the special contractors for principally waste disposal.

The whole operation covers a span of about six years, or four years after reactor shutdown.

(Slide.)

It is interesting to compare our costs with those for the Elk River reactor because it is the only power reactor that has been dismantled. So I took a look at the costs that they quoted in their final report and compared them with the results of our study on a percentage basis. It is quite a reasonable way to do it, because you are looking at $42 million as opposed to less than $6 million since the reactors are of a greatly different size.

There are some differences. The Elk River staff labor was quite a bit larger, but it has to do with the way the numbers were presented in their report. You couldn't sort out a lot of miscellaneous items that were thrown into labor, such as rail cars and transportation costs. There are a whole raft of things that got thrown into this category that I couldn't sort out.

The material disposal costs are not very different.

Similarly the demolition costs are not way out of line on a percentage basis.

Their power costs are a lot lower. That is understandable because they had already disposed of all the water that would require lots of power to evaporate. I did remove the spent fuel shipment out of our numbers before constructing these percentages.

They had fairly high costs for special equipment because they were developing some of this equipment for the first time. The manipulators and the plasma torch equipment and so on. We were able to take advantage of these developments in our program.

So their equipment costs were fairly significant. And they had a miscellaneous category.

So, I think on the basis of this kind of a comparison, the two studies look reasonably agreeable.

(Slide.)

Let's look now at what you do to put a PWR in safe storage.

Well, it looks similar to some extent as we did for immediate dismantlement.

You obviously have to plan the operation and, of course, you shut down, you chemically decontaminate it. Your mechanical decontamination and fixing of certain areas, deactivate the equipment in the plant, isolate certain areas that you don't want to go in and clean up because the radiation dosages are too high, set up your final systems for surveillance and maintenance, and then go ahead and provide surveillance of the place for as many years as you want to.

(Slide.)

We went through this exercise for a PWR, and arrived at costs of this nature.

As you might expect, the staff labor was the major item again because here we are really not shipping out very much in the way of contaminated materials, just the radwaste materials, filters, ion exchange resins and that sort of thing.

Fuel shipments were the same because we are shipping the same fuel and perhaps this cost should be subtracted since it is really not a decommissioning cost.

The electricity costs were again large, since we still had to evaporate the same amount of water.

Equipment and supplies were considerably lower.

Nuclear insurance was lower.

And contractor services were also lower.

Now this is just for getting the plant ready and putting it into a safe storage condition.

Now this whole operation added up to 12.6 million dollars with a 25 percent contingency, and it takes about a year and a half to two years after reactor shutdown.

We also estimated that to maintain it in that status using essentially remote surveillance techniques, electronic surveillance equipment with an offsite central station would run about $80,000 a year.

(Slide.)

Okay, here we are looking at the cumulative costs, that is, the time distribution and the cumulative costs for these various options.

Here is immediate dismantlement, about $42 million.

If you put it into safe storage, hold it for ten years and then dismantle it, they estimate it will run about $50 million.

If you hold it for 30 years before you dismantle, it will run about $52 million.

Now we decided that by 50 years there was going to be a lot of the contaminated material, the principal contaminant of which is cobalt 60, decayed down to a point where you could release it. Thus the amount of material that would have to be disposed of is certainly smaller out here over the 50 to 100-year increment. That is why the costs come down to about $47 million, and back up to 51 for 100 years.

Now these observations were true in constant 1978 dollars.

It is interesting to look at the same family of curves in a present value analysis.

(Slide.)

Here you see if you look at the present value of these dollars at the time of reactor shutdown, it is about $39 million for immediate dismantlement.

If you wait long enough, it almost goes away, it looks like, to about $15 million.

Now I think a financial analyst would put little confidence in any numbers out beyond 20 years in this kind of analysis, because you really don't know what the financial problems are going to be like. But, as with any present value analysis, the longer you defer the payments, the cheaper it looks.

Let's look at the other parameter that we more or less view in here. That is occupational exposures.

(Slide.)

Along with the manpower estimates on these jobs, we estimated the exposure for the workers doing the job. And to accomplish this, we collected data from a number of operating sites and constructed a composite picture of the radiation fields within the plant and then used these factors along with the assumed decontamination factor for the initial chemical decontamination of the systems to arrive at these area dose rate numbers that we used in our estimate.

We looked at the reactor building, that is, the containment building. The accumulated man-rem exposure for decommissioning or taking apart and disposing of the reactor building is shown here to be almost 500 man-rem.

This was divided up by removal of the reactor vessel and its internals and removal and disposal of steam generators. And this is all the rest of the stuff in the building.

Similarly for the auxiliary building which contains a lot of the equipment for the systems, exposure is something over 200 man-rem.

For the fuel building, it is about 150 man-rem.

And for fuel handling, it is the same in both cases because they obviously are handling the same fuel.

There are some differences in the miscellaneous category.

This is the dose to transport workers. These are the truck drivers hauling the stuff to the burial ground. In this case we made the assumption that each shipment had dose rates that were the maximum allowable under the present regulations, so it is a maximized estimate.

And then at the far right is the dose to the general public. And in this case almost all of that dose to the public results from the transport of this material around through the countryside to the burial grounds.

(Slide.)

Now if we look at these things from the time options we talked about earlier in cost, you will see here is the immediate dismantling plus transportation on top.

If we put it into safe storage and kept it there for ten years and then, this little bit here is the exposure associated with putting it into safe storage right after shutdown. And that is constant across the board.

This portion is the dismantlement, the exposure associated with dismantlement after ten years. And then you get the transportaion.

Now we made the assumption that the dismantlement work was done in essentially the same way at these later points as was done originally using same type of equipment and the same techniques. So they could use the dose estimates we had here and simply scale them down by decay in the principal contaminant which was cobalt 60, thus arriving at these smaller ones.

After about 30 years you don't save very much in terms of exposure by delaying, because the principal part of the dose was experienced during the preparation for safe storage.

(Slide.)

Now here is the comparison of the dollars and man-rems for the different time periods.

Again, immediate dismantlement and then 10, 30 and 50 years.

And it looks likely that if one were to do an extremely detailed analysis for a time basis, you would find some kind of a minimum or optimum point somewhere in this vicinity of about 30 years where your exposure isn't decreasing significantly and -- well, the costs came down in 50 years for the reasons I mentioned earlier becuase there was less contaminating material at this point.

I outlined a little earlier our methodology for arriving at these acceptable levels of radioactivity, and this slide illustrates the results that we got for a PWR using this technique.

We assumed an annual dose limit of 1 millirem per year for this purpose, and went through the calculation looking at the radionuclide spectrum that was anticipated present in the facility. And this includes all of the activation products and fission products and so on that might be present.

We calculated then the surface contamination level in the facility per square meter to be allowed in the facilities at time zero and after 100 years and still meet this 1 millirem per year maximum exposed individual.

Similarly we looked at what levels might be allowed out on the ground on the site surrounding the facility for a couple of conditions.

One, where it was essentially lying there mixed to a depth of one centimeter on the surface. This would be like normal mixing, weathering.

And secondly, if you went out and physically tilled the soil to mix the radioactivity to a depth of 15 centimeters.

Here there are two sets of data because in one case we used the source term from the GESMO studies, and this was a calculated source term for release of radionuclides from operating reactors.

The second case we used measured data from operating PWRs. So we had really two different source terms here. And you can see you get results which are different by almost a factor of two depending on the type of source term you had, the makeup of it, the spectrum of nuclides that were present.

Now we don't particularly advocate a dose limit of 1 millirem per year. We used it here basically as an example, a point of reference.

(Slide.)

These are the basic conclusions of the PWR study.

There wasn't any doubt that you can do the job with existing equipment and technology. It didn't require any major breakthroughs of any kind.

Costs are fairly significant at $42 million but are not really very large compared with the original cost of the plant.

Again the occupational exposures are significant, but if you think about it for a minute we are talking about 1300 man-rem over a four-year period. And an operating reactor during a normal refueling outage will probably have a man-rem exposure of around 300 or so.

The dose to the public was very small. In fact, the dose from the actual operations within a plant was the smallest contributor. The major public dose was primarily from the transport of the material to the burial grounds.

And we ran across a number of things in the detailed analyses that suggested that some modification of the design details of the plant would make it a lot easier to decommission it. But there are certain things that can be done that are not really all that expensive if you think about them in the beginning, and could be of very significant assistance.

Well, that wraps up my presentation of the general nature and studies and details of PWR.

My colleague, Dr. Murphy, will continue now with our presentation on the details of the fuel reprocessing plant.

DR. MURPHY: Good morning.

I told Dick Smith that it is really his fault that we had trouble with our slide projector, and then had trouble with our audio equipment. It is his fault because he brought me along, and wherever Murphy goes, "Murphy's Law" goes.

(Laughter.)

(Slide.)

This slides shows the Barnwell Nuclear Fuel Plant. This was the reference plant for the fuel reprocessing plant decommisisoning study. I will point out to you the areas of the plant that were decommissioned in the study.

We decommissioned the fuel receiving and storage station. This is the place where the spent fuel is brought from the reactor and stored in water basins until the fuel is ready to be reprocessed. The fuel is reprocessed in this building here, the main process building. This is where the fuel elements are sheared. The fuel is dissolved from the cladding and the plutonium and uranium are chemically separated from the fission products, activation products and the transuranic elements.

Because the fuel is dissolved, the radioactive waste that results from this process is in a liquid form. This radioactive waste is then stored in underground tanks that are located in this area. These underground tanks were decommissioned as well as this building here that serves as the control building for the underground storage operation.

Now the Barnwell plant does not have a solidification facility for solidifying the liquid waste that's stored in these underground plants. We wanted to extend the applicability of our study, and so we included in the study a conceptual solidification plant for the high level liquid waste.

We assumed that the solidification plant would be located right here, and the solidification process was patterned after the process that has been developed at Battelle Northwest to convert this high level liquid waste to a glassified product.

In addition to these facilities, auxiliary facilities were decommissioned. This building that contains the ventilation equipment was decommissioned. And this 100-meter stack was decommissioned.

(Slide.)

The decommissioning modes that were studied for the fuel reprocessing plant included immediate dismantlement, passive safe storage with deferred dismantlement, and custodian safe storage with deferred dismantlement.

Now we assumed, and Dick Smith did with the reactor study, that the people who would do the dismantling of the safe storage operations were people who were familiar with the plant, they were plant operators. We assumed that the operation of decommisisoning was carried out in a fairly efficient manner, and by this I mean that we recognized that because of the high radiation areas in the building that in an eight hour day a man might only get in six hours of work because he has to wear protective clothing and needs to have some time to put the clothing on and take it off, and this sort of thing.

And so we considered that six hours of work in an eight hour work day was probably an efficient use of a man's time.

We also assumed that you didn't have any unforeseen one week or one month shutdowns for one reason or another.

Immediate dismantlement was assumed to require about two years for planning and preparation which took place while the plant was still in operation. And then a little bit more than five years for the actual dismantlement operations was needed.

For safe storage, we assumed that preparations for safe storage required about a year and a half -- the planning and preparation for safe storage took about a year and a half, and then the actual operations took about two and a half years. It takes a little bit longer for passive safe storage, a few months longer for passive safe storage than it does for custodial safe storage because for passive safe storage you have to put the facility in a condition such that you can maintain it remotely. You shut down the ventilation systems, you build some barriers that are not built in custodial safe storage in which case the surveillance is going to take place on site rather than remotely.

Deferred dismantlement again would take about two years for planning and preparation and about four years for the actual deferred dismantlement. Now the reason that deferred dismantlement takes less time than immediate dismantlement is that in the initial safe storage preparations you do the chemical decontamination the same as you do in immediate dismantlement, and you don't have to repeat it for the deferred dismantlement because it's already done as part of the initial safe storage operations.

(Slide.)

This slide shows the breakdown of the cost for immediate dismantlement. The total cost for immediate dismantlement was calculated to be about 67 million dollars. You can see that the big cost items are labor and waste management.

I should point out that these costs include a 25 percent contingency factor. Labor costs include both the actual decommissioning worker costs, and the costs of the support staff.

We assumed that the fuel reprocessing plant is the only plant on the site, and so the support staff costs have to be borne as part of the decommissioning operation.

The labor cost that's shown here includes all of the labor except for that associated with the actual transportation of the radioactive waste off site. And by this I mean the labor cost for the truck driver or the railroad worker if the waste is transported by rail.

The labor cost for packaging the waste is included in these labor costs up here.

The bars here indicate that this portion of the labor cost is associated with the dismantlement of the main process building.

This portion of the labor cost is associated with the dismantlement of the liquid waste storage area, and then all of the other labor costs, that is the labor cost associated with dismantling the waste solidification plant.

The fuel receiving storage basin and the auxiliary areas are included in the last section.

You can see that waste management costs are very high and we will talk a little bit about that in the next slide. So I will pass over that for the time being.

Again, these are waste management costs associated with dismantling the main process building. These are the waste management costs associated with dismantling the liquid waste storage area, and these are waste management costs associated with the remainder of the facility.

Before leaving this slide, I should point out that with regard to subcontractor costs, the slide indicates that these costs were about 4.6 million dollars. About 4 million dollars of this cost is associated with demolition of the facility after the radioactivity has been removed and with site restoration. And as Dick Smith has already pointed out, these are optional activities not required by NRC and so one might subtract this 4 million from the total 67 million that I indicated was the total cost of immediate dismantling for this plant.

(Slide.)

Waste generated during dismantlement of the fuel reprocessing plant includes solidified liquids form chemical decontamination activities, contaminated process vessels, equipment and piping, stainless steel liners for floor and walls of high contamination areas, concrete rubble, stainless steel sections of the high level liquid waste storage tanks, filters, glove boxes, section of ventilation duct work and combustible and noncombustible trash.

Now some of the waste contained long lived activity. Some of the waste contained transuranic activity and these wastes were assumed to go to deep geologic disposal.

The other wastes in the plant were assumed to go to shallow land burial. You can see from the slide that about 60 percent of the total waste generated in the decommissioning activities was assumed to be of such a nature to be contaminated with transuranics so that it was necessary to dispose of it by deep geological disposal. The other 40 percent was sent to shallow land burial.

Now a deep geological disposal site has not been operated and so there is a great deal of uncertainty in the actual cost of disposing of waste by deep geologic disposal. And what we did, you can see that the cost of deep geologic disposal is very high here. It's almost 30 million dollars.

What we had to do is to look at some other studies that had been done in which the assumption had been made that waste was sent to deep geologic disposal. And these other studies had assumed some cost for deep geologic disposal.

We looked at these other studies and found that there was quite a range in the cost that were assumed for deep geologic disposal and we took the average of these. I think there were three studies that we looked at

And so I simply want to point out that there is a great deal of uncertainty in the cost of deep geologic disposal. They certainly will be higher than the cost of shallow land burial, and significant fraction of the waste from the fuel reprocessing plant has to go to deep geologic disposal.

(Slide.)

This slide shows accumulative radiation exposure for decommissioning workers and for transport workers and for the general public from dismantlement of the fuel reprocessing plant.

The first bar shows the accumulative radiation exposure for workers to decommission the main process building, and then the exposure to workers for decommissioning the liquid waste storage area, and so on.

We have here the radiation exposure to transport workers and finally the radiation exposure to the general public. The radiation exposure to the general public is very small. About half of this results from aerosol releases during decommissioning of the plant, and the remainder results from transportation of the wastes.

In determining the radiation exposure due to transporation, we assumed that the packages of waste that were transported would have the maximum surface dose rates allowed in the Code of Federal Regulations and then we simply used the number of packages that we calculated and the total distance.

The wastes that went to shallow land burial, we assumed, were transported by truck for a distance of 500 miles. That's 800 kilometers.

Wastes that were transported to deep geologic disposal were transported by rail a distance of 1500 miles, 2400 kilometers.

To determine the radiation exposure to decommissioning workers we estimated the radiation levels in various parts of the plant and simply multiplied them by the number of man years required to decommission these various areas.

For the decommissioning workers the total of 142 man years of effort was required. The total man-rems for decommissioning workers comes out to be 512 and as I said, this was 142 man years required. The average man-rem per quarter then is 0.9 man-rem per quarter. And we feel then that it is possible to keep the average exposure rate to the decommissioning worker within allowable limits.

(Slide.)

This slide compares the costs of immediate dismantlement with the costs of deferred dismantlement after passive safe storage and after custodial safe storage. We assumed that deferred dismantlement would take place 10 or 30 or 100 years after passive safe storage or 10 or 30 or 100 years after custodial safe storage.

And these are then the total costs compared with the 67 million dollars required for immediate dismantlement.

Now the red bar here represents the preparations that have to be done to place the facility in safe storage.

The yellow bar represents the cost of interim care for 10 or 30 or 100 years.

The green bar represents the cost for deferred dismantlement at the end of the interim care period. In the costs of passive safe storage -- the cost of preparations is a little bit higher for passive safe storage than it is for custodial safe storage because you have to put the facility in a condition so that you can perform remote surveillance. You shut down the ventilation system, you build some barriers and so the costs of initial decommissioning for passive safe storage are about 2 million dollars higher than the cost of initial decommissioning for custodial safe storage.

Similarly the costs of deferred dismantlement for passive safe storage are a little bit higher than they are for custodial safe storage because you have to tear down the barriers that you initially erected, and you have to restore the ventilation system because you have got workers coming in to dismantle the plant and obviously you are going to have to have a ventilation system in operation while you have got workers in the plant, and so the cost of final dismantlement for passive safe storage is about a million dollars higher for passive safe storage than it is for custodial safe storage.

On the other hand, the interim care costs are much higher for the custodial safe storage because you are doing on site surveillance and maintenance whereas with passive safe storage you are doing remote surveillance and maintenance.

So all in all after about 10 years, the total cost, the total decommissioning cost for custodial safe storage, with deferred dismantlement, rapidly exceeds the total cost for passive safe storage with deferred dismantling.

(Slide.)

This slide shows the accumulative radiation exposure to decommissioning workers and to transportation workers and to the general public for immediate dismantlement, and for deferred dismantlement after passive safe storage, and after custodial safe storage.

And again we have assumed that deferred dismantlement takes place after 10 or 30 or 100 years. And you can see that the exposure decreases if you defer dismantlement. Note that the exposure during interim care is higher for custodial safe storage than it is for passive safe storage.

This is because custodial safe storage implies that interim care is an on-site activity whereas passive safe storage implies that interim care is a remote activity.

(Slide.)

This slide compares the cost and the radiation exposure for immediate dismantlement and for deferred dismantlement.

The yellow bars represent the cost and the green bars represent the radiation exposures, and these are now total radiation exposures to decommissioning workers, transportation workers, and the general public. And if one, then, were to have to make a choice as to whether to decommission a plant, dismantle a plant immediately or to defer dismantlement, one would of course look at something like this and say, well, what happens to the cost if we defer dismantlement, what happens to the radiation exposure if we defer dismantlement, and of course, there are other factors that one would also have to consider. And these are social and political factors, and maybe other economic factors.

And so the choice of whether to dismantle a plant immediately or to defer dismantlement would have to be made on a site specific basis. But two of the factors that you would consider would be how the costs change as you defer dismantlement, and also how the total radiation exposure changes if you defer dismantlement. And of course, the costs go up, the total radiation exposures go down.

(Slide.)

Dick indicated that we developed a methodology for determining the allowable residual contamination level in the plant based on a dose of 1 millirem per year to the maximum exposed individual.

Notice that with time after plant shutdown, the residual contamination level changes. The reason that it changes is that the mix of radionuclides have different half lives.

(Slide.)

Finally, this slide summarizes the conclusions from our fuel reprocessing plant study.

Decommissioning is feasible with existing technology. We were able to postulate existing techniques or at least techniques that were in the advanced stage of development for decommissioning the plant.

Decommissioning costs are 67 million dollars for immediate dismantlement. Waste management costs are high. They are high because a lot of the waste has to be sent to deep geologic disposal.

Probably the most difficult activity was the dismantlement of the high level liquid waste storage tanks. These underground tanks are where the waste from the fuel reprocessing is stored.

We assumed that quite a lot of concrete had to be chipped away from the walls of the building. It would be desirable to do some things to minimize concrete contamination by increasing the number of stainless steel liners that are used, or painting the concrete walls with some sort of a strippable coating.

Remote maintenance, and by this I mean if the plant is designed for remote maintenance, then you can use the existing facilities for remote maintenance to help you decommission the plant. This reduces the cost and occupational exposures of decommissioning the plant.

A liquid waste capability is an advantageous thing to have in decommissioning the plant. Compartmentation of process areas is advantageous. It reduces occupational exposures while you are decommissioning the plant.

You noted that there was a modest occupational exposure that resulted from deferred dismantlement and this may be an incentive to defer dismantlement for 10 or 30 or 100 years.

That concludes my presentation on decommissioning of a fuel reprocessing plant.

DISCUSSION MATERIAL ON STUDIES OF DECOMMISSIONING A FUEL REPROCESSING PLANT AND A PRESSURIZED WATER REACTOR

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Contents

Safety and cost information was developed for the conceptual decommissioning of a large [1175 MW(e)] pressurized water reactor (PWR) and a large nuclear fuel reprocessing plant (FRP). Two approaches to decommissioning, Immediate Dismantlement and Safe Storage with Deferred Dismantlement, were studied to obtain comparisons between costs, occupational radiation doses, potential radiation dose to the public, and other safety impacts.

For the PWR, Immediate Dismantlement was estimated to require about six years to complete, including two years of planning and preparation prior to final reactor shutdown, at a cost of $42 million, and an accumulated occupational radiation dose of about 1325 man-rem. Preparations for Safe Storage were estimated to require about three years to complete, including 1-1/2 years for planning and preparation prior to final reactor shutdown, at a cost of $13 million and an accumulated occupational radiation dose of about 430 man-rem. The annual cost during the Safe Storage period was estimated to be about $80 thousand. Deferred dismantlement following a 30-year period of Safe Storage was estimated to require about $37 million and an occupational radiation dose about 24 man-rem.

For the FRP, Immediate Dismantlement was estimated to require about seven years to complete, including two years of planning and preparation prior to final plant shutdown, at a cost of $67 million, and an accumulated occupational radiation dose of about 532 man-rem. Preparations for Safe Storage were estimated to require about four years, including about 1-1/2 years for planning and preparation prior to final plant shutdown, at a cost of $20 to $22 million and an accumulated occupational radiation dose of 72 to 84 man-rem for the custodial and passive modes, respectively. The annual cost during the Safe Storage period was estimated to be about $880 K for the custodial mode and about $182 K for the passive mode. Deferred dismantlement following a 30-year period of Safe Storage was estimated to require about $50 million and an accumulated occupational radiation dose of about 226 man-rem.

SAFETY AND COSTS OF DECOMMISSIONING NUCLEAR FUEL CYCLE FACILITIES

195 STUDIES CONDUCTED FOR THE
OFFICE OF STANDARDS DEVELOPMENT,
U.S. NUCLEAR REGULATORY COMMISSION
BY BATTELLE, PACIFIC NORTHWEST
LABORATORIES

GENERAL STUDY INFORMATION

DECOMMISSIONING

PREPARATION OF A FACILITY FOR RETIREMENT FROM ACTIVE SERVICE AND PLACEMENT OF THE FACILITY IN SUCH A CONDITION THAT FUTURE RISK FROM THE FACILITY TO PUBLIC SAFETY IS WITHIN ACCEPTABLE BOUNDS.

DECOMMISSIONING STUDY OBJECTIVES

ASCERTAIN ADEQUACY OF AVAILABLE TECHNOLOGY,
ESTIMATE CUMULATIVE RADIATION DOSE,
ESTIMATE MANPOWER AND COSTS,
FOR DECOMMISSIONING NUCLEAR FACILITIES
VIA ALTERNATIVE MODES.

BASIC WORK ELEMENTS IN DECOMMISSIONING STUDIES

- REGULATIONS REVIEW
- DECOMMISSIONING EXPERIENCE
- FACILITY CHARACTERIZATION
- WORK PLANS, METHODS, SCHEDULE
- COSTS
- SAFETY
- ALLOWABLE RESIDUAL RADIOACTIVITY
- FINANCING ALTERNATIVES

GENERAL KEY BASES FOR DECOMMISSIONING STUDIES

- EVALUATE SPECIFIC REAL FACILITY AS REFERENCE
- CONTAMINATION LEVELS ARE ESTIMATED ASSUMING GOOD HOUSEKEEPING
- GENERIC SITE
- SPECTRUM OF VIABLE DECOMMISSIONING MODES
- PLANS PROVIDE BALANCE OF SAFETY AND COSTS
- ALARA PRINCIPLES FOR OCCUPATIONAL EXPOSURE
- CURRENT DECOMMISSIONING TECHNOLOGY
- EFFICIENT DECOMMISSIONING PERFORMANCE
- REFERENCE FACILITY IS ALONE ON THE SITE
- TRU AND HIGH ACTIVITY WASTES TO GEOLOGIC DISPOSAL; OTHER RADIOACTIVE WASTES GO TO SHALLOW LAND BURIAL

DECOMMISSIONING MODES

DISMANTLEMENT
- COMPLETE DECONTAMINATION AND REMOVAL OF RADIOACTIVITY
- NO SURVEILLANCE

SAFE STORAGE

HARDENED (ENTOMBMENT)
- MAJOR DECONTAMINATION AND REMOVAL OF RADIOACTIVITY
- HARDENED ENTOMBMENT OF RESIDUALS
- INFREQUENT SURVEILLANCE

PASSIVE (PROTECTIVE STORAGE)
- PARTIAL DECONTAMINATION AND REMOVAL OF RADIOACTIVITY
- SEALING OF RESIDUALS
- REMOTE CONTINUAL SURVEILLANCE

CUSTODIAL (LAYAWAY) (MOTHBALL)
- PARTIAL DECONTAMINATION AND REMOVAL OF RADIOACTIVITY
- CONFINEMENT OF RESIDUALS
- CONTINUOUS SURVEILLANCE

DISPOSITION CRITERIA
DECOMMISSIONING NUCLEAR FACILITIES

OBJECTIVE: DERIVE ACCEPTABLE RESIDUAL RADIOACTIVE CONTAMINATION LEVELS FOR UNRESTRICTED USE OF DECOMMISSIONED NUCLEAR FACILITIES.

- BASED ON RECOMMENDED DOSE (RATE) LIMITS FOR MEMBERS OF THE PUBLIC
- CONSIDER ALL POTENTIAL EXPOSURE PATHWAYS
- METHOD GENERALLY APPLICABLE TO ALL NUCLEAR FACILITIES
- CONSISTENT WITH EXISTING CRITERIA FOR DECOMMISSIONING

GENERAL METHODOLOGY FOR CALCULATING ALLOWABLE CONTAMINATION LEVELS

- DEVELOP RADIONUCLIDE RELEASE SCENARIOS
- COMPUTE ANNUAL DOSES FOR RADIONUCLIDE RELEASES FROM THE REFERENCE RADIONUCLIDE INVENTORY
- COMPUTE RATIO OF CALCULATED ANNUAL DOSES TO ANNUAL DOSE LIMIT
- COMPUTE ALLOWABLE RELEASES OF REFERENCE INVENTORY THAT RESULT IN THE ANNUAL DOSE LIMIT
- COMPUTE THE MAXIMUM CONTAMINATION LEVELS THAT RESULT IN THE ALLOWABLE RADIONUCLIDE RELEASES
    - USE MOST RESTRICTIVE PATHWAYS AND ORGAN DOSES

BASIC ALTERNATIVES FOR FINANCING DECOMMISSIONING

- PAY WHEN INCURRED
- PREPAID SINKING FUND
- ANNUAL PAYMENT SINKING FUND

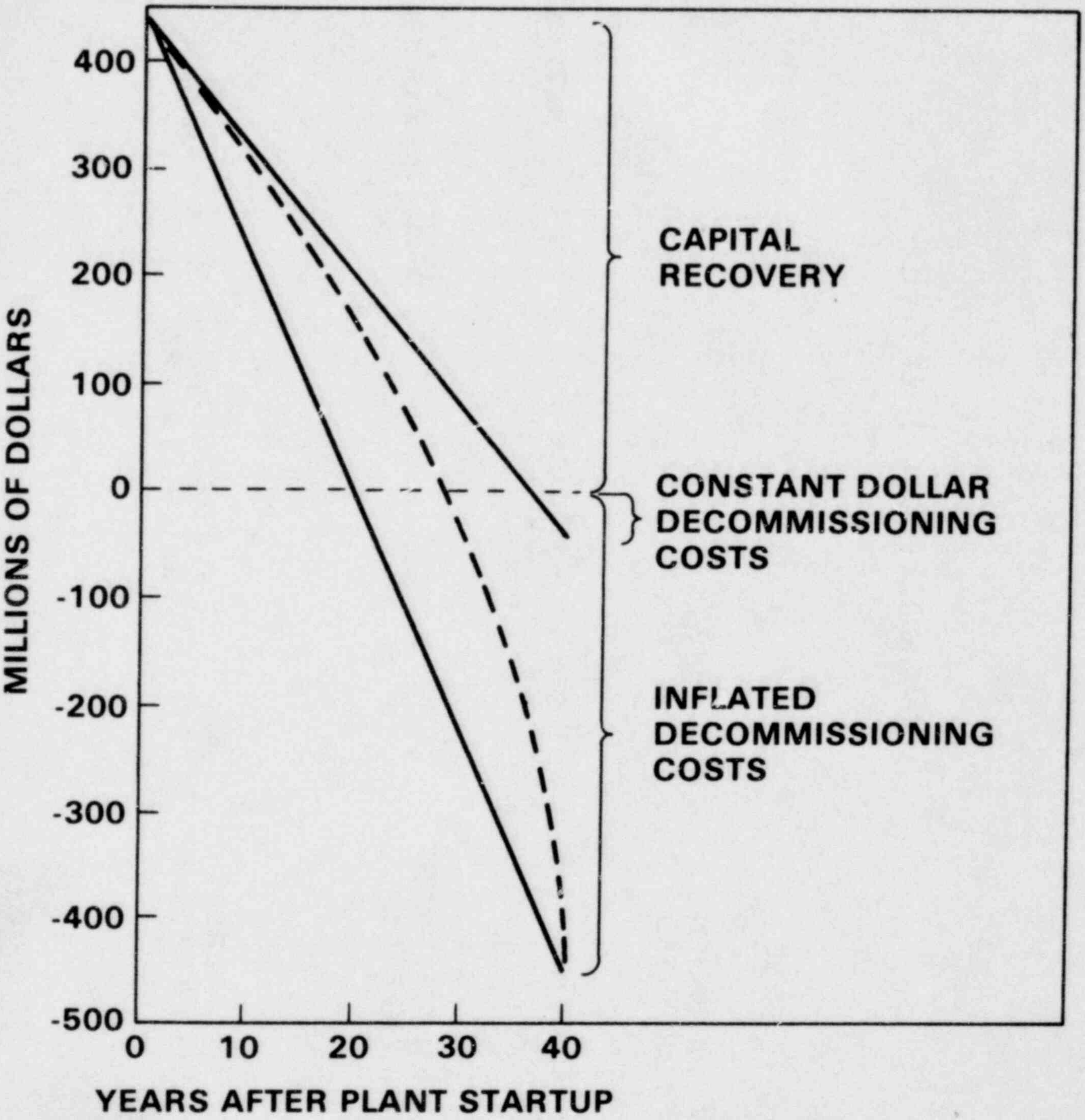
FINANCIAL ALTERNATIVES

CASE	FORMULA	PRESENT VALUE COST
PAY WHEN INCURRED	$P_{I} = \frac{S(1 + j)^{n}}{(1 + k)^{n}}$	$10 MILLION
PREPAID SINKING FUND	$P_{II} = S\left\{1 + (j-i)\sum_{a=1}^{n} \frac{(1 + j)^{a-1}}{(1 + k)^{a}}\right\}$	$27 MILLION
ANNUAL PAYMENT SINKING FUND	$P_{III} = \left[\frac{S(1 + j)^{n}}{\sum_{b=1}^{n} (1 + j)^{b-1} (1 + i)^{n-b}}\right]\sum_{a=1}^{n} \frac{(1 + j)^{a-1}}{(1 + k)^{a}}$	$15.3 MILLION

i = INTEREST RATE = 8%
j = INFLATION RATE = 6%
k = DISCOUNT RATE = 10%

FUNDS ACCUMULATED AFTER 40 YEARS = $452 MILLION

DEPRECIATION WITH NEGATIVE SALVAGE VALUE



DECOMMISSIONING A FUEL REPROCESSING PLANT

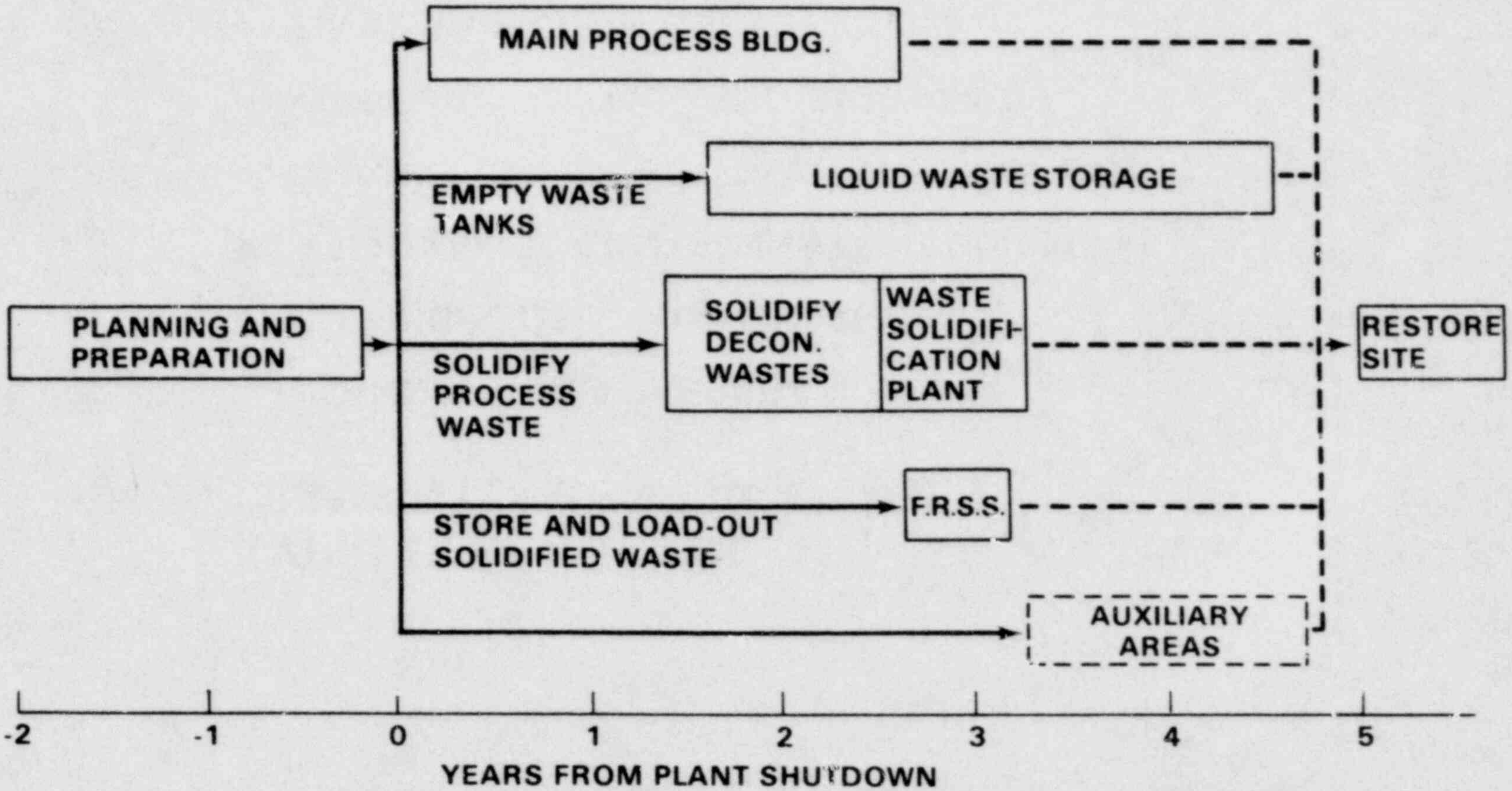
DECOMMISSIONING MODES

- IMMEDIATE DISMANTLEMENT
- PASSIVE SAFE STORAGE WITH DEFERRED DISMANTLEMENT
- CUSTODIAL SAFE STORAGE WITH DEFERRED DISMANTLEMENT

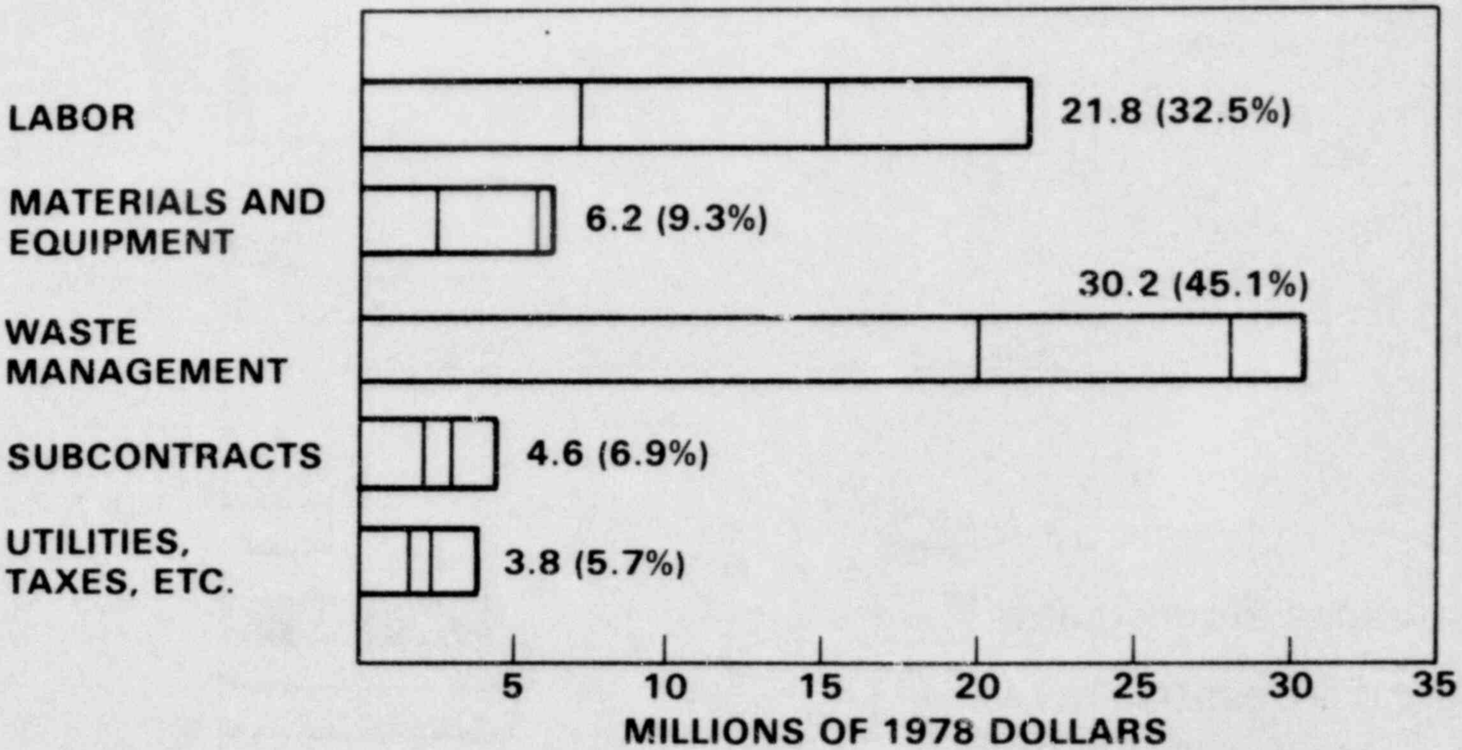
TYPICAL SEQUENCE OF DISMANTLEMENT ACTIVITIES

- PLANNING AND PREPARATION
- CHEMICAL DECONTAMINATION
- REMOVAL OF CONTAMINATED EQUIPMENT
- MECHANICAL DECONTAMINATION OF STRUCTURES
- WASTE PACKAGING AND SHIPMENT
- FINAL RADIATION SURVEY
- STRUCTURE DEMOLITION AND SITE RESTORATION (OPTIONAL)

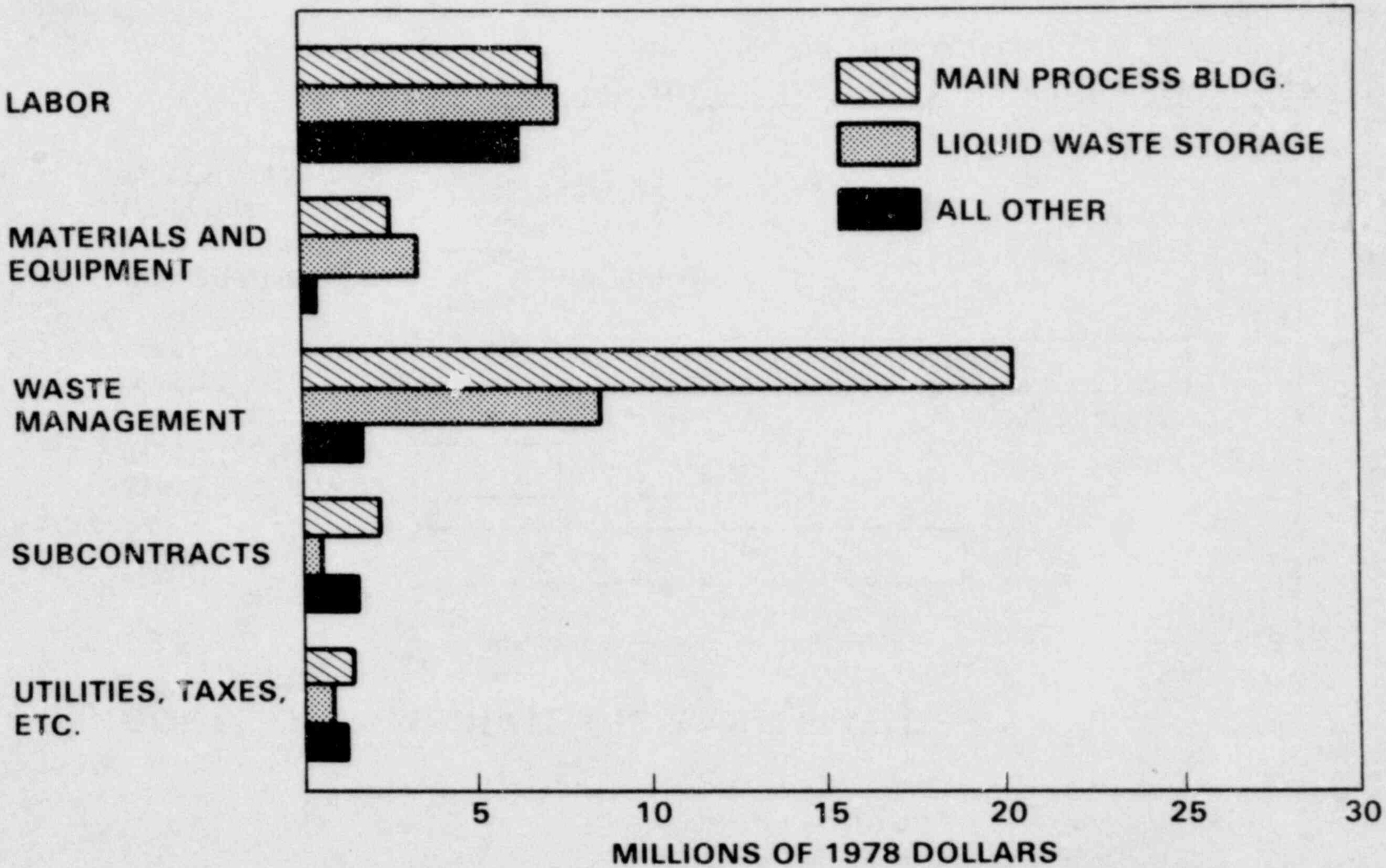
SEQUENCE OF MAJOR DISMANTLEMENT ACTIVITIES



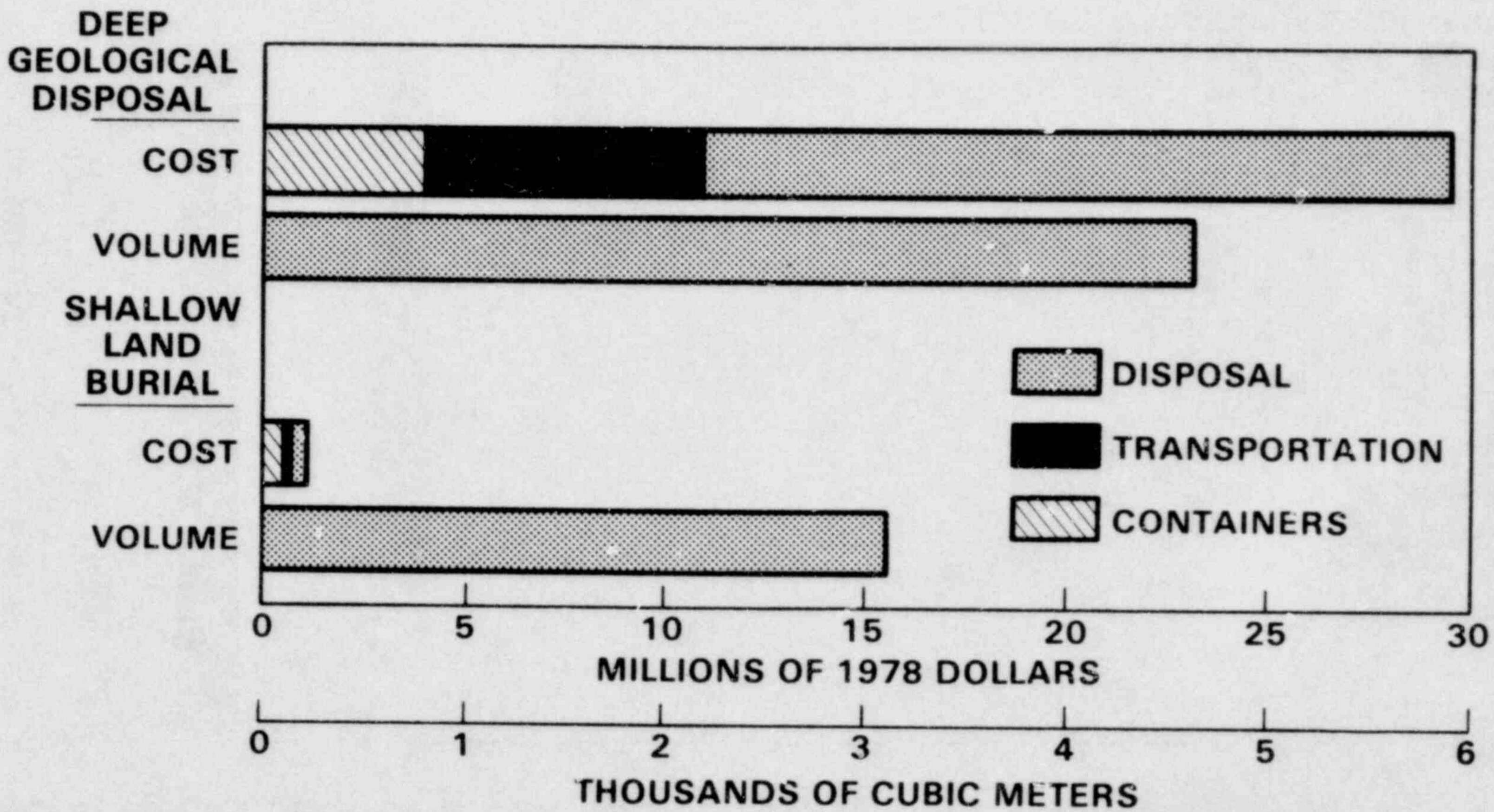
COSTS OF IMMEDIATE DISMANTLEMENT



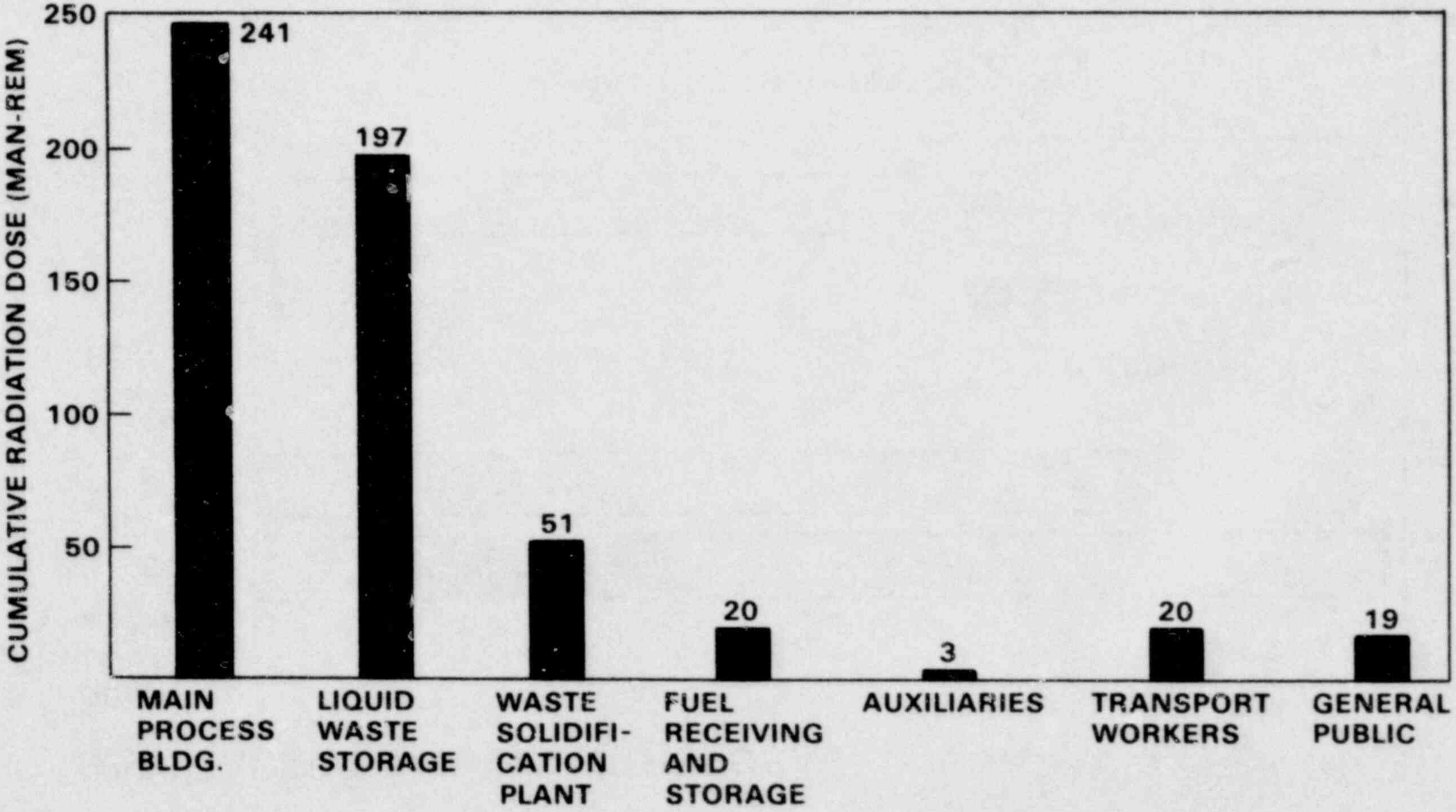
COSTS OF IMMEDIATE DISMANTLEMENT



RADIOACTIVE MATERIAL DISPOSAL



RADIATION DOSES FROM DISMANTLEMENT OF REFERENCE FUEL REPROCESSING PLANT



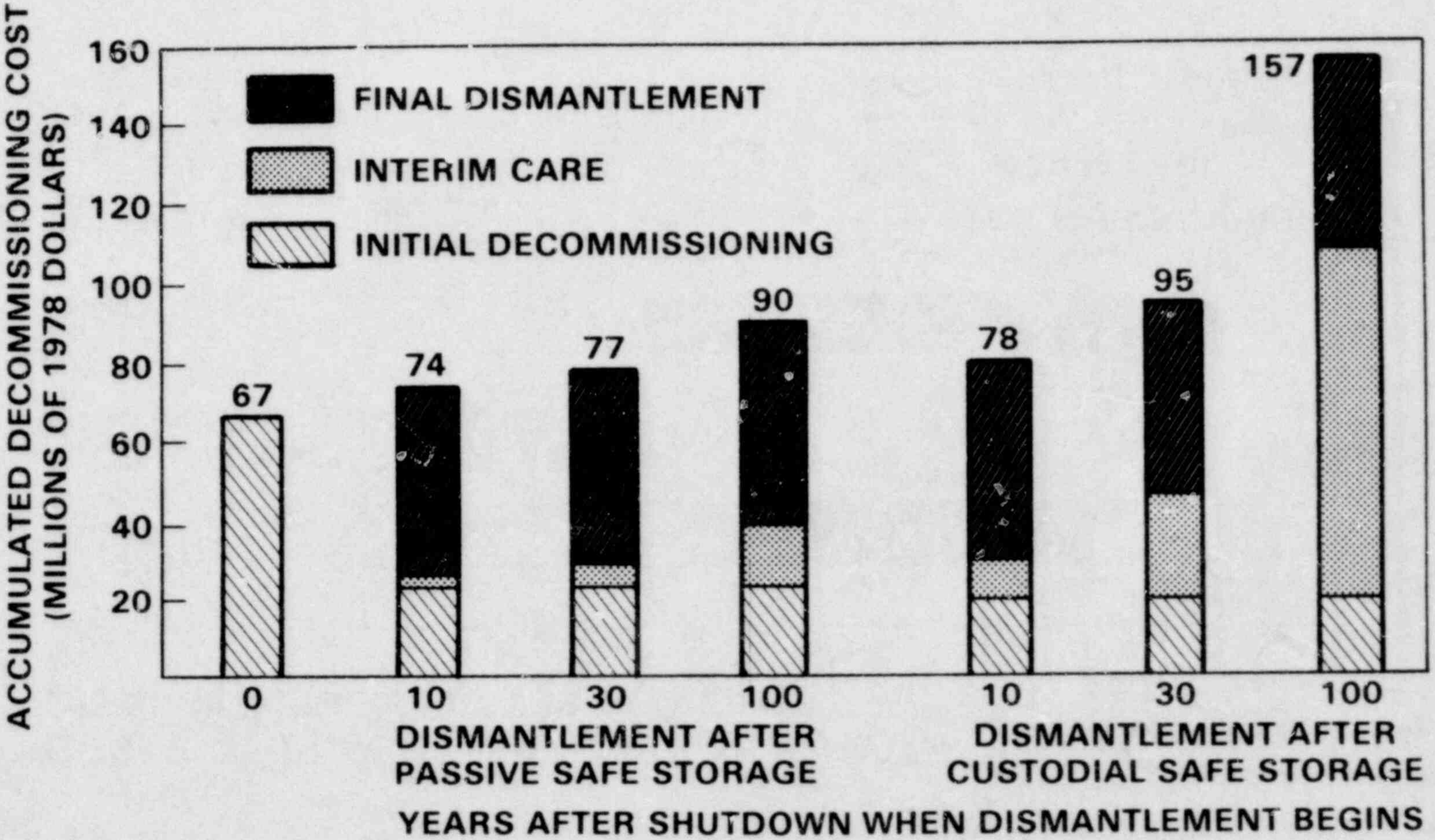
OCCUPATIONAL RADIATION DOSES FROM DISMANTLEMENT OF REFERENCE FUEL REPROCESSING PLANT

FACILITY AREA	MAN YEARS	MAN-REM	AVERAGE MAN-REM/QUARTER
MAIN PROCESS BUILDING	51.4	241	1.17
LIQUID WASTE STORAGE	51.8	197	0.95
WASTE SOLIDIFICATION PLANT	27.1	51.2	0.47
FUEL RECEIVING AND STORAGE	9.3	19.8	0.53
AUXILIARIES	2.7	3.3	0.30
TOTALS	142	512	0.90

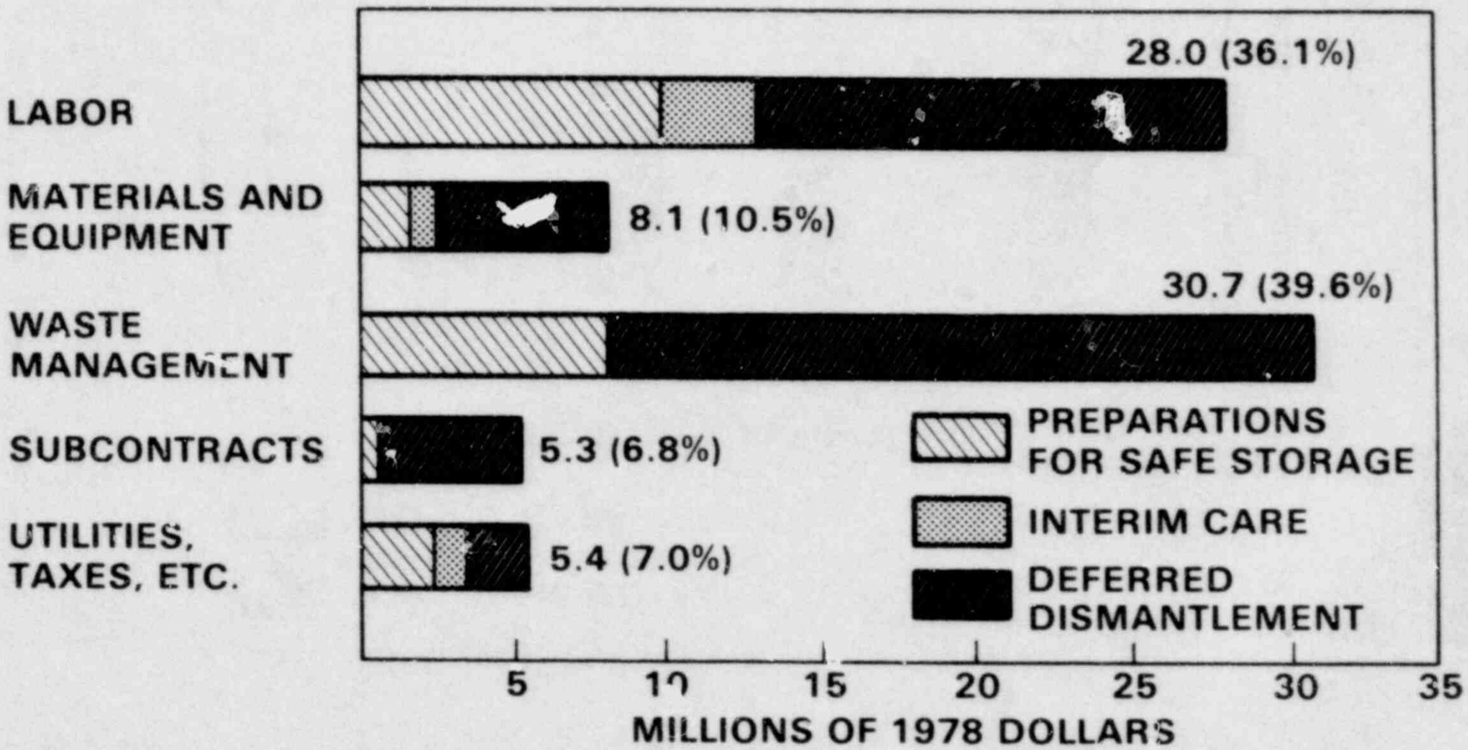
TYPICAL SEQUENCE OF SAFE STORAGE ACTIVITIES

- PLANNING AND PREPARATION
- CHEMICAL DECONTAMINATION
- MECHANICAL DECONTAMINATION AND FIXING OF RESIDUAL CONTAMINATION
- EQUIPMENT DEACTIVATION
- ISOLATION OF CONTAMINATED AREAS
- FINAL PREPARATIONS FOR SURVEILLANCE AND MAINTENANCE
- INTERIM CARE

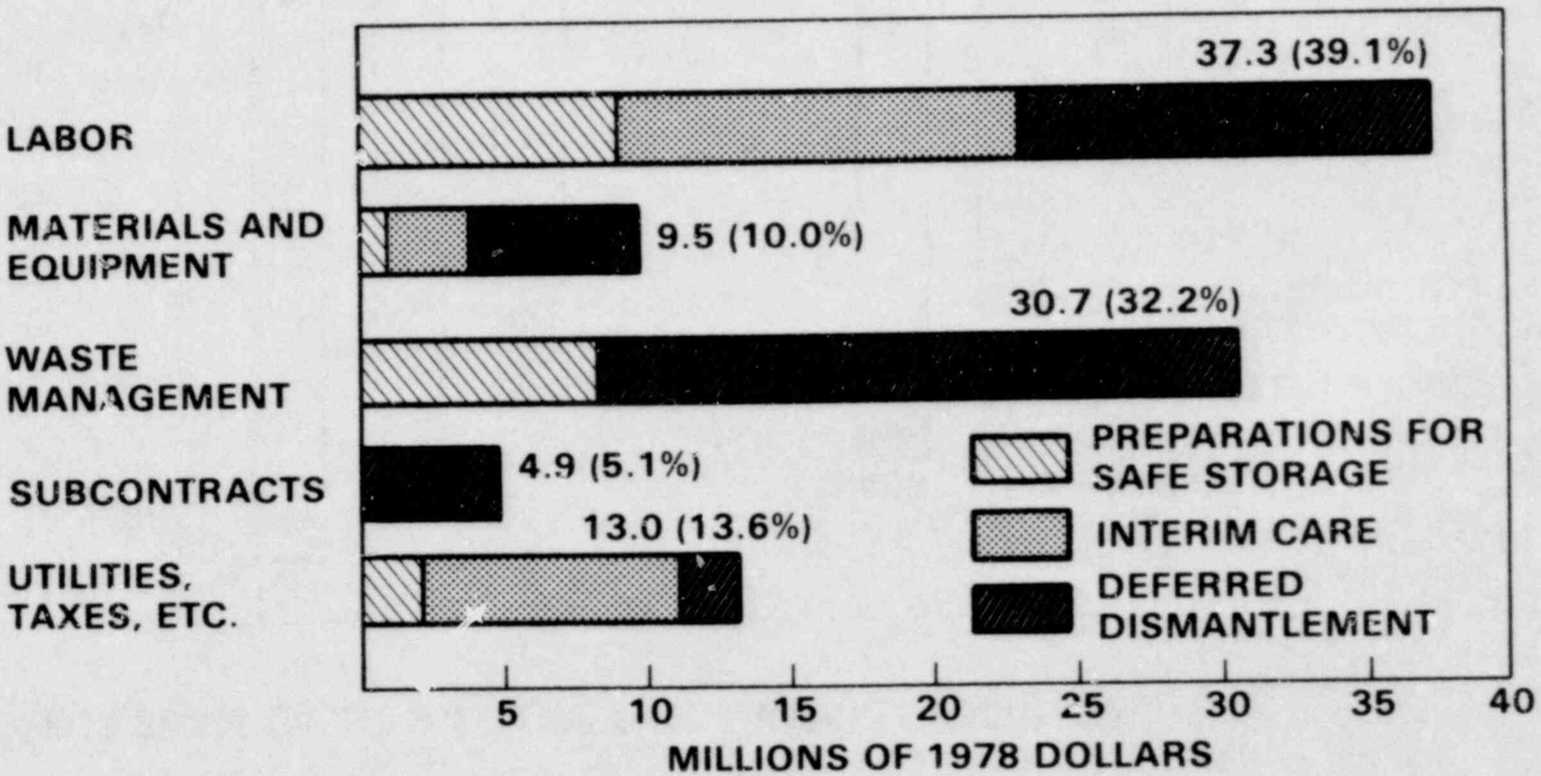
SUMMARY OF DECOMMISSIONING COSTS



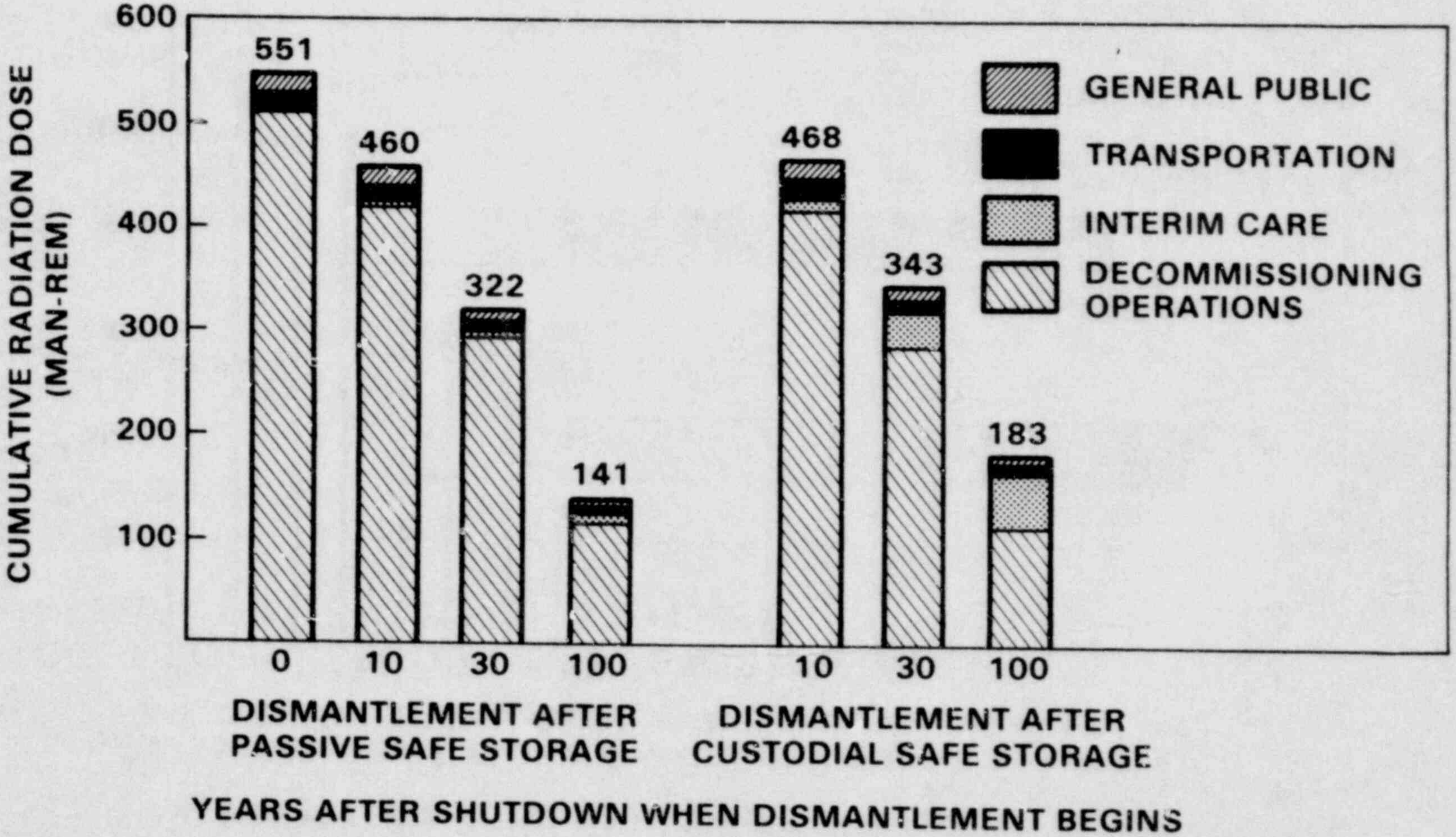
COSTS OF PASSIVE SAFE STORAGE WITH DISMANTLEMENT AFTER 30 YEARS



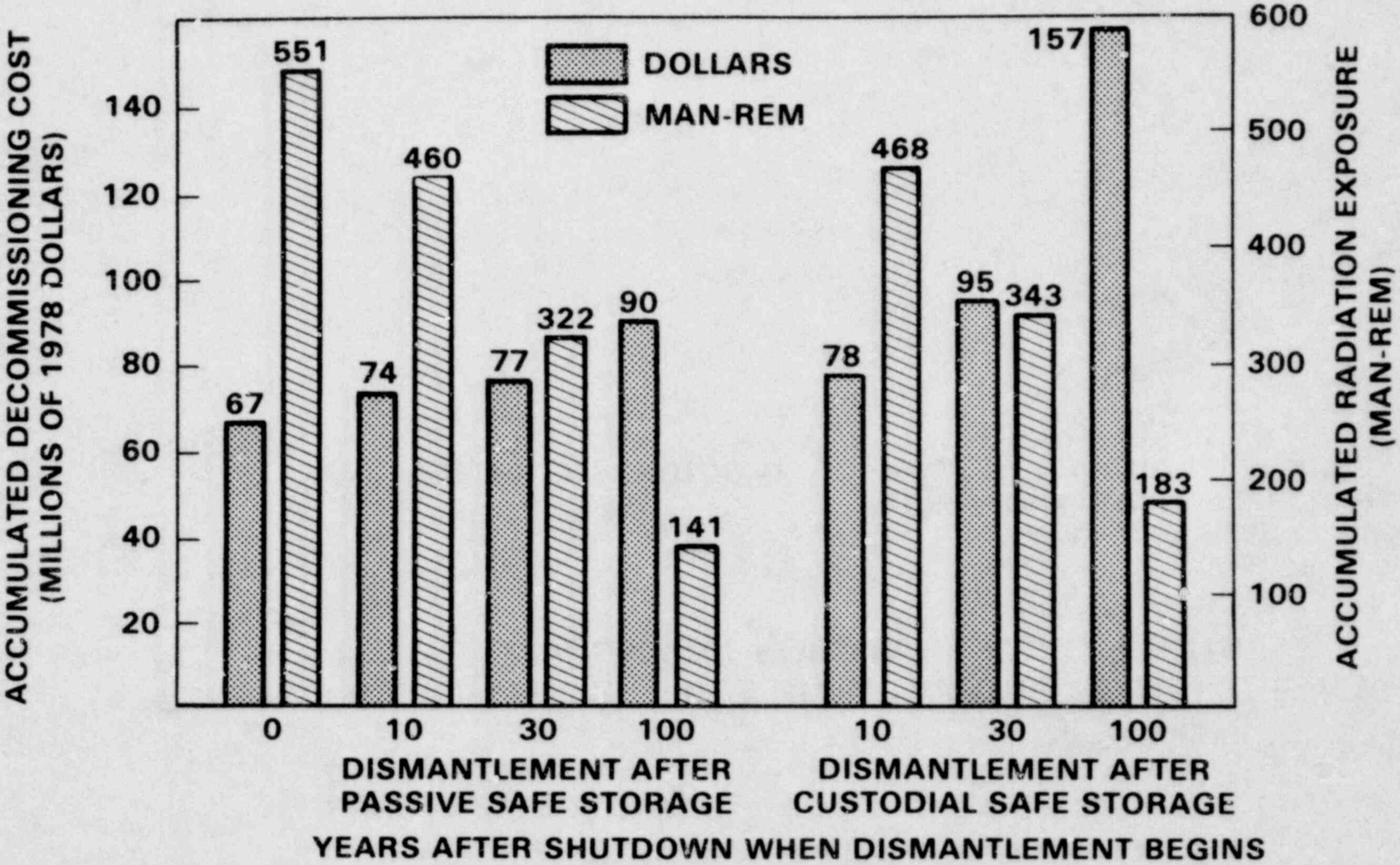
COSTS OF CUSTODIAL SAFE STORAGE WITH DISMANTLEMENT AFTER 30 YEARS



RADIATION DOSES FROM DECOMMISSIONING



COST AND EXPOSURE COMPARISONS FOR DECOMMISSIONING A FUEL REPROCESSING PLANT



EXAMPLES OF DISPOSITION CRITERIA FOR THE REFERENCE FUEL REPROCESSING PLANT FOR UNRESTRICTED USE

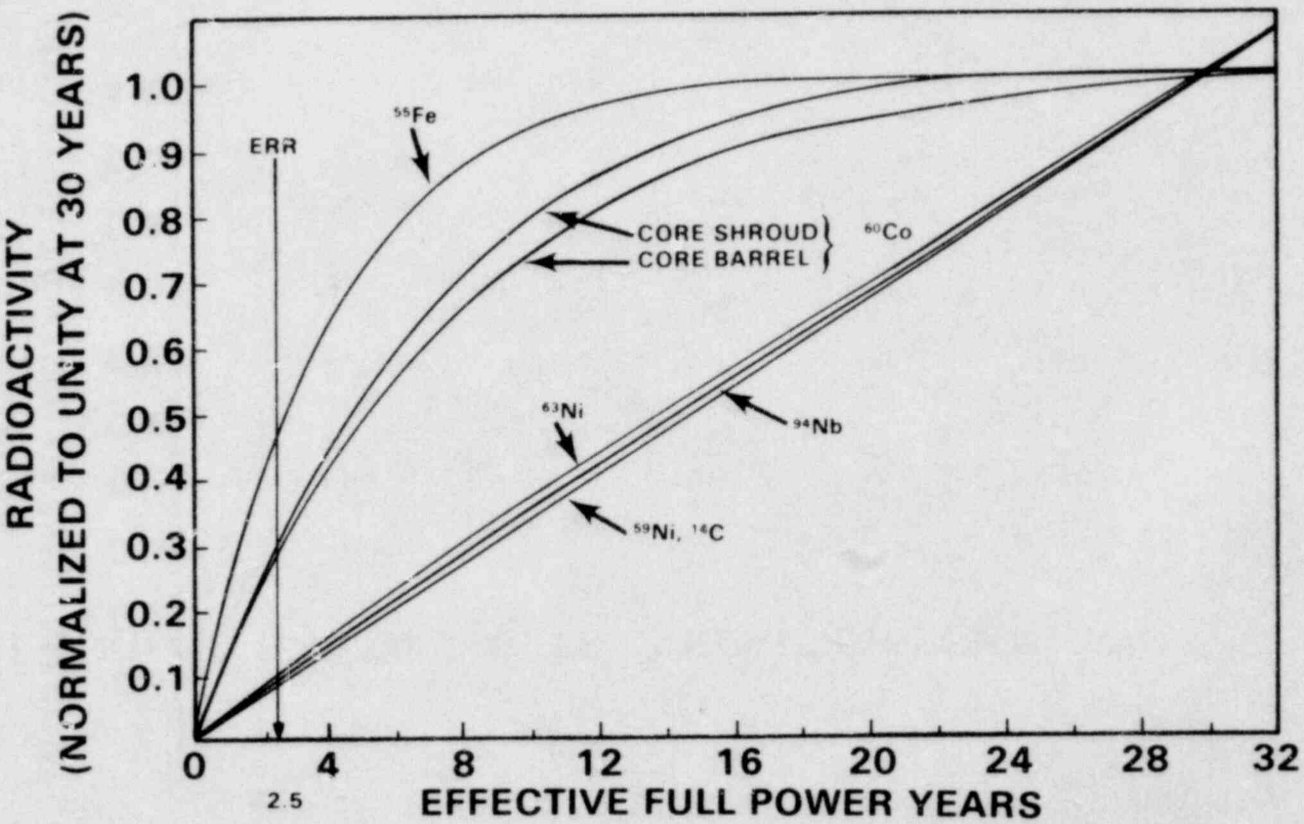
LOCATION	TIME AFTER PLANT SHUTDOWN YEARS	ALLOWABLE RESIDUAL CONTAMINATION LEVEL, uCi/m^2, BASED ON MAXIMUM ANNUAL DOSE OF 1 mrem/yr
FACILITY	0	1.4E-2
	10	1.5E-2
	30	1.7E-2
	100	2.0E-2
SITE	0	8.2E-3
	10	5.6E-3
	30	4.3E-3
	100	3.2E-3

CONCLUSIONS FROM FUEL REPROCESSING PLANT STUDY

- DECOMMISSIONING IS FEASIBLE WITH EXISTING TECHNOLOGY
- DECOMMISSIONING COSTS ARE SIGNIFICANT BUT NOT EXORBITANT
- WASTE MANAGEMENT COSTS ARE HIGH
- HLLW STORAGE DECOMMISSIONING IS DIFFICULT, COSTLY
- INCENTIVES TO MINIMIZE CONCRETE CONTAMINATION
- REMOTE MAINTENANCE REDUCES COSTS, OCCUPATIONAL EXPOSURES
- LLW PROCESSING CAPABILITY IS ADVANTAGEOUS
- COMPARTMENTATION OF PROCESS AREAS IS ADVANTAGEOUS
- MODEST OCCUPATIONAL EXPOSURE INCENTIVE TO DEFER DISMANTLEMENT

DECOMMISSIONING A PRESSURIZED WATER REACTOR

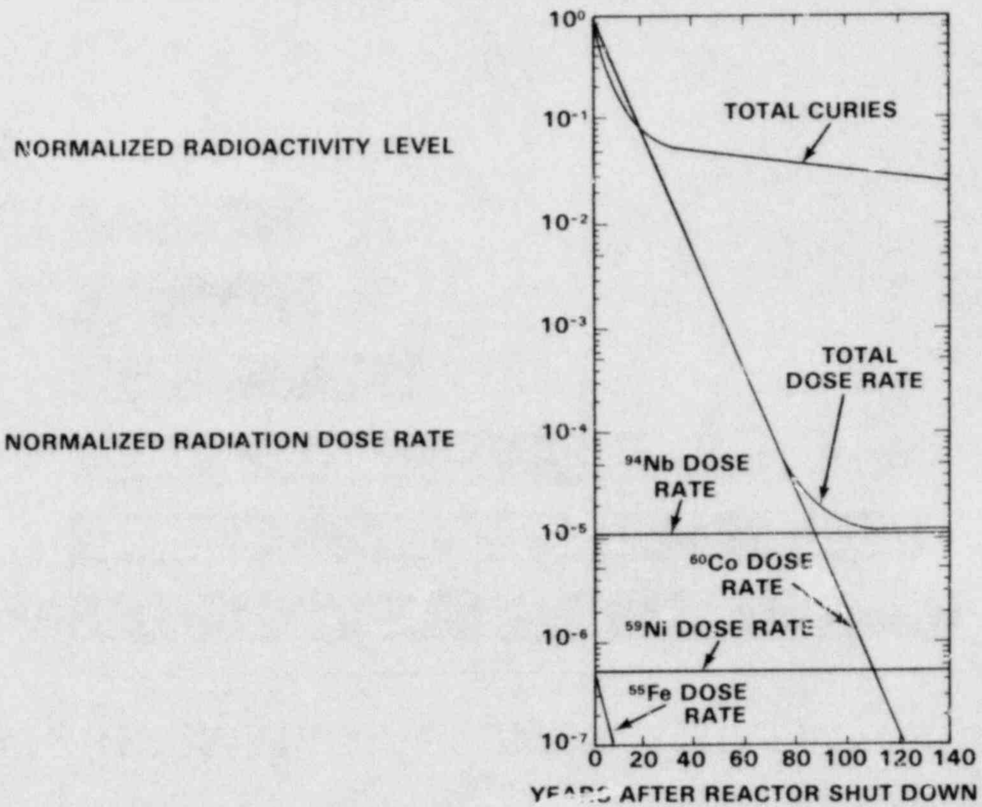
BUILDUP OF ACTIVATION PRODUCTS



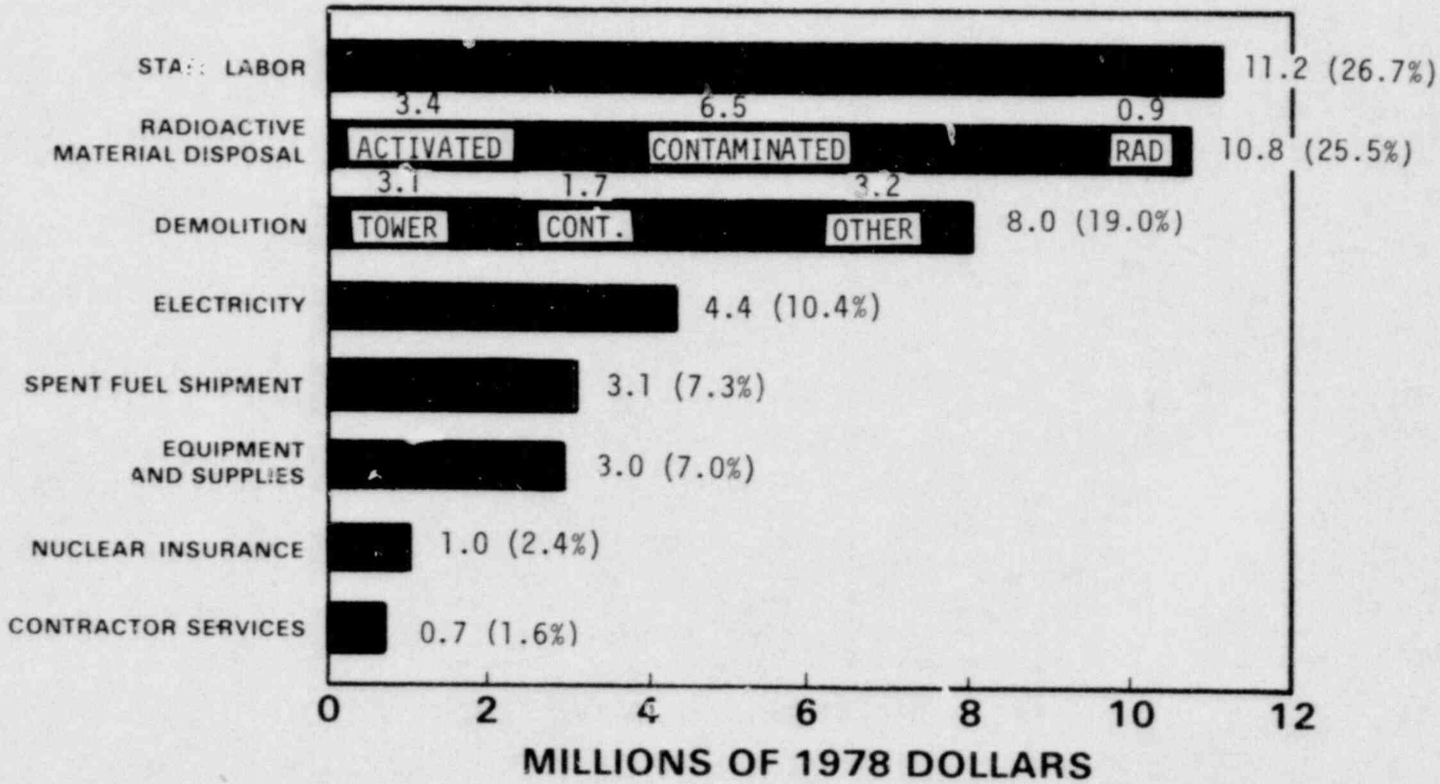
CORE SHROUD RADIOACTIVITY AT REACTOR SHUTDOWN

RADIONUCLIDE	^{55}Fe	^{60}Co	^{63}Ni	^{93}Mo	^{14}C	^{94}Nb	^{59}Ni
HALF LIFE (YEARS)	2.7	5.3	100	3,500	5,750	20,000	80,000
EMISSIONS	IB, γ	β, γ	β	IB, γ	β	β, γ	IB, γ
RADIOACTIVITY (Ci)	1.3×10^{6}	9.6×10^{5}	1.2×10^{5}	3.6×10^{-1}	1.5×10^{2}	5.4	7.4×10^{2}
EXTERNAL DOSE RATE (R/hr)	0.11	560,000	—	—	—	2.0	0.09

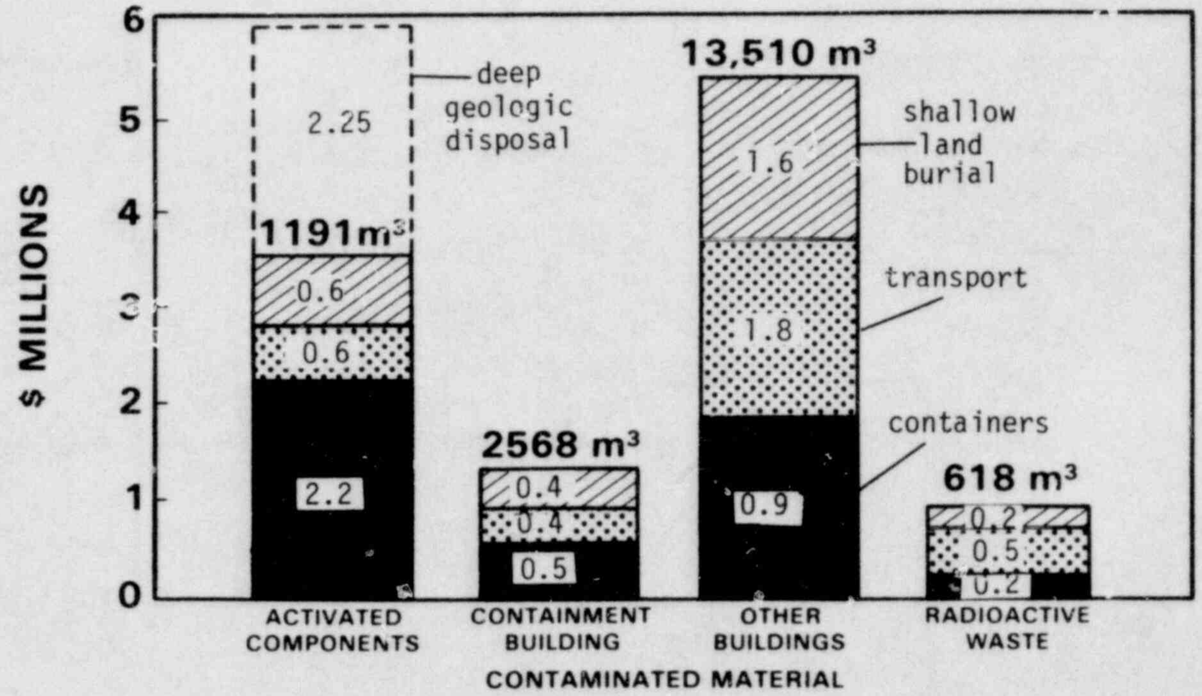
DECAY OF ACTIVATION PRODUCTS



COSTS OF IMMEDIATE DISMANTLEMENT



RADIOACTIVE MATERIAL DISPOSAL COSTS



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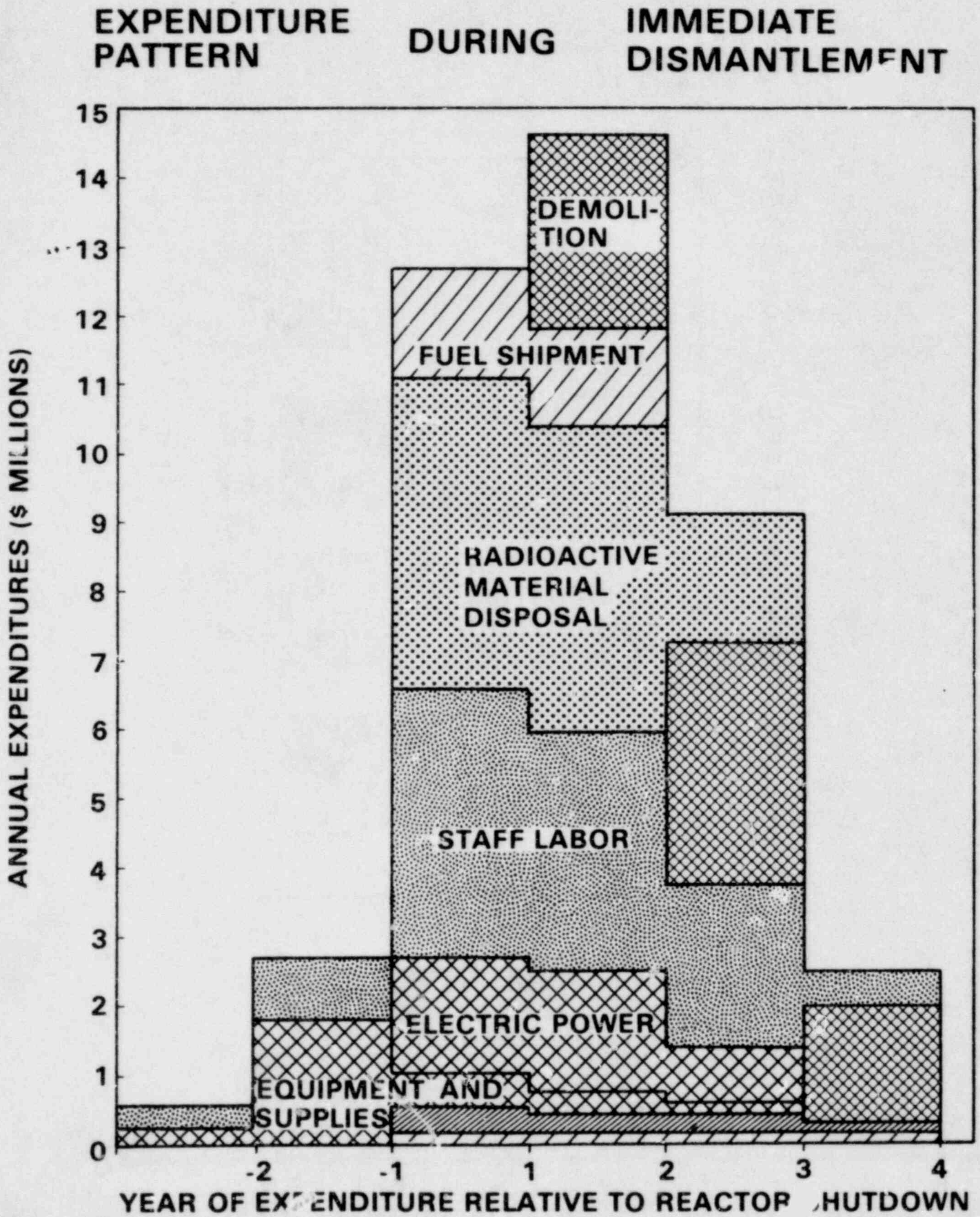
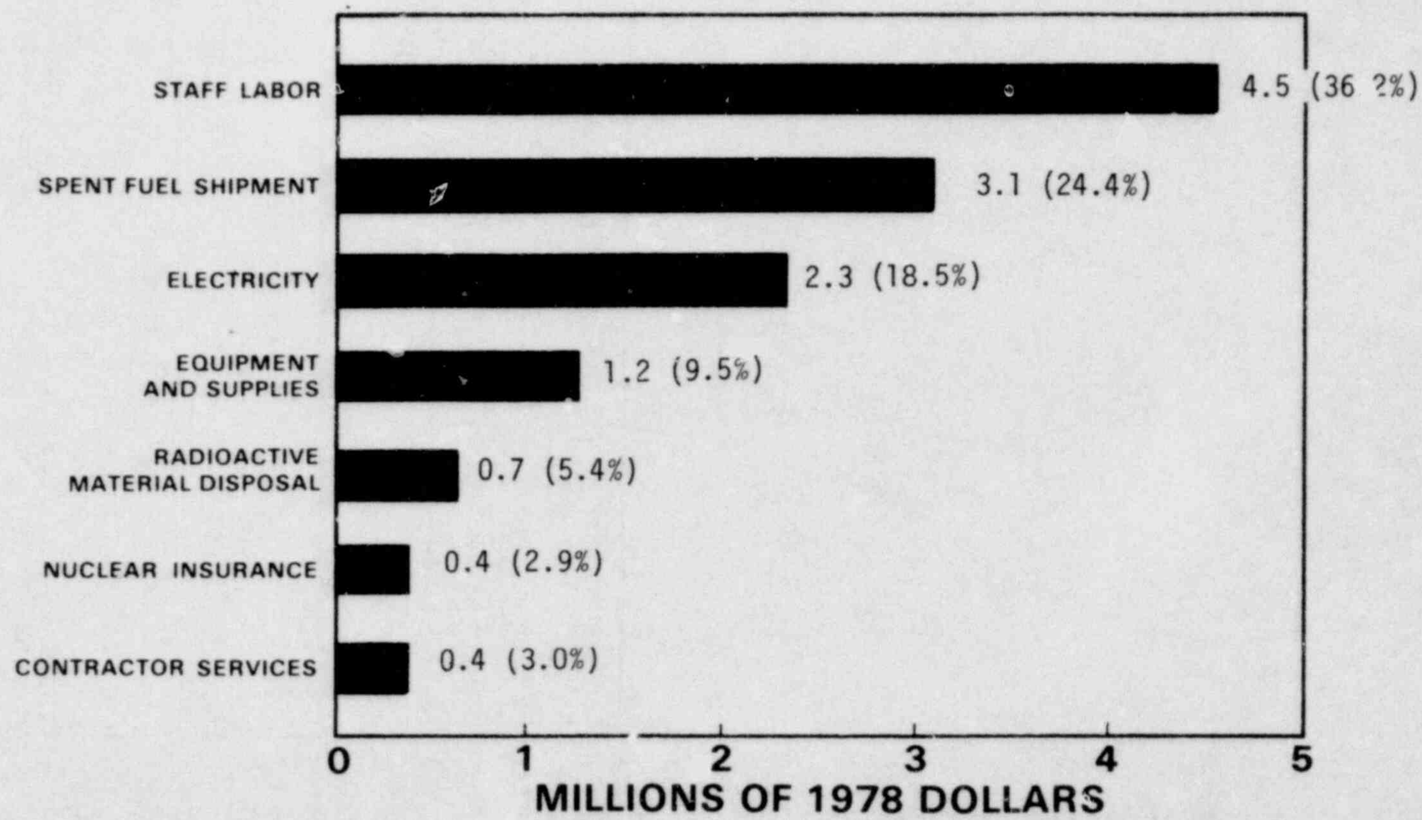
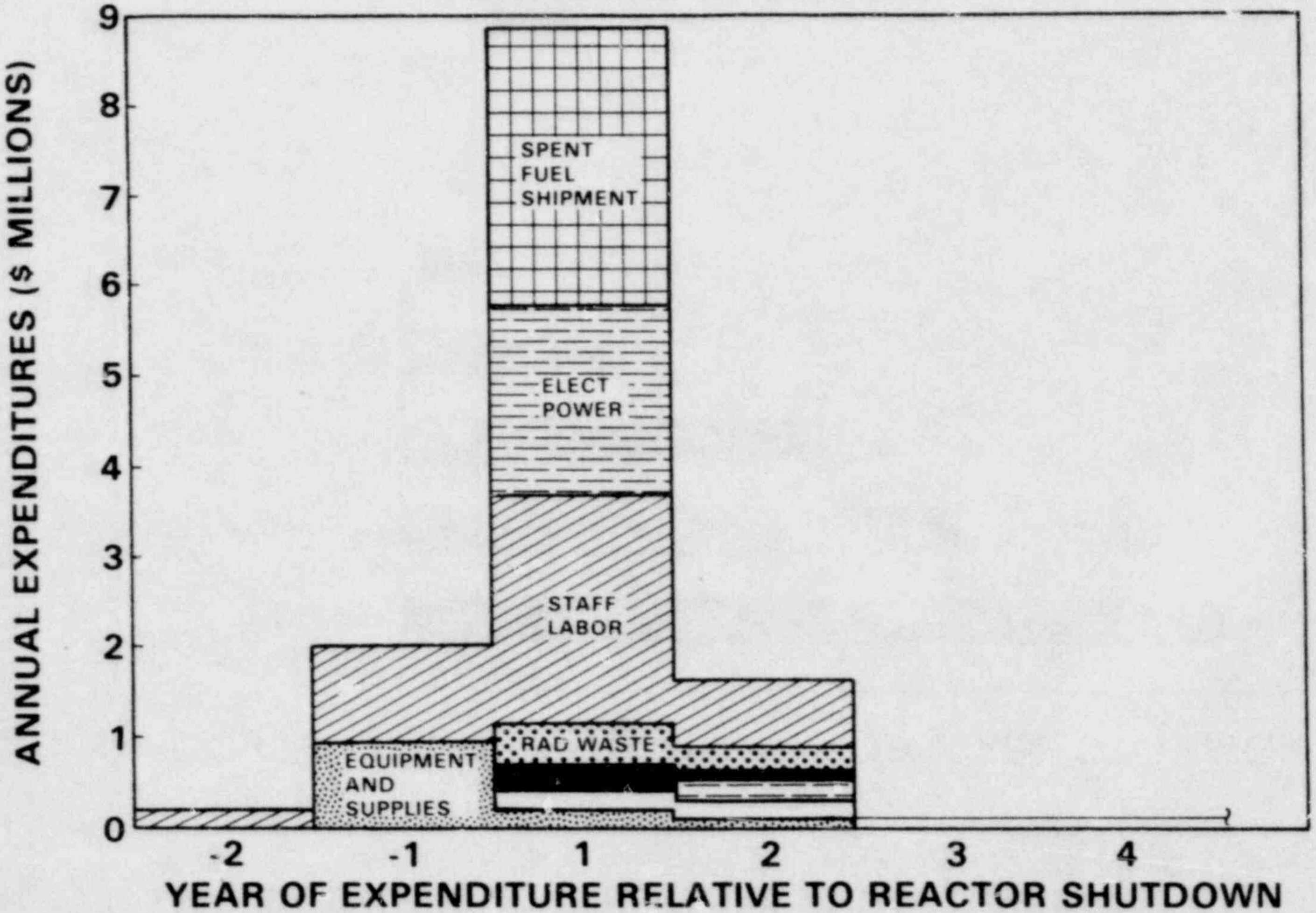

EXPENDITURE PATTERN DURING IMMEDIATE DISMANTLEMENT
DEMOLITION
FUEL SHIPMENT
RADIOACTIVE MATERIAL DISPOSAL
STAFF LABOR
ELECTRIC POWER
EQUIPMENT AND SUPPLIES
ANNUAL EXPENDITURES ($ MILLIONS)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
-2
-1
1
2
3
4
YEAR OF EXPENDITURE RELATIVE TO REACTOR SHUTDOWN

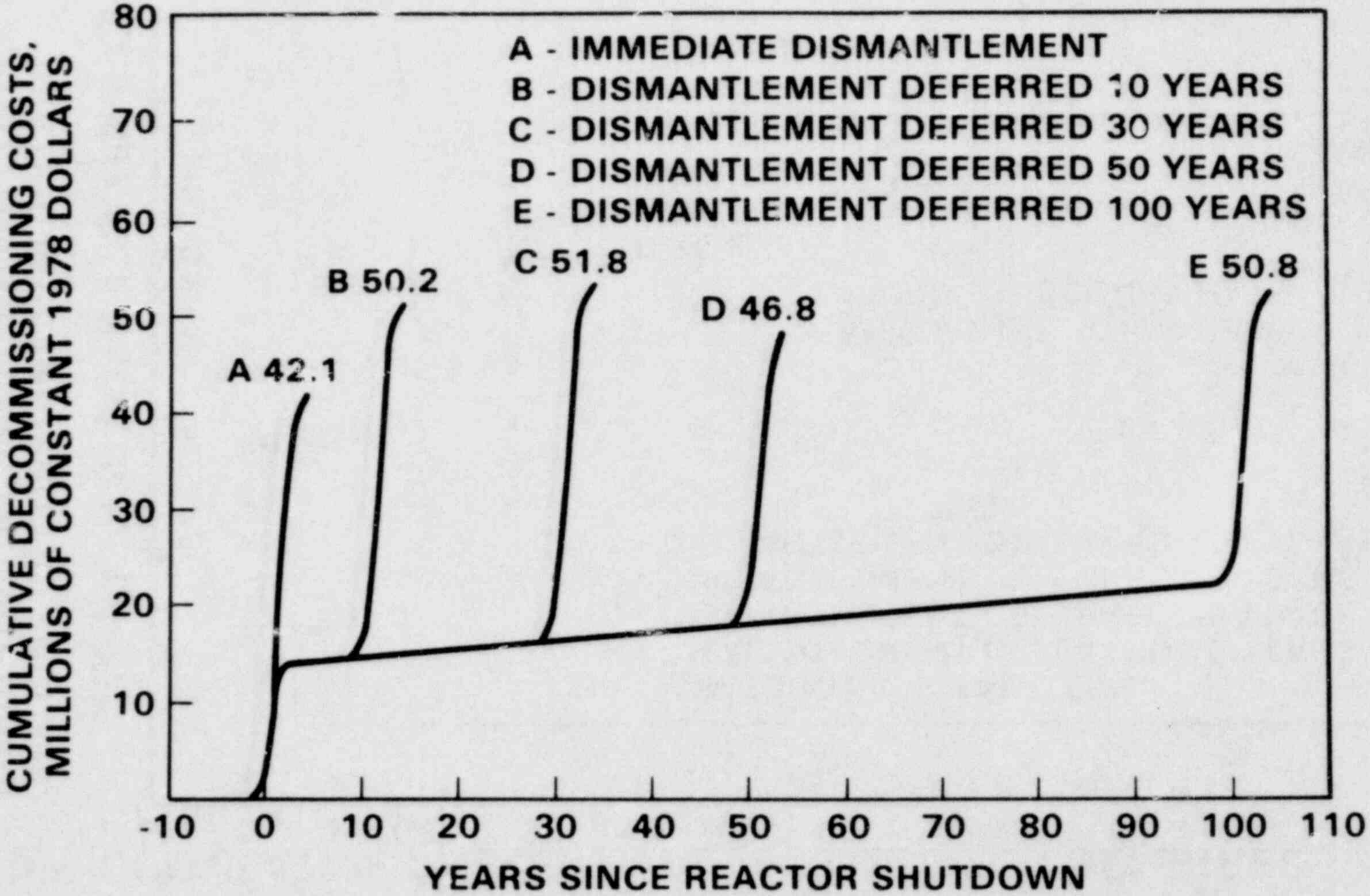
COSTS OF PREPARATIONS FOR SAFE STORAGE



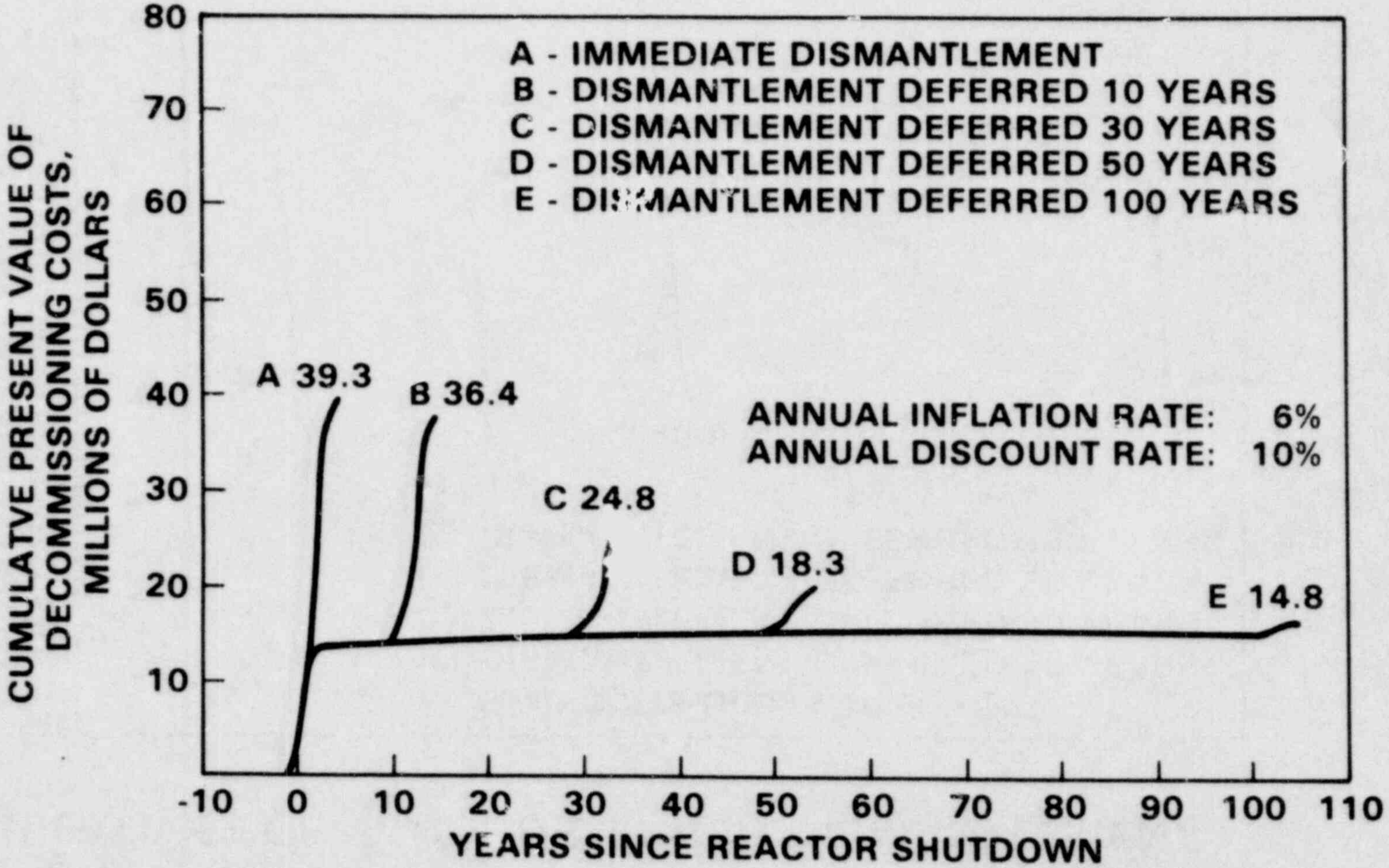
EXPENDITURE PATTERN DURING PREPARATIONS FOR SAFE STORAGE



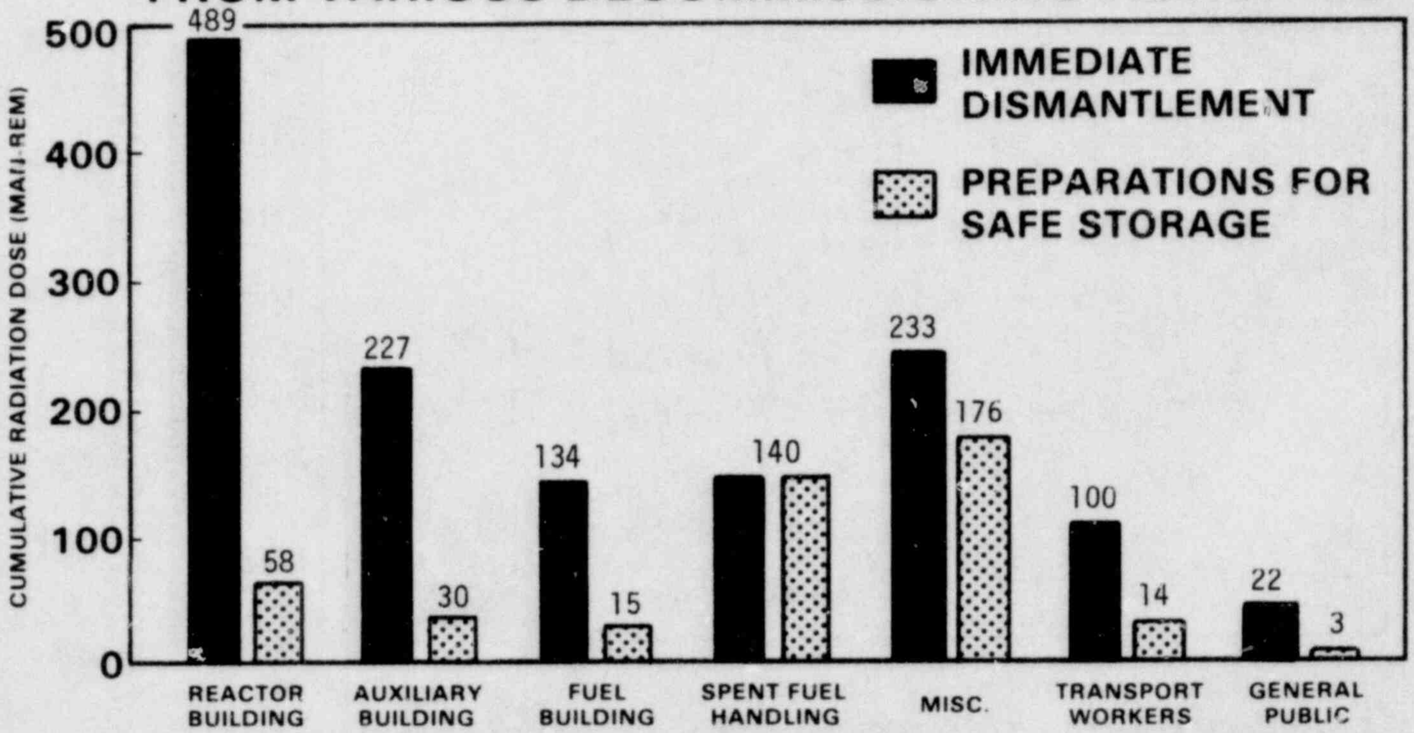
CUMULATIVE COSTS FOR DEFERRED DISMANTLEMENT



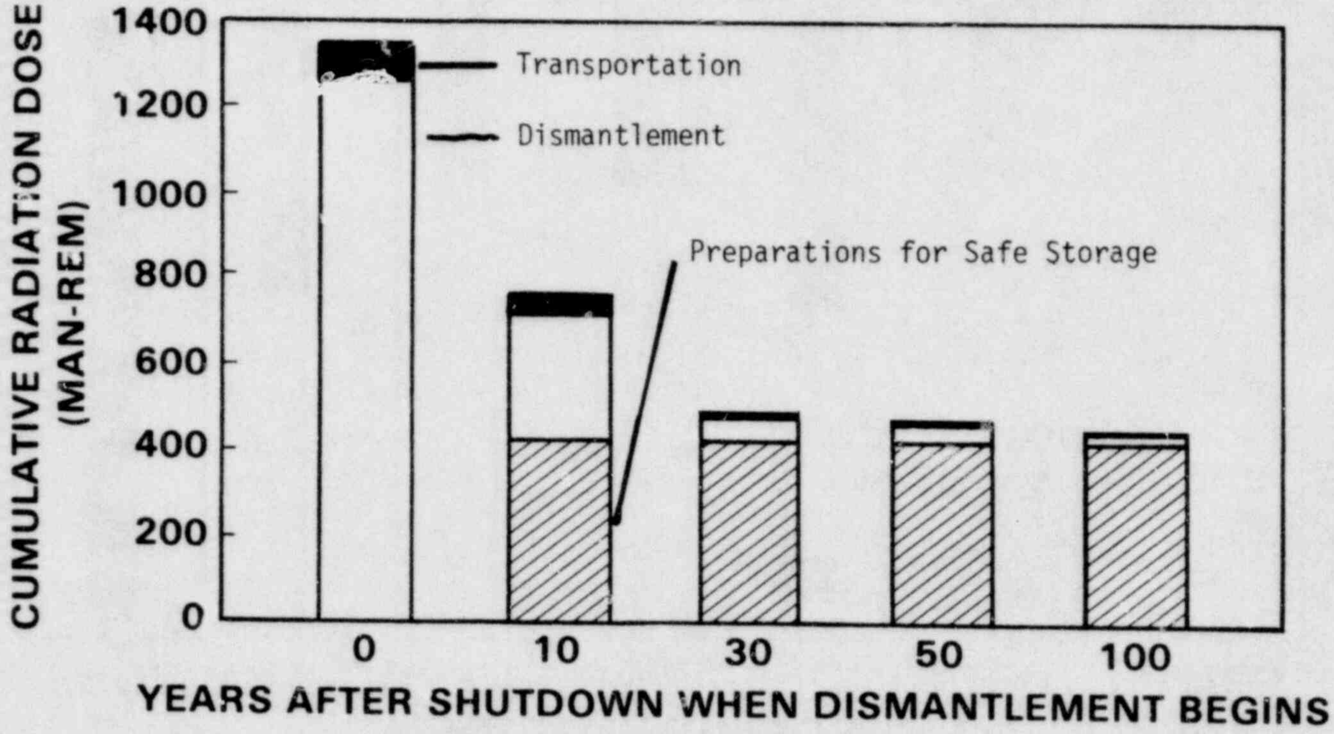
CUMULATIVE PRESENT VALUE COSTS FOR DEFERRED DISMANTLEMENT



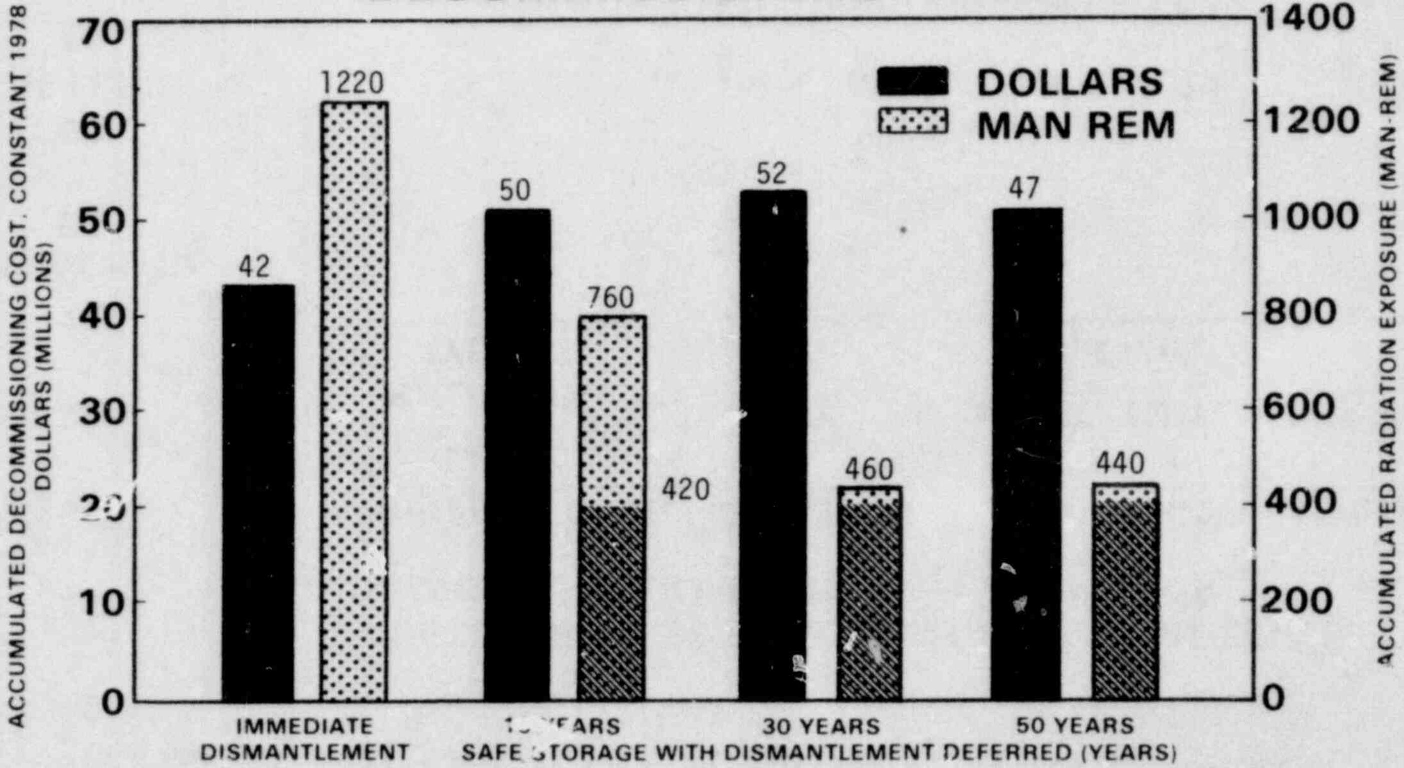
RADIATION DOSES FROM VARIOUS DECOMMISSIONING ACTIVITIES



RADIATION DOSES FROM DECOMMISSIONING



COST AND EXPOSURE COMPARISONS FOR DECOMMISSIONING A PWR



SUMMARY OF THE DISPOSITION CRITERIA FOR THE REFERENCE PWR FACILITY AND REFERENCE SITE

ACCEPTABLE RESIDUAL CONTAMINATION LEVELS FOR AN ANNUAL DOSE LIMIT OF 1 mrem PER YEAR

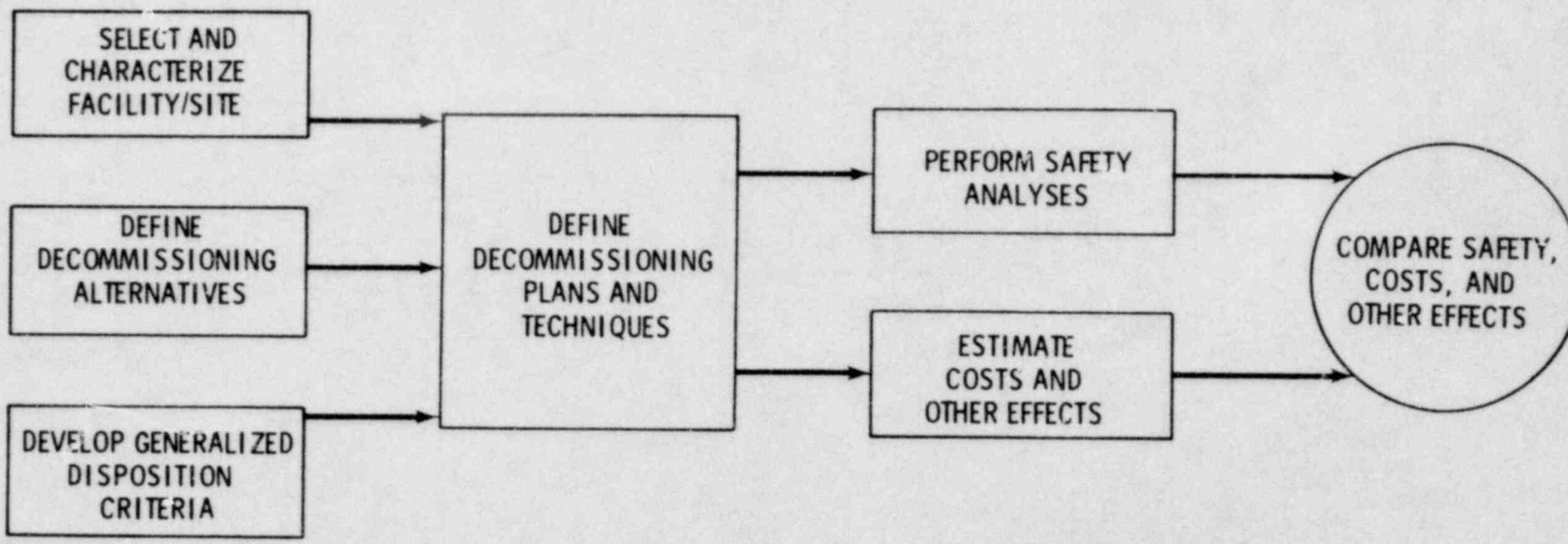
	SURFACE CONTAMINATION		SOIL CONTAMINATION	
	TIME AFTER SHUTDOWN (YEARS)	(μCi/m^2)	MIXED TO 1 cm (pCi/g)	MIXED TO 15 cm (pCi/g)
PWR FACILITY	0	2.3×10^{-1}	—	—
	100	3.2×10^{-1}	—	—
SITE (GESMO)	0	1.4×10^{-2}	9.4×10^{-1}	6.2×10^{-2}
	100	1.1×10^{-2}	7.4×10^{-1}	4.9×10^{-2}
SITE (NUREG-0218)	0	1.1×10^{-2}	7.4×10^{-1}	4.9×10^{-2}
	100	6.6×10^{-3}	4.4×10^{-1}	2.9×10^{-2}

CONCLUSIONS FROM PWR STUDY

- DECOMMISSIONING CAN BE ACCOMPLISHED USING PRESENT-DAY TECHNOLOGY
- COSTS ARE SIGNIFICANT, BUT MANAGEABLE
- OCCUPATIONAL RADIATION DOSES ARE SIGNIFICANT, BUT MANAGEABLE
- PUBLIC RADIATION DOSES ARE SMALL, MOSTLY FROM TRANSPORT OF RADIOACTIVE MATERIALS
- THERE ARE COST AND DOSE REDUCTION INCENTIVES TO DESIGN BETTER FOR DECOMMISSIONING

BACKGROUND MATERIAL

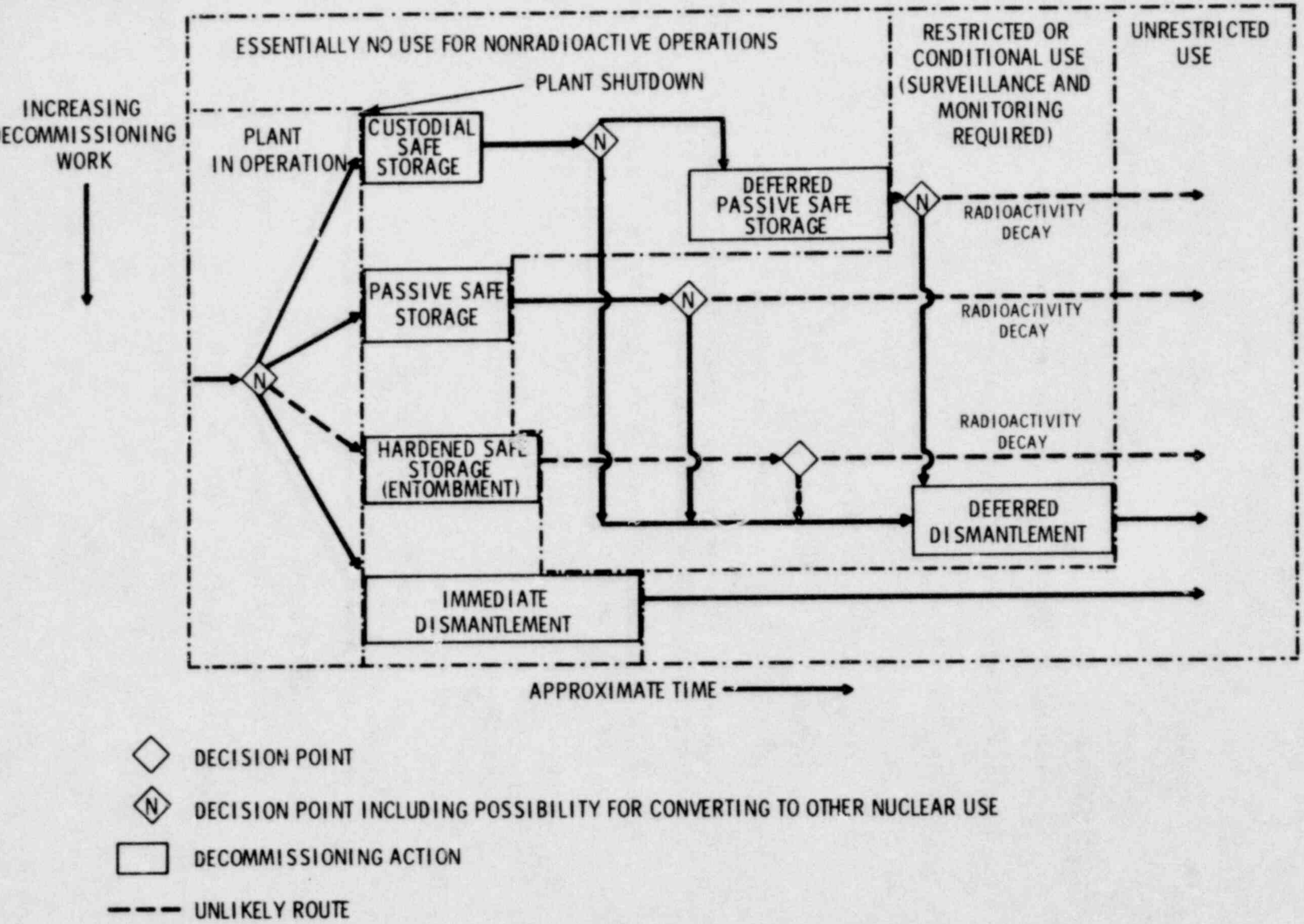
TECHNICAL APPROACH FOR DECOMMISSIONING STUDY



SUMMARY OF DECOMMISSIONING MODE CHARACTERISTICS

Mode	Facility Status	Plant/Site Use
Dismantlement	Plant Equipment - removed Continuing Care Staff - none Security - none Environmental Monitoring - none Radioactivity - removed Surveillance - none Structures - removal optional	Plant - Unrestricted Site - Unrestricted
Safe Storage		
Hardened	Plant Equipment - none operating Continuing Care Staff - none on site Security - hardened barriers, fencing and posting Environmental Monitoring - infrequent Radioactivity - hardened sealing Surveillance - infrequent Structures - partial removal optional	Plant - Conditional Non-nuclear Site - Conditional Non-nuclear
Passive	Plant Equipment - none operating Continuing Care Staff - optional (onsite) - routine inspections Security - remote alarms Environmental Monitoring - routine periodic Radioactivity - immobilized/ sometimes sealed Surveillance - periodic Structures - intact	Plant - Nuclear Only Site - Conditional Non-nuclear
Custodial	Plant Equipment - some operating Continuing Care Staff - some required Security - continuous Environmental Monitoring - continuous Radioactivity - confined Surveillance - continuous Structures - intact	Plant - Nuclear Only Site - Nuclear Only

GENERALIZED DECOMMISSIONING PATHWAYS AND ALTERNATIVES FOR MANY FUEL CYCLE FACILITIES



GENERIC ORGANIZATION OF DECOMMISSIONING REPORTS

Report Titles: SAFETY AND COSTS OF DECOMMISSIONING A REFERENCE NUCLEAR

Main Report

1. Introduction
2. Summary
3. Review of Decommissioning Experience
   - Includes lessons on past decommissioning
4. Decommissioning Alternatives and Study Approach
5. Regulatory Considerations for Decommissioning
6. Approaches to Financing of Decommissioning
   - Includes section on taxation
7. Characteristics of the Reference _ _ _Facility
   - Site facility description and reference inventory, dose rates
8. Methodology for Determining Acceptable Contamination Levels for the Decommissioned Reference Facility

8A. Environmental Monitoring and Record Keeping is a separate section for LLW Burial Ground Study Only

9. Decommissioning Activities

   [LLW study may have one section for safe storage and one section for dismantlement]
10. Decommissioning Costs
    - Cost of all activities will be summarized here, including plant organization and manpower, materials and services, waste disposal and transportation
11. Public and Occupational Safety
    - Routine and accident, including non-radiological
12. Discussion of Results
13. Design [and Operational for LLW and Mill Tailings Only] Considerations to Facilitate Decommissioning
14. Glossary

GENERIC ORGANIZATION OF DECOMMISSIONING REPORTS

Appendix

A. Reference Facility Description

B. Reference Site Description

C. Estimates of Residual Radioactivity

D. Financial Considerations

E. Radiation Dose Methodology

- Include details for "disposition criteria" derivation and dose calculational models used throughout the report and any detailed calculational results

F. Decommissioning Activities for Immediate Dismantlement

G. Decommissioning Activities for Safe Storage

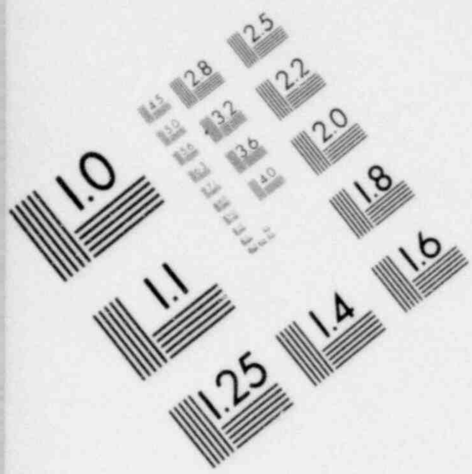
- Includes deferred dismantlement
- For the mill study, sections F and G may be decommissioning of the mill plant and tailings, respectively.

H. Cost Assessment Details

I. Safety Assessment Details

J. Environmental Monitoring (for LLW study and possibly mill tailings)

K. Record Keeping (for LLW study and possibly mill tailings)



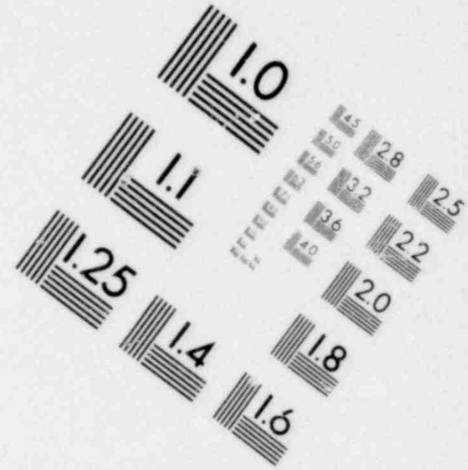
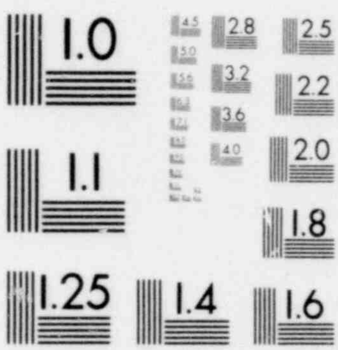
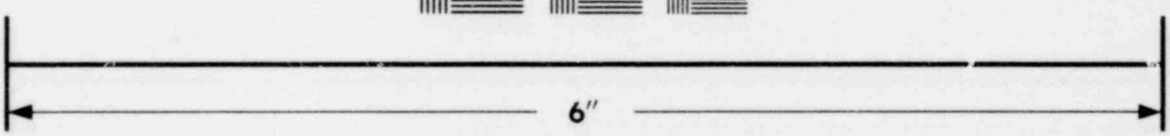
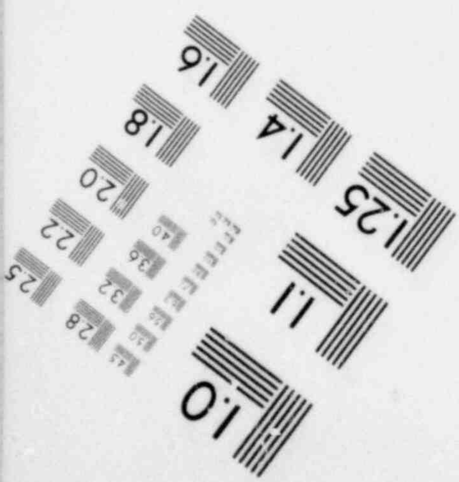
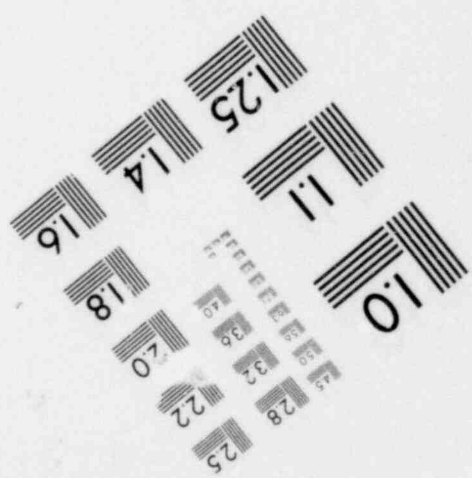


IMAGE EVALUATION TEST TARGET (MT-3)









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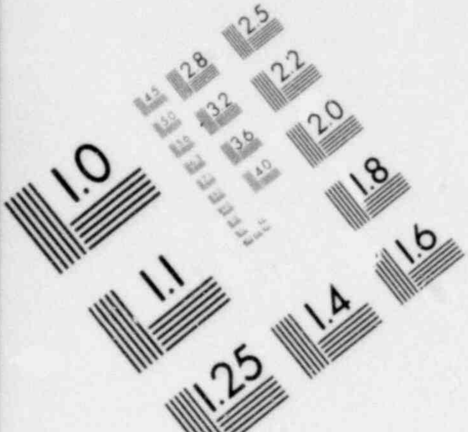


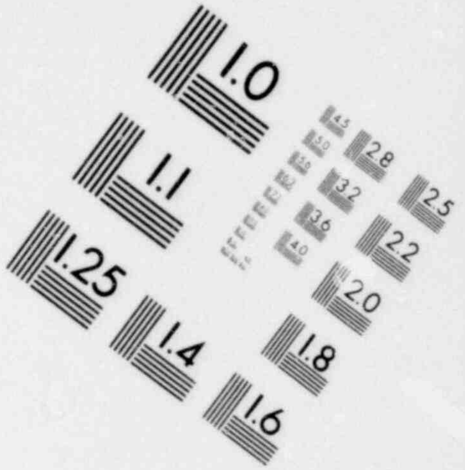
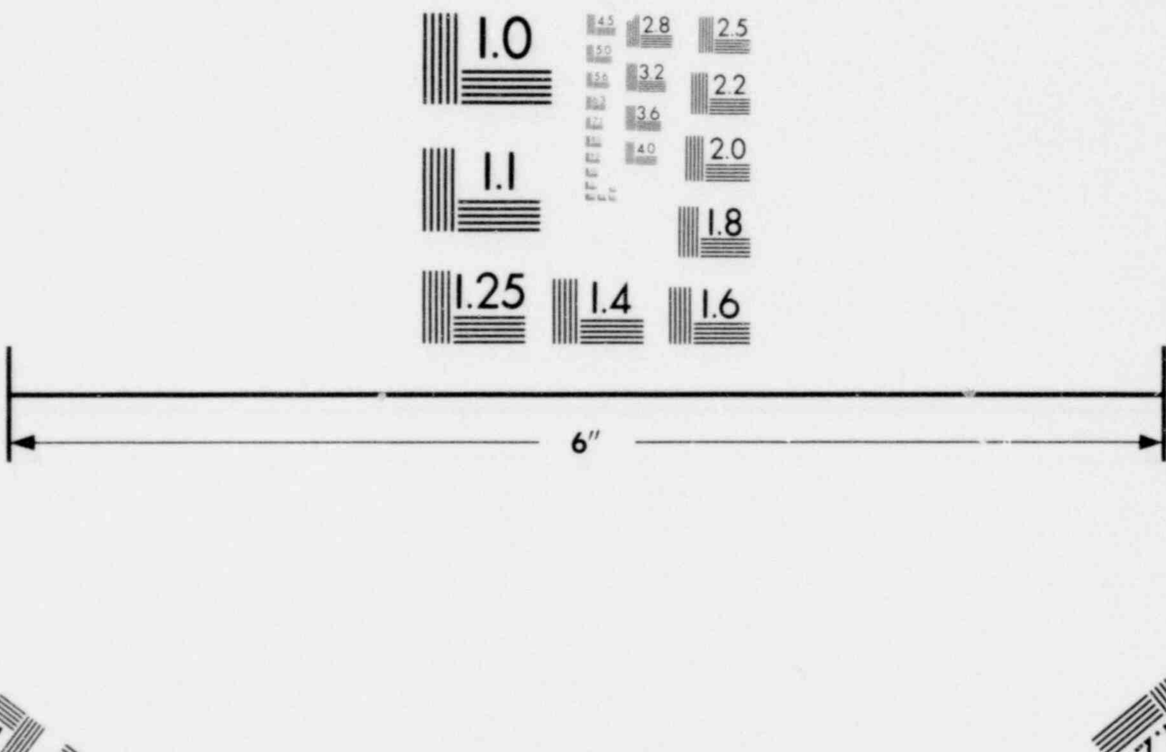
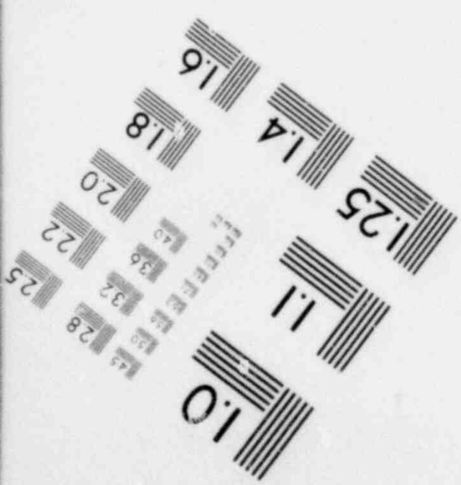
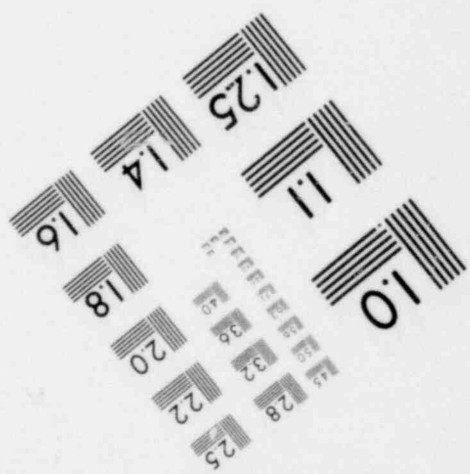


IMAGE EVALUATION TEST TARGET (MT-3)







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SUMMARY OF ACTIVITIES FOR DECOMMISSIONING FUEL CYCLE FACILITIES

ACTIVITY	IMMEDIATE DISMANTLEMENT	HARDENED SAFE STORAGE (ENTOMBMENT)	PASSIVE SAFE STORAGE, INTERIM CONTINUING CARE AND EVENTUAL DISMANTLEMENT	CUSTODIAL SAFE STORAGE, INTERIM CONTINUING CARE AND EVENTUAL DISMANTLEMENT
PLANNING AND PREPARATION	X	X	X	X
CHEMICAL DECONTAMINATION	X	X	X	X
EQUIPMENT DEACTIVATION	X	X	X	X
EQUIPMENT				
REMOVAL	X	X	●	●
RELOCATION		X	X	
MECHANICAL DECONTAMINATION	X	X	X	X
IMMEDIATE DEMOLITION AND SITE RESTORATION	X			
FIXING OF RESIDUAL RADIOACTIVITY		X	X	X
ISOLATION OF CONTAMINATED AREAS		X	X	
INTERIM CONTINUING CARE, SURVEILLANCE		PARTIAL	X	X
ULTIMATE DEMOLITION AND SITE RESTORATION		POSSIBLE	●	●

X = APPLIES
● = APPLIES AFTER INTERIM CARE

GENERIC ORGANIZATION OF DECOMMISSIONING REPORTS

Appendix

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H. Cost Assessment Details

I. Safety Assessment Details

J. Environmental Monitoring (for LLW study and possibly mill tailings)

K. Record Keeping (for LLW study and possibly mill tailings)

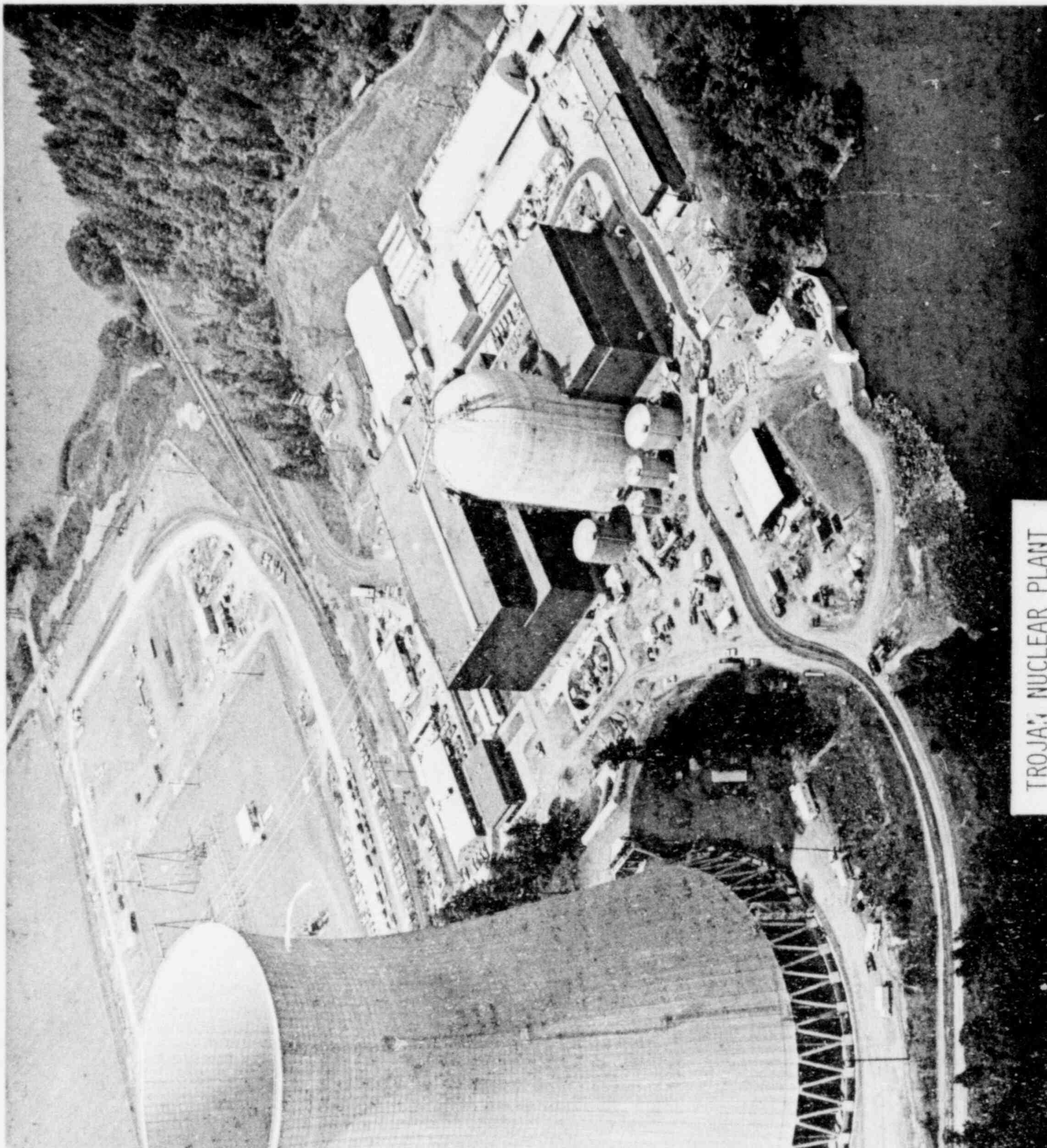
DECOMMISSIONING HISTORY

REACTORS

- 5 POWER REACTORS
- 4 DEMO REACTORS
- 6 TEST REACTORS
- 50 RESEARCH REACTORS
- MODES - PROTECTIVE STORAGE, ENTOMBMENT AND DISMANTLING

FUEL CYCLE FACILITIES

- U MILLS - 22 INACTIVE, ALL SOME DECOMMISSIONING, TAILINGS MAJOR PROBLEM, RISK NOT FULLY DEFINED
- UF^6 CONVERSION - NONE TO DATE, ANTICIPATE NO PROBLEMS
- FUEL FAB - ONE DECOMMISSIONED, SEVERAL DECONTAMINATED AND RELEASED
- REPROCESSING - NONE, NFS SITUATION INCONSISTENT WITH CURRENT POLICY
- BURIAL GROUNDS - NONE



TROJAN NUCLEAR PLANT

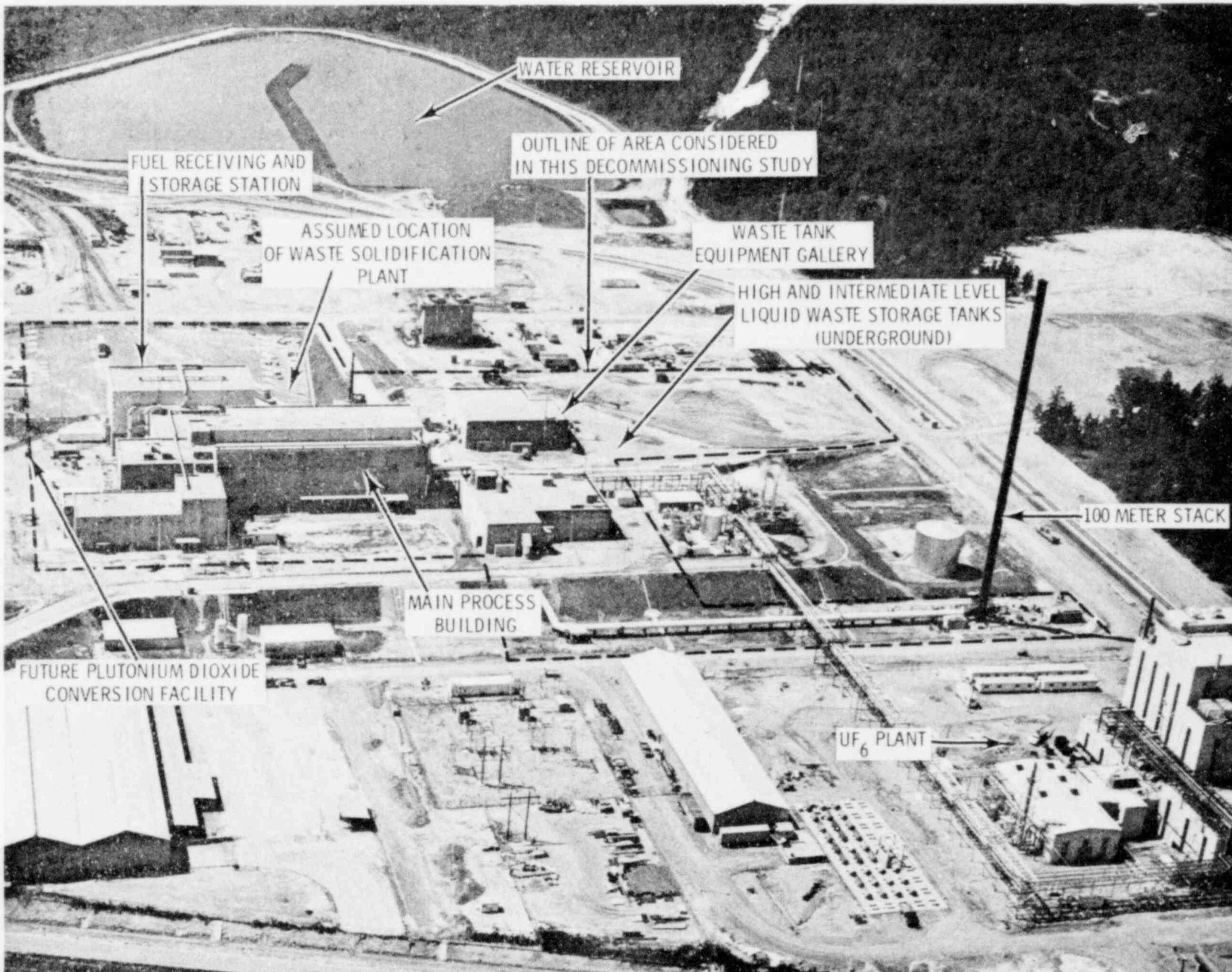

WATER RESERVOIR
OUTLINE OF AREA CONSIDERED IN THIS DECOMMISSIONING STUDY
FUEL RECEIVING AND STORAGE STATION
ASSUMED LOCATION OF WASTE SOLIDIFICATION PLANT
WASTE TANK EQUIPMENT GALLERY
HIGH AND INTERMEDIATE LEVEL LIQUID WASTE STORAGE TANKS (UNDERGROUND)
100 METER STACK
MAIN PROCESS BUILDING
FUTURE PLUTONIUM DIOXIDE CONVERSION FACILITY
UF_6 PLANT

TABLE 3.1. A Digest of Nuclear Reactor Decommissionings[a]

Facility Name and Location	Reactor Type	Category[b]	Power Rating[c]	Type of Decommissioning	License Status	Monitoring System	Safe Storage Measures	Year Decommissioned	Decommissioning Cost	Miscellaneous Information
HRE-1 (Homogeneous Reactor Experiment) HNL	Fluid-fuel	TR	1 MW	Dismantled	—	—	—	1954	—	—
HRE-2 (Homogeneous Reactor Experiment) HNL	Fluid-fuel	TR	<1 MW	Dismantled	—	—	—	1954	—	—
ARE (Aircraft Reactor Experiment) HNL	Fluid-fuel	TR	1 MW	Dismantled	—	—	—	1955	—	—
PM-2A (Portable Medium Power Plant) Greenland	Pressurized water type, light water moderated and cooled	M	10 $MW_{(t)}$	Dismantled	—	—	—	1964	—	—
HPR's (Hanford Production Reactors; 8 total) Richland, WA	Graphite moderated, water cooled	PR	—	Safe Storage, 4-Standby, 4-Retired, (Layaway)	—	Continuous surveillance	Continuous maintenance	1965-1971	—	—
CVTR Carolina-Virginia Tube Reactor) Parr, SC	Pressure tube, heavy water (D_2O) cooled and moderated	LPR	65 $MW_{(t)}$	Safe Storage (mothballed)	Byproduct per 10 CFR 30	Periodic surveillance	Welded closure, locked doors, security fence	1968[e]	—	—
Hallam Hallam, Neb.	Graphite moderated, sodium cooled	DPR	256 $MW_{(t)}$	Entombed	Operating authorization terminated	Not required	Welded closure, concrete cover, weatherproofed	1969	—	Decommissioning took 3 years
PNPF (Piqua Nuclear Power Facility) Piqua, Ohio	Organic cooled and moderated	DPR	45 $MW_{(t)}$	Entombed	Operating authorization terminated	Not required	Welded closure concrete cover, waterproofed	1969	—	Decommissioning took 3 years
BONUS (Boiling Nuclear Superheater Power Station) Ricon, Puerto Rico	BWR with nuclear superheating	DPR	50 $MW_{(t)}$	Entombed	Operating authorization terminated	Not required	Welded closure, concrete cover, locked doors, security fence	1970	—	—
Walter Reed Research Reactor Washington, DC	Atomics International Model L-54, homogeneous-fueled	MTR	50 kW	Dismantled	—	—	—	1971	—	—
Pathfinder Sioux Falls, SD	BWR nuclear superheat	LPR	190 $MW_{(t)}$	Safe Storage (mothballed) with steam plant conversion	Two part license: 10 CFR 50 possession-only and byproduct 10 CFR 30	Continuous security force[f]	Welded closure, security fence	1972	$3.7M	—
EBR-1 (Experimental Fast Breeder Reactor) NRTS - Idaho	Liquid metal cooled	TR	—	Deactivated, decontaminated, converted for public access	—	Public access via National Park Service	—	1973	$775,000 (cost to convert for public access only)	Dedicated a National Monument in 1966
Saxton Reactor Facility Saxton, PA	PWR	LTR	23.5 $MW_{(t)}$	Safe Storage (mothballed)	Possession only	Intrusion alarms	Welded closure, locked doors, security fence	1973	~$2.5M	Owned, operated, and decommissioned by SNE (Saxton Nuclear Experiment Corporation)
SEFOR (Southwest Experimental Fast Oxide Reactor) Strickler, AR	Sodium cooled, fast	LTR	20 $MW_{(t)}$	Safe Storage (mothballed)	Byproduct to state	Intrusion alarms	Welded closure, locked doors, security fence	1973		—
Elk River Reactor; Elk River, Minn.	BWR, fossil fuel superheating	DPR	58 $MW_{(t)}$	Dismantled and partial conversion	Operating authorization terminated	Not required	Not required	1974	$6.15M	Decommissioning took 3 years
ASTR (Aerospace Test Reactor) U.S. Air force - NARF Ft. Worth, TX	—	M	10 MW	Dismantled	—	—	—	1974	—	—
GTR (Ground Test Reactor; U.S. Air Force - NARF Ft. Worth, TX	—	M	10 MW	Dismantled	—	—	—	1974	—	—
RTA Reactivity Test Assembly) U.S. Air Force - NARF Ft. Worth, TX	—	M	1 MW	Dismantled	—	—	—	1974	—	—

For explanation of notes see the bottom of the next page.

POOR ORIGINAL

TABLE 3.1. (Continued)

Facility Name and Location	Reactor Type	Category[b]	Power Rating[c]	Type of Decommissioning	Licence Status	Monitoring System	Safe Storage Measures	Year Decommissioned	Decommissioning Cost	Miscellaneous Information
FERMI 1 Monroe Co. Mich.	Sodium cooled, fast	LPR	200 $MW_{(t)}$	Safe Storage (mothballed)	Possession only[g]	Continuous security force[f]	Locked doors, security fence	1975	$6.95M	—
PM-3A (Portable Medium Power Plant) McMurdo Station, Antarctica	Pressurized Water Type, light water moderated and cooled	M	9.4 $MW_{(t)}$	Dismantled	—	—	—	1975	—	—
HTR (Hanford Test Reactor) Richland, WA	Graphite moderated	TR	Zero Power	Dismantled	—	—	—	1977	$0.18M	—
B & W Lynchburg, VA	Pool	LTR	6 $MW_{(t)}$	Partially Dismantled	Byproduct per 10 CFR 30	Not required	Not required	—	—	—
GE EVESR Alameda Co. CA	BWR with nuclear superheat	LTR	17 $MW_{(t)}$	Safe Storage (mothballed)	Possession only	Continuous security force	Lo[illegible] [illegible]oors, sec[illegible] [illegible]ce	—	—	—
NASA Plumbrook, Sandusky, Ohio	Light water	LTR	0.1 $MW_{(t)}$	Safe Storage (mothballed)	Possession only	Continuous security force[f]	Locked doors, security fence	—	—	—
Peach Bottom 1 York Co., Penn.	Gas cooled, graphite moderated	LPR	115 $MW_{(t)}$	Safe Storage (mothballed)	Possession only	Continuous security force[f]	Not yet established	—	—	—
VBWR (Vallecito Boiling Water Reactor) Alameda Co. CA	BWR	LPR	50 $MW_{(t)}$	Safe Storage (mothballed) with steam plant conversion	Possession only	Continuous security force[f]	Locked doors, security fence	—	—	—
Westinghouse Test Reactor Waltz Mill, PA	Tank	LTR	60 $MW_{(t)}$	Safe Storage (mothballed)	Possession only	Continuous security force[f]	Locked doors, security fence	—	—	—
SRE (Sodium Reactor Experiment); AI, Santa Susana, CA	Graphite moderated, sodium cooled	PP	20 $MW_{(t)}$ modified 1964 to 30 $MW_{(t)}$	Safe Storage (mothballed - 1967); dismantling started (1974)	—	—	—	In progress[h]	—	—
IRL (Industrial Reactor Laboratories Inc., Research Reactor); Plainsboro, NJ	Pool	TR	5 $MW_{(t)}$	Partially dismantled	—	—	Unrestricted use	1977	Less than $1M	Decommissioned by NL Industries Incorporated; Decommissioning took ~two years[i]

NOTES:

(a) Blank spaces in the tabular columns indicate author was unable to locate the information from the literature studied

(b) Categories of Reactors:

PP	=	Power Production
PR	=	Production Reactor (AEC)
LPR	=	Licensed Power Reactor
LTR	=	Licensed Test Reactor
DPP	=	Demonstration Power Plant
M	=	Military
TR	=	Test Reactor (Experimental/Research)

(c) Power ratings are given in electrical (e) or thermal (t) megawatts (MW) or kilowatts (kW)

(d) Byproduct Licenses may be either "Byproduct NRC" issued in accordance with 10 CFR Part 30 or "Byproduct License" issued by an agreement state in accordance with authority granted by 10 CFR Part 150.

(e) First to be placed in safe storage (mothballed); provided significant experience in developing criteria and methods.

(f) Not required for NRC due to other onsite security force availability unrelated to the decommissioning activities. If the security force had not been available, the NRC may have required other control measures (e.g., manned security or access control).

(g) Title 10 CFR Part 50, § 50.59, "Authorization of Changes, Tests and Experiments" and § 50.90, "Application for Amendment of License or Construction Permit" provides the rules by which a licensee may amend his license to obtain a possession-only status. Once this possession-only license is issued, reactor operation is not permitted.

(h) The SRE facility is only 1 of 8 complete decontamination and dismantling programs at the AI Santa Susana, CA., DOE-owned site as part of the AI Decontamination and Disposition of Facilities Program.

(i) The site is the first for a decommissioned commercial reactor to be approved by the government for unrestricted use.

ACRONYMS:

AI	-	Atomics International
BWR	-	Boiling Water Reactor
DOE	-	Department of Energy, formerly Energy Research and Development (ERDA)
HNL	-	Holifield National Laboratory, formerly Oak Ridge National Laboratory (ORNL)
HTGR	-	High Temperature Gas-Cooled Reactor
LASL	-	Los Alamos Scientific Laboratory
NARF	-	Nuclear Aerospace Research Facility
NASA	-	National Aeronautics and Space Administration
NRTS	-	National Reactor Testing Station
SRL	-	Savannah River Laboratory

PHILADELPHIA - Battelle Presentation - Comment and Response Session

Comment

An individual mentioned that shutdowns have been experienced in Pennsylvania and that during these shutdowns the deterioration of the facility was quite significant. He questioned how significant this is in the cost figures presented and if it had even been considered.

Response

The assumption was made in these studies that steps were taken during shutdown to carefully preserve all aspects of the facility so that deterioration would not take place.

Comment

My concern is with the crew jumping ship before complete dismantlement of the facility and not staying on to see it through all stages of decommissioning.

Response

Bonus or other incentives could be set up to insure staff follow-through during decommissioning. Another consideration could be a second reactor which is still in operation on the same site.

Comment

How do you arrive at labor costs?

Response

In the study, labor costs are broken down completely and the range considered from high-level management down to technicians and work crews.

Comment

You mentioned the possibility of cost doubling. How do you explain this?

Response

Generalized labor structure was used. We did not utilize the highly compartmentalized craft or specialty structures that exist in some areas. The use of these could double the cost of labor.

Comment

You say that your costs represent the middle range in waste disposal. What in fact is the full range and is it represented in this report?

Response

Studies on this matter varied in cost by a factor of two. An architectural engineering firm completed separate cost estimates independently. The figure at which they arrived was within 10 percent of the Battelle figure.

Comment

There is in fact a heavy reliance on craft unions to handle decommissioning rather than the facility staff when you are looking at an individual utility in an area where craft unions predominate the labor market. Is this not a significant factor in determining cost?

Response

Yes.

Comment

What caveats would you offer in applying these labor costs elsewhere?

Response

Costs were site-specific. Great care must be used in applying them elsewhere. A study of the sensitivity of costs to plant size is underway.

Comment

You talk about the costs for industry. What is the Federal government doing?

Response

The Federal government owns a number of nuclear sites. For now, the principal effort is in categorizing and assigning a priority to the decommissioning of these sites. The most urgent need today is to clean up old milling sites and this is what government is targeting. The Department of Energy is cataloging government-owned sites and is attempting to develop a five-year plan to decommission.

Comment

If the Federal government cannot complete decommissioning of their own facilities, why are they expecting the States to do exactly that?

Response

The government has been largely utilizing temporary techniques such as mothballing. However, there is a clear need for permanent solutions.

Comment

My comment here is that I think that it should be pointed out that waste management must begin at the Federal level.

Comment

We have been trying for awhile to get the government to dispose of low-level wastes and have run into habitual indecision. We feel that not Congress, but Federal agencies must do something.

Response

I agree totally. Waste management is an urgent problem. In the interest of emphasizing decommissioning at this workshop, we are trying to avoid detailed discussions of waste disposal.

Comment

New York State is unique in having contained all waste from the nuclear facilities within the State. Reviews are available which cover the cost and management of materials. I have a question concerning the costs presented in your report:

1. PWR - Projection on page G-25 (NUREG/CR-0130) for decontamination presents a figure of $190-280 thousand. My question is whether you can consider this a reasonable figure? In Dresden One, $16 million was spent to reach a 50 percent decontamination level.
2. On page 10 - 6, cost estimates for demolition of reactor containment vessels were $1.6 million. In our Elk River demolition, $1.05 million was spent decommissioning a much smaller vessel. Your figures compared to ours lead me to question the reality of the estimates

presented. Reprocessing plant estimates go as high as $30 million. I find difficulty in comparing your estimates with actual experience. And if these numbers are in fact unrealistic, then the entire financial scheme developed in the presentation is also inaccurate.

Response

Decontamination of a working facility for continued use must be done quite carefully. Decontamination for destruction is a vastly different procedure. NFS West Valley (an inactive reprocessing plant in New York State) was not representative, although recommended for this study. The cost at NFS was dominated by high-level waste tanks. High cost was due to storage of waste in a chemical form which became ineffective in light of regulations which were developed just after the plant was licensed for operation. We must be quite careful in extrapolating the NFS results. Decontamination costs at Dresden One (a working facility) represented a specific waste problem. Demolition costs (in our studies) were derived from a contrator's cost estimates. The estimates were prepared from examination of detailed plans of the plants and the estimates offered were what this specific contractor felt would be for that (reference) plant.

Comment

How many existing plants have the ability to do the work discussed in the presentation?

Response

The older plants in operation do not have the ability unless they have been back-fitted and upgraded. Prior to 1972 and 1973, plants licensed have simple and not very capable rad waste management systems. In the mid-1970's selective upgrading was begun. A significant number of plants today have or have in development the capabilities.

Comment

An individual made the point that there is an avoidance of the entombment issue in the presentation. All the utility companies which he represents have filed for permits to permanently entomb a number of nuclear facilities. And he asks for comment on this avoidance.

Response

Permanent entombment is indeed a viable option under NEPA. Perhaps it is less desirable for other reasons mentioned in the presentation. No criterion is clearly available today for entombment, but estimates are being included in decommissioning.

Comment

Furthermore, the same individual stated that entombment is favorable in light of the lack of disposal sites and disposal options available.

Response

It was strongly felt that if there are no means of disposing of wastes, then a facility should not be licensed to operate in the first place.

Comment

In the presentation there is a cost graph which covers a 40-year life for a nuclear facility. I have never seen, nor can I expect, 40 years to be a reasonable life span for a nuclear facility. I would like to see cost figures redone for what I would feel would be a more realistic life span.

Response

The life span is dependent entirely on the type of facility.

PHILADELPHIA - Closing Plenary

After the presentation of the working group reports, the floor was opened for a final comment period.

Mr. Robert Bernero:

Suggestion:

From past experience, a utility will not submit a plan until told to do so.

It is therefore suggested that:

1. NRC require the licensee to submit a preliminary plan within a given period after initial criticality (approx. 10 years).

   Rationale: Since different plans for decommissioning relate to various levels of cost, a general plan should be chosen in order to forecast finance.

2. NRC should require a specific plan two years prior to RX shutdown. This plan will vary as a radiation survey from plant-to-plant will show a variance in radiation parameters. Since there will be no positive clear line of demarcation of irradiated piping and components, NRC should require an independent radiation survey be held, documented and verified by NRC or their delegates. This would determine, from plant-to-plant, the amount of material to be removed.

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Summary:

1. Without a submitted pre-plan of some kind from the operators of nuclear facilities, it would be impossible for the NRC to forecast a waste repository program.

2. A required 10-year radiation survey (should be required) would be helpful to extrapolate and approximate amount of component/piping removal.

3. All of the above will trigger the operators to formulate their own plan of action and provide much needed input to the NRC.

Thank you for your considerations and would appreciate invitations to further workshops.

Howard T. Schobl
Nuclear Services Corp.

Please accept the following as both my comments and observations of the NRC Federal State Workshop on Decommissioning:

1. The participants and observers both were often at a loss because they had not gotten the three background documents despite the fact that they had been sent out with invitations from NRC.

2. The three background documents on (1) cost of decommissioning LWR, (2) cost of decommissioning Nuke facilities, and (3) new directions of NRC in decommissioning had many questionable to erroneous numbers in them. Peter Skinner of New York did an excellent job of pointing some - not all - of these out.

3. There were very few participants. I estimate that there were fewer than 100 participants and observers at these workshops on September 19, 1978. Considering the importance - both monetarily and healthwise - this number constitutes a very poor showing. I believe this shows the NRC's reluctance to advertise the importance of this workshop properly and fully. I hope the other two are better attended.

4. The NRC presented certain givens; i.e., those assumptions which the NRC takes as Gospel. The worst of these is that there is a proven, publicly acceptable, non-harmful technology available to knock down and handle these facilities with an acceptable level of danger to individuals or the general public.

5. I admit that there are radwastes and we must do something with them. I do not agree that the NRC's reports constitute the only route that can be taken with radwaste from decommissioning. Further, I did not hear any alternate radwaste strategy even considered.

6. The NRC presented some very unbelievable numbers. For instance, the NRC calls out 1 mrad/yr exposures when a facility is released for general use by the public. The NRC does not attempt to guarantee any particular exposure after the release. Therefore, pockets of undetected or purposely sealed-away material can break out in the ensuing years. This type of action can show the 1 mrad/yr or 1 mrem/yr exposure as a complete farce.

7. In the NUREG-0436 on NRC decommissioning directives, there is a table on page A-5. The footnotes go up to f. on page A-6. In the Regulatory Guide 1.86 following the table, the same table is repeated without footnote f (page B-5). Footnote f is the only teeth in the table. Eliminating footnote f castrates the effectiveness of the entire table.

8. I do not agree with the NRC's "deminimus" concept. I do not agree that there is any level of radioactivity acceptable to me because there are non-dangerous alternatives that obviate any supposed need for nuclear power.

9. I appreciate the help that Karl Abraham; Mr. Elasser, of NRC; Mr. Herb Jacobs, Government Energy Council; Mr. Joel Epstein, Governor's Office; and Congressman Joshua Eilberg gave me to get into this conference.

Marv Lewis

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COMMENTS by ANGELO F. ORAZIO on NRC POLICY
on DECOMMISSIONING of NUCLEAR FACILITIES

Philadelphia: September 18, 1978

As you all know, New York State has a special reason to be concerned with the Federal government's decommissioning policy: the Nuclear Fuel Services fuel reprocessing plant at West Valley.

Two disastrous mistakes were made in that case. First, the Atomic Energy Commission licensed that plant to operate, knowing that it would create large volumes of long-lived, high-level radioactive wastes, without seriously considering how those wastes could be disposed of permanently. At the time, back in the middle 1960's, the AEC was satisfied that such wastes could be stored permanently in liquid form in tanks with 40 year design lifetimes.

To make matters worse, NFS neutralized the material in the larger of the two high-level waste tanks on the West Valley site. That was a sensible way to slow corrosion and prolong the life of the tank; unfortunately, most of the radioactive material precipitated and formed sludge at the bottom of the tank. It will be difficult and expensive to remove to a permanent repository, whenever one is built.

The second mistake was more straightforward. The AEC did not make certain that NFS would be able to pay for the permanent decommissioning of the plant (that is, for restoring the site to a condition suitable for unrestricted use). Until a Federal waste repository is built, of course, that is probably moot. Nevertheless, I can't be sure that New York State taxpayers won't have to foot the bill for decommissioning the West Valley plant ten or fifteen years from now, and that bill could be anything up to $600,000,000.

I intend to do everything in my power to make sure that my constituents never have to face a possibility like that again. That is why I am co-sponsoring (with Assemblyman Hoyt) a nuclear power plant decommissioning fund bill. Our bill requires anyone who plans to build a nuclear power plant in New York State to set up a sinking fund to provide for decommissioning the plant, and orders the Public Service Commission to report to the Legislature on how the cost of decommissioning existing plants should be defrayed.

My main concern, is to be sure that the health and safety of the public are adequately protected by whatever decommissioning policy NRC adopts; that the public knows what technology has been developed for decommissioning and what the cost is going to be; and that the right people bear the cost. I believe it is only fair that these costs be included in the selling price of the electricity generated by nuclear plants.

I want to stress that we are concerned with the real health and safety of real people, and the real cost to real electric ratepayers. Some people have suggested that NRC ought to require licensees to dismantle their facilities as soon as they stop operating, to reassure the public that decommissioning can be done safely and at a reasonable or at least a known cost. They say, even though immediate dismantling may expose workers and the public to more radioactivity than safe storage and delayed dismantling. The argument has some plausibility, and if an operator wants to dismantle his plant immediately after shutdown for such reasons, NRC probably shouldn't prohibit him from doing so. NRC regulations, however, are not supposed to be vehicles for the nuclear industry's public relations; there is no sense in requiring immediate dismantling.

From what I have seen of NRC's new decommissioning policy plans, and from the two technical reports on decommissioning fuel reprocessing plants and pressurized water reactors, I believe the Federal government has set reasonable goals, and is making a determined effort to reach them. However, to develop a useful decommissioning policy, the Federal government must provide a high-level waste repository. The outcome of the Department of Energy's program in that area is still uncertain.

In the end, even though I don't know what the exact solutions will be, I believe the decommissioning and the waste disposal problems will be solved because they must be solved. That is a matter of faith, and to be frank, many New Yorkers don't share it. What we all need from NRC and DOE, is accurate data on all the costs of nuclear power, regulations which assure public health and safety, and continuing consultation. I hope this workshop will advance all those aims.

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Statement for the Nuclear Regulatory Commission workshops on Decommissioning of Nuclear Power Plants; Philadelphia, PA, September 18-20, 1978.

"Decommissioning" - what to do with the useless, highly radioactive hulks of nuclear power plants after their lifetime of 30 to 40 years is over - is another one of the many unsolved problems of nuclear power which threaten existing and future generations with enormous health and economic costs. That no provision has been made by utilities which operate nuclear facilities for shutting them down, and that construction of facilities has proceeded apace without anyone knowing how to deal with their remains, should surprise no one. It is simply another example of the complete disregard which the nuclear industry has shown for the public welfare; in the interests of letting nothing get in the way of the power and profits which nuclear energy offers to the corporations which promote it.

The Subcommittee on the Environment, Energy, and Natural Resources of the U.S. House of Representatives has this to say about the economics of nuclear energy:

"Contrary to widespread belief, nuclear power is no longer a cheap energy source. In fact, when the still unknown costs of radioactive waste and spent nuclear fuel management, decommissioning and perpetual care are finally included in the rate base, nuclear power may prove to be much more expensive than conventional energy sources such as coal, and may well not be economically competitive with safe, renewable resource energy alternatives such as solar power. Nuclear power is the only energy technology which has a major capitalization cost at the outset of the fuel cycle and at the end of the fuel cycle. As the cost of nuclear energy continues to climb, and as a solution to the problems of radioactive waste management continues to elude government and industry, States such as California are rejecting the increased use of nuclear power and favoring the greater use of renewable energy technologies."

Decommissioning by itself represents only a fraction of the costs which nuclear power imposes on society. Yet, even this fraction cannot be calculated with any degree of assurance, and may well be large enough by itself to spell the end of nuclear construction.

After approximately 30 years of operation every nuclear power plant will no longer be operable. The plant will be so radioactive that it will have to be sealed and guarded for a minimum of centuries, and possibly thousands of years. "These inoperable plants cannot be dismantled or moved without monstrous expense and tremendous risk of exposure to radioactivity because of the tens of thousands of tons of steel and concrete in each plant that are permeated with intense radiation." (Natural Resources Defense Council)

Nor can these costs be eliminated by shutting down a nuclear plant during its lifetime. The process of irradiation begins as soon as a reactor begins operating, and continues year after year as new fuel cores are inserted into the reactor.

Although experience with decommissioning is limited, there are a few examples to indicate what the lower range of costs may be. An experimental reactor at Elk River, Minnesota that cost about $24.5 million to build required $6.2 million to dismantle. At Oyster Creek, N.J. it is estimated that dismantlement would cost $100 million, or more than 150 percent of the $65 million construction cost. Instead, the utility is choosing a more "economical" route - "entombing" the plant at a cost of $35 million, leaving a permanent radioactive blot on the land.

The Department of Energy has reported that it currently has 300 obsolete or unneeded nuclear facilities, and will have 100 more by 1981. It estimates that $25 to $30 million annually for 100 years, a total of $2.5 to $3 billion, will be required to decommission these plants alone.

At West Valley, New York, where a privately owned fuel reprocessing plant was forced to shut down due to citizen opposition to the lack of guarantees that radiation would not leak from the plant, it may cost $600 million or more to decommission and decontaminate the facility. Since the private corporation had a loophole in its contract, it appears that the State of New York will have to pay for the clean up costs, although the corporation was able to collect profits while the plant was operating.

Current guesses are that dismantling may cost from $31 million to $100 million per power plant, or between 3 and 10 percent of a $1 billion capital cost. However, as the Subcommittee states:

"But these figures are all estimates, from the lowest to the highest, and no one really knows how much it will cost or who will pay the bill to decommission this Nation's commercial nuclear reactors. Decommissioning costs therefore represent substantial unknown costs of nuclear-generated electricity - costs ratepayers may be burdened with 40 years after the reactor startup date."

In considering the problems of decommissioning it is important not to forget the unsolved problems of long-term storage of radioactive wastes from nuclear power plants. Eahc plant produces thousands of pounds of low and high level wastes each year, including several hundred pounds of plutonium, one pound of which contains enough radioactivity to cause cancer in every person in the United States. "Each large nuclear power plant makes as much radioactivity every year as the explosion of 1,000 Hiroshima atom-bombs. The 140 plants planned for operation in the U.S. by 1985 will produce more radioactivity than 140,000 Hiroshima bombs every year - more poison than a full-scale nuclear war." (Committee for Nuclear Responsibility).

Both the Nuclear Regulatory Commission and the nuclear industry admit that there is NO known solution to the permanent storage of these wastes. Such ideas as encasement in salt beds or dumping in outer space have been found sadly lacking. Yet, planning and construction of nuclear plants continues with little concern for the future of humanity.

Professor James D. Watson, Nobel Prize winner from Harvard, a leading cancer researcher, states:

"I am increasingly worried that the current blossoming of the nuclear power industry will be an irreversible calamity for the human race... Only the tiniest of traces of plutonium are needed to induce cancer and if its use becomes widespread, the possibility must be faced of awful incidents, either accidental or deliberate, that will cause wide regions of our earth to become forever uninhabitable."

Construction of nuclear power plants should be halted NOW, and existing plants should be shut down. Nuclear power is dangerous, uneconomical, and unnecessary. We CAN meet our energy needs through conservation and safe, renewable energy sources. There is no justification for burdening all future generations with the threat of a radioactive wasteland.

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for the Keystone Alliance

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ATLANTA - Opening Plenary - Comment and Response Session

Comment

A question was asked by an individual regarding a recent essay in Time Magazine concerning the production of energy from nuclear power. His question was: "Is this article to be taken into consideration when answering the questions?"

Response

This article was an oversimplification and you should use your own best judgment in answering the 14 questions to be considered in the workshop.

Comment

Is there an existing dose rate?

Response

Yes, there is, but the limit refers to operational facilities.

Comment

Why do you worry about one to five mrems/yr when Colorado residents get two hundred mrems/yr naturally?

Response

It is suggested that you take the local background and use it as a reference.

Comment

Do changes in topography have an affect?

Response

A small affect, not significant.

Comment

Do we have an expert consultant to assist us?

Response

Yes, a representative from NRC will be available to each group.

Comment

Regarding the quantitative ideas of risk, we must take a careful look and we cannot base it on cost alone. Is this correct?

Response

Nuclear power has a risk, and we must compare that risk with other risks.

Comment

Are you evaluating alternative risks, environmental impact? From such things as coal and oil?

Response

Not in the decommissioning policy workshop. The NRC Division of Nuclear Reactor Regulation has a number of studies ongoing that will result in an evaluation of the impact of other generating options. This information is critical to the risk-benefit analysis that is addressed in the Environmental Impact Statement.

Comment

Can observers ask questions?

Response

It is up to the chairman at each individual workshop. The purpose of this workshop is a dialogue with the States.

Comment

Please clarify the Federal Energy Regulatory Commission responsibilities.

Response

Regulation of electricity and regulation of wholesale to retail. The Federal Energy Regulatory Commission is responsible for the regulation of interstate rates for gas, oil, and electricity.

ATLANTA - Battelle Presentation - Comment and Response Session

Comment

Is taxation considered?

Response

No. It is a local phenomenon.

Comment

Is it a mistake to consider present value costs?

Response

No.

Comment

What occupational exposure limits did you use?

Response

Three man-rem per quarter, which is within acceptable limits, was used.

Comment

What are the reasons for the contamination differences between the site and the facility?

Response

Different radionuclides were involved.

Comment

Can you give us a general estimate of the unit cost reduction for multiple reactors at the same site?

Response

Not yet. A study of multiple reactor sites is to be initiated during this coming fiscal year.

Comment

1400 rem for decommissioning sounds like a large number, but in perspective, it may not be large compared to the exposures of the whole country.

Response

I agree.

Comment

What is the difference in figures on costs presented?

Response

One is for fuel reprocessing, and the other is for power water reactors.

Comment

When you use a 10 percent discount rate, what is the problem?

Response

What is the difference between discount rate and inflation is a better question.

Comment

What is the time required for decommissioning?

Response

Approximately 4 years after an initial 2-year period of planning and preparation.

Comment

What licensing changes are required by NRC after decommissioning?

Response

NRC's licensing authority ends upon site release. However, some States have further licensing requirements for decommissioning.

Comment

Has NRC been advised of the change in the situation on hardened entombment?

Response

Give entombment a fair evaluation. It is a postulatable alternative.

Comment

Why did you use 40 years for normal life? Wouldn't 34 be better?

Response

Yes, it is arbitrary.

Comment

When examining the alternative to mothballing employed in the two studies, are you selecting a worse case situation?

Response

Mothballing can significantly reduce overall costs in the case of a site with multiple facilities. However, mothballing is a temporary procedure.

Comment

Clarify commissioning versus decommissioning.

Response

Commissioning is the authorization to acquire and use the radioactive material. Decommissioning is the authority to remove or stabilize the radioactive material. The problems arise in jurisdiction.

Comment

What is the status of waste storage facilities in the U.S.?

Response

We are concerned here with questions of decommissioning, not waste management.

Comment

What about military reactors?

Response

This is a different problem. The Department of Defense owns the sites and the Department of Defense is now cataloging and studying priorities. The emphasis is on abandoned sites.

Comment

Are cost reductions anticipated for only remote maintenance?

Response

We can only postulate. There will probably be a savings in manpower.

ATLANTA - Closing Plenary - Comment and Response Session

After the presentation of the working group reports, the floor was opened for a final comment and response period.

Comment

What about the reports from Philadelphia and Albuquerque workshops?

Response

All attendees will be mailed copies of the reports of all workshops.

Comment

An individual mentioned the tax problem and stressed its importance. He said we cannot let the Internal Revenue Service consider the decommissioning fund as ordinary income.

Comment

What about the cost of decommissioning versus construction?

Response

When corrected for inflation during the life of the plant, the cost of decommissioning a reactor falls in the range of 5 to 10 percent of the construction costs.

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ALBUQUERQUE - Opening Plenary - Comment and Response Session

Comment

There is confusion between the terms "dismantling" and "entombment." Do you do some of each? Do you do one or the other?

Response

You can actually do one or the other or both. Dismantling means to take a reactor apart, and the pieces would be transported to a waste disposal site. One could also envision entombing a reactor at a site, dismantling part of the reactor, and entombing the remainder at the site.

Comment

How does conversion of a nuclear reactor pertain to dismantling? The reactor could be converted to another reactor system or, alternatively, to a coal-fired plant.

Response

The steam turbine portion of a reactor could, for instance, be used for a coal-fired plant. Therefore, the reactor portion of a nuclear power plant could be dismantled, but the steam turbine portion converted for use on a coal plant.

Comment

Are the 14 questions just a starting point? Should further questions be generated?

Response

The 14 questions are just a starting point. You are not confined just to questions we have posed. You can answer or rephrase any or all as you choose.

Comment

Pertaining to the Clean Air Act, are the States empowered to set more stringent rules?

Response

The States can set more stringent rules, but not less stringent.

Comment

How did the certain States become Agreement States?

Response

A State becomes an Agreement State by requesting that status from NRC. It is a lengthy process which eventually results from the Governor agreeing to certain guidelines and assuming certain regulatory responsibilities.

Comment

Can a State employ a more strict (air, etc.) limit on emissions standards?

Response

A State can employ a more strict limit on emissions standards.

Comment

Would a more strict State law concerning NRC jurisdiction be valid?

Response

A more strict law would be valid.

Comment

Are the current mill operators required to follow the NRC decommissioning procedures?

Response

Current mill operators are required to follow NRC decommissioning procedures.

Comment

Given the great variety of nuclear facilities, how can you require a single dollar value bond or escrow for decommissioning?

Response

Such a dollar (single) value bond or escrow can probably not be required for the decommissioning of all nuclear facilities.

Comment

Are there any life-expectancy numbers for reactors and reprocessing plants?

Response

Most reactors should last for 30 years or even more. Reprocessing plants 20 to 30 years.

Comment

Are there some plant parts which could be used for a long time even after plant decommissioning?

Response

Yes, there are some plant parts which might be reused at another site.

Comment

Up to what point in time (progressing toward decommissioning and including it) is Price-Anderson coverage needed?

Response

Price-Anderson will cover in the operational period of the plant. Decommissioning is probably not covered by the Act.

Comment

When is Price-Anderson removed (in decommissioning)?

Response

At the end of plant operations when the final fuel load is removed.

Comment

When do Agreement States take over decommissioning (as the process takes place)?

Response

They can control it from the outset if they choose.

Comment

What would the NRC do if a licensed reactor just terminates his license and closes down (he gives up)?

Response

NRC would have to step in and take over the operation and eventual decommissioning. It is highly unlikely that a large utility would do that due to the liabilities it would incur.

ALBUQUERQUE - Battelle Presentation - Comment and Response Session

Comment

Have you made any attempt to understand the trade-off for man rems versus dollars?

Response

There has been no real attempt to pin down the man rem versus dollar issue. It is known that this is likely to be an important aspect of setting the man rem level(s).

Comment

If entombment is a possibility, then how do you reconcile dismantling and storing it permanently?

Response

Entombment, in place at the site, is something we would not want to do unless dismantlement were impossible for one reason or another.

Comment

If you are going to convert the plant, do you have the same costs for decommissioning?

Response

Probably not. They might be less, but not much.

Comment

Have you looked at the sensitivity of cost estimates with regard to site?

Response

We know the cost estimates are site-specific, but these studies have not been carried out to verify this assumption.

Comment

If the radioactivity in the core shroud is the highest, then what is the trade-off between removing this hottest part and entombing the rest?

Response

Such a study has not been carried out, but it could be of interest. However, in general, entombment is looked upon as an undesirable alternative relative to dismantlement.

Comment

What kind of containers are used to ship pieces?

Response

In general, the hot pieces can be shipped via spent fuel canisters. The lower-activity pieces can be shipped by less elaborate containers.

Comment

How old is the fuel that is removed from the core?

Response

A fraction of the fuel from a reactor is removed once each year.

Comment

The entombment in place seems to have a heavy burden of longevity. What does this longevity mean?

Response

It means that the area where the entombment has taken place will be unusable for possibly hundreds of years. Again, however, entombment is considered an undesirable method relative to dismantlement.

Comment

Describe the acid wash decontamination and how it works.

Response

An acid wash is circulated through the reactor's cooling system to wash out the radioactive material which has built up as a residue on the inner surfaces of that system. The liquid is then captured and disposed of.

Comment

What kind of decontamination can you get with the wash?

Response

The wash is capable of bringing the inner surfaces of the cooling system down to a level where short-term hands-on dismantlement operations can take place.

Comment

How long after decommissioning is the site ready to reuse?

Response

The site is ready for immediate use.

Comment

Give an example of how a plant might be built so that it can be decommissioned?

Response

Certain critical hot sections could be built so that they can be unbolted easily instead of cut apart.

Comment

What housekeeping procedures might be used during the life of a plant to aid in decommissioning?

Response

Periodic circulation of acid wash and general site cleaning on a periodic basis would certainly aid in ultimate decommissioning later on.

Comment

Aren't we talking of decommissioning all types of facilities and, therefore, unrestricted use of all lands afterwards?

Response

In general, yes.

Comment

Explain the difference between site and facility contamination levels.

Response

The nature of a reprocessing plant allows possible contamination within the plant from the operations and at or around the site itself where small spills take place or used equipment is stored. In general, the facility contamination levels will be much higher than that at the site outside the facility.

Comment

When you are talking about site contamination, are you talking about surface contamination?

Response

In general, we are talking about surface contamination except where some high-level wastes might have spilled and penetrated to some moderate depth.

Comment

If you start with the assumption that you can't move liquid underground waste storage tanks, what incentive do you have to dismantle a plant?

Response

You can, of course, remove the liquid waste from the tanks and solidify it. This solidified waste is then taken to a waste repository. It is possible that the tanks could then be dismantled and removed. But the easier approach might be to fill them with an inert solid and leave them entombed.

Comment

You can dismantle stainless steel tanks with acid wastes storage systems?

Response

Yes.

Comment

Can you dismantle carbon steel tanks with neutralized wastes storage systems?

Response

With considerable difficulty.

Comment

Your costs per Kg for wastes are less than the President's Working Group figures of $117/Kg?

Response

There is a difference. We will try to resolve it.

ALBUQUERQUE - Closing Plenary - Comment and Response Session

At the close of the final session, an individual expressed concern about uncertainties in the cost estimates in the presentations. He specifically addressed the costs for permanently disposing of radioactive wastes, the costs that would be incurred using craft labor, and the potential increases in man hours--and consequently costs--that might result from changes in occupational radiation exposure standards.

He felt that these uncertainties, together with financing options and tax implications, should be addressed in more detail in future meetings.

COSTS AND FINANCING OF REACTOR DECOMMISSIONING: SOME CONSIDERATIONS

POOR ORIGINAL

by
Vincent L. Schwent
Staff, California Energy Commission

September, 1978

ESTIMATES OF DECOMMISSIONING COSTS

Despite the paucity of actual decommissioning experience and the lack of detailed, specific decommissioning procedures, estimates of the costs of completely dismantling a power reactor have been ventured, as seen in Figures 1 and 2. These figures present some interesting conclusions:

- o Utility estimates for today's larger reactors (700-900 MWe) tend to range from $50 to $100 million (in today's dollars) for total dismantling.
- o Estimates by federal authorities or contractors associated with federal agencies tend to be much lower than utility estimates.
- o The widely-quoted Atomic Industrial Forum (AIF) study produced the lowest estimates ($27-31 million) of all those collected.

Implications. It is difficult to gather information on the detailed analyses underlying most of the cost estimates presented. Credibility varies: some of these estimates are probably based on little more than simple extrapolation from or repetition of the estimates provided by others, while other estimates (for example, those for San Onofre 1 and those in the AIF report) appear to have been the result of substantial analytical effort.

Further efforts wil be required to determine more fully the assumptions behind the estimates and possible deficiencies.

As noted, the utility estimates indicated that decommissioning a new 1,000 MWe reactor would cost more than $100 million. This is three times the AIF estimate (see Figure 2) and higher than those of the governmental entities or their contractors. Future study on the financing of decommissioning might attempt to verify these cost estimates and determine the reasons for the non-uniformity.

Problem Area: Uncertainty in Cost Estimates

A large degree of uncertainty exists in today's estimates of the costs of decontaminating and decommissioning reactors and this uncertainty grows as costs are estimated for dates in the future.

Cost estimates are uncertain because of the uncertainties in the exact procedures involved, the relevant regulatory requirements, the future costs of labor and materials, and the lack of relevant experience.

The NRC is attempting to develop procedures for decommissioning reactors and a report on pressurized water reactors was released last June (NUREG/CR-0130). The development of detailed and specific procedures and relevant health standards (e.g., bulk material standards) plus the accumulation of additional experience will all help to decrease the present cost uncertainties.

FIGURE 1
UTILITY COST ESTIMATES FOR DECOMMISSIONING (COMPLETE DISMANTLING)

Plant Operator Location	Reactor Size (MWe)	Reactor Type	First Operation	Dollar Cost (Millions)	% of Original Cost
Beaver Valley I Duquesne Light Shippingport, Pa.	852	PWR	1976	$ 50[a]	10%[a]
Three Mile Island I Met. Ed., JCP&L, Penn. El. Goldsboro, Pa.	792	PWR	1974	$ 95.8('77)[b]	
Three Mile Island II Met. Ed., Penn. El. Goldsboro, Pa.	880	PWR	1978	$ 94.5('77)[b]	
Turkey Point III Florida P&L Florida City, Fla.	666	PWR	1972	$100[c]	19%[d]
Millstone I Northeast Utilities Waterford, Conn.	652	BWR	1970	$ 59.5[e]	
Millstone II Northeast Utilities Waterford, Conn.	828	PWR	1975	$ 59[e]	
Connecticut Yankee Northeast Utilities Haddon Neck, Conn.				$48.7[e]	
Farley I Alabama Power Dothan, Ala.	860	PWR	1977	$100[c]	
Brunswick I Caroline P&L Southport, N.C.	821	BWR	1977	$128.5[c]	
Arkansas Nuclear I Arkansas P&L Russellville, Ark.	836	PWR	1974	$100[c]	
St. Lucie I Florida P&L Hutchinson Is., Fla.	803	PWR	1976	$100[c]	
Hatch I Georgia Power Baxley, Ga.	786	BWR	1975	$100[c]	

FIGURE 1
(Continued)

Plant Operator Location	Reactor Size (MWe)	Reactor Type	First Operation	Dollar Cost (Millions)	% of Original Cost
Calvert Cliffs I Baltimore G&E Lusby, Md.	850	PWR	1975	$100[c]	
North Anna I Virginia Elec. & Power Mineral, Va.	934	PWR	1978	$ 75[f]	
San Onofre 1 SCE, SDG&E San Clemente, Ca.	436	PWR	1968	$ 63-78 ('77)[g]	
Diablo Canyon 1 PG&E Diablo Canyon, Ca.	1060	PWR	1978	$ 35 (no contamination considered)[h]	

SOURCES

a. Duquesne Light's Statement 11-1 before the Pennsylvania Public Utility Commission, RID 373, pp. 24-25, gives the utility's share (47.5 percent) of Beaver Valley I decommissioning at $24,275,675.

b. Updated cost estimate, May 20, 1977, by W. A. Verrochi in Pennsylvania Electric's Statement No. 4, Exhibit 4-D-1, before the Pennsylvania PUC, RID 392.

c. Testimony of G. R. Faust, Gilbert Associates, Inc., before the Connecticut Public Utility Commission on the matter of providing for the costs of decommissioning Millstone I and II.

d. Letter from William B. DeMilly, Florida Public Service Commission, to Ben H. Fuqua, Vice President, Florida Power and Light, April 3, 1974.

e. Nucleonics Week, January 6, 1977, pp. 5-6.

f. Final Environmental Impact Statement, April 1973, Nuclear Regulatory Commission, Docket 50-338, p. 8-8.

g. R. Jon Stouky and E. J. Ricer, San Onofre Nuclear Generating Station Decommissioning Alternatives, Report 1651, for Southern California Edison (NUS Corp., February 1977).

h. Testimony of Peter N. Skinner, New York State Law Department, to the New York Public Service Commission, Case No. 26974, December 2, 1977, p. 21.

POOR ORIGINAL

FIGURE 2
GOVERNMENT AND INDUSTRY COST
ESTIMATES FOR DECOMMISSIONING

Reactor Size (MWe)	Reactor Type	Dollar Cost (Millions)	% of Original Cost
1100	PWR	$27('75)[a]	
1100	BWR	$31('75)[a]	
*	*	$25-50[b]	
*	*	$36-60[c]	
1000	*	$35-50('76)[d]	
115'	*	*	24%[e]
1175	PWR	$42('78)[f]	

*Not specified.

SOURCES

a. William J. Manion and Thomas S. LaGuardia, An Engineering Evaluation of Nuclear Power Reactor Decommissioning Alternatives, AIR/NESP-009SR (Atomic Industrial Forum, National Environmental Studies Project, November 1976).

b. Nucleonics Week, January 26, 1978, p. 15.

c. General Accounting Office, RED-76-7.

d. K. M. Harmon et al., "Decommissioning Nuclear Facilities", in Proceedings of the International Symposium on the Management of Wastes from the LWR Fuel Cycle, CONF 76-0701, sponsored by the Energy Research and Development Administration, Denver, Colo., July 1976.

e. See Figure 1, reference (h).

f. R. I. Smith et al., Technology, Safety and Costs of Decommissioning a Reference Pressurized Water Reactor Power Station, NUREG/CR-0130, U.S. Nuclear Regulatory Commission, June, 1978.

FINANCING THE DECOMMISSIONING OF REACTORS

Reasons for Special Financing of Decommissioning

Three factors argue that special efforts to provide for the eventual costs of decommissioning are warranted and necessary: the substantial costs involved in decommissioning, the necessity for equitable treatment of ratepayers, and the possibility of utility insolvency in the distant future.

1. Large Costs. The costs of decommissioning one of today's commercial reactors are a substantial expense for a utility to incur. Even at today's prices, costs could run to more than $100 million and complete dismantlement could take six to seven years to complete.[1] Any financing mechanism should provide for inflation, which, given a reasonable estimate of 4 to 8 percent per year, might increase the costs to from $300 million to $1 billion during the life of today's new reactors.*

2. Equitable Treatment of Ratepayers. Because the costs of decommissioning are large and because these costs are the direct and predictable result of operating a reactor to produce electricity, consideration should be given as to who should pay for the expense of decommissioning. If no mechanism is implemented to provide for the costs of decommissioning before the money is needed, the ratepayers of a utility at the time of decommissioning might be burdened with the costs of decommissioning a shutdown reactor from which they have derived little benefit (i.e., elecricity). Since present knowledge and experience can enable us to anticipate and to estimate of the costs of decommissioning, it would not be unfair to expect the consumers of nuclear power to pay the costs of decommissioning the plant. This can best be accomplished by collecting funds for this purpose during the operating life of the reactor by means of some financing mechanism.

3. Utility Solvency in the Distant Future. While the cost of decommissioning a reactor today might be a substantial expense, few commercial reactors may actually require decommissioning in the near future. Decommissioning of today's reactors may not take place until 30 to 130 years from now.** Therefore, the future ability of utilities to pay the future costs of decommissioning may be the more important issue. As a result, consideration should be given to the possibility that a utility, while perhaps capable of handling the expense today, may be unable, because of unforeseen future financial and/or economic events, to meet the costs of decommissioning (inflated over time) at that point in the future when decommissioning is most likely to be necessary. If in the future a utility with a decommissioning obligation is no longer present as a corporate or public entity, or is insolvent or otherwise unable to provide the necessary monies, the

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*Inflation rates of 4 to 8 percent, when compounded annually for 30 years, would produce cost increases of 224 percent and 906 percent, respectively. A decommissioning that costs $100 million today would, using these inflation rates, cost between $324 million and $1.009 billion 30 years from now.

**Range results from the possible inclusion of a 0-100 year delay to permit the decay of short-lived radionuclides added to an anticipated 30-year operating life.

liability will probably fall to the state or the federal government. It may be wise to protect against such a situation by the implementation at the outset of reactor operation of a mechanism to ensure that the necessary monies will be available when needed in the future.

In conclusion, it seems reasonable that one requirement for any acceptable financing mechanism is that, in a fair and equitable manner, it collects from the consumers of the power the cost of decommissioning the power source before the need occurs in a manner which reflects the true cost of providing the power.

Availability of Funds at Time of Decommissioning.

Having established that some financing mechanism is required, the preceding argument regarding the future solvency of utilities also has implications for the type of mechanism chosen. In the event that provision was not made to cover the costs of decommissioning, a utility on shaky financial ground might have a difficult time extracting the necessary monies from its operating revenues at the time when the work is to be performed. Even if the regulatory agency at that future time were to permit the utility to obtain the necessary monies from the ratepayers, the large amounts of money involved might further weaken the financial position of such a utility.

While it is possible that all utilities will still exist and be solvent at the time of decommissioning, this cannot be assured. Recent years have seen the financial position of many utilities slip substantially, from New York's giant Copnsolidated Edison to smaller utilities such as Public Service of New Hampshire and California's own San Diego Gas & Electric.* Given the period of time that will pass before today's new reactors may require decommissioning, it may be unwise to assume that all reactor operators will be able to remain financially secure. Additional unforeseen events might also weaken an individual utility. If a smaller utility with a large investment in one or two reactors was to experience an accident, earthquake, or other catastrophic event that damaged its reactor, the utility might, in short order, find itself the possessor of an inoperative, non-revenue-producing reactor in need of immediate decommissioning.

In light of the possiblity of future utility insolvency, it can be argued that in the selection of financing mechanisms for decommissioning the anticipted future solvency of the reactor operator should be carefully examined. A future situation in which a utility might be unable to pay for decommissioning costs directly out of future revenue (see "Expensed" funding mechanism in Figure 3) might be the same situation in which it would be unable to shift future revenue to pay for decommissioning funds that are in a depreciation account on the

*In 1974 Con Ed issued no dividends on its common stock and sold nuclear facilities to another power company to maintain stability. The ability of SDG&E to support a major share of the Sundesert Nuclear Project was officially challenged by the California Public Utilities Commission in May 1978 in its refusal to allow the utility to increase its rates to pay for Sundesert; SDG&E subsequently killed the project. For details on the case of Public Service of New Hampshire, see Nucleonics Week, December 8, 1977.

Figure 3
MECHANISMS FOR FINANCING DECOMMISSIONING

	Financing Mechanism	Who Pays	Handles Changing Cost Estimates	Accumulated Funds at Premature Shutdown	Funds Availability at Shutdown
1.	Expensed - Costs expensed when they are incurred. Pennsylvania PUC method.	Ratepayers at time of retirement.	No	None	None
2a.	Lump Sum Funded Account - Lump sum of cash deposited at reactor start in investment account. Principal plus accumulated interest will cover estimated cost.	Ratepayers at beginning of service.	Not without additions to principal.	Some, but full amount not accum. until anticipated shutdown.	Funds exist as liquid assets.
2b.	Sinking Fund Account - Equal installments of cash are deposited each year of plant operation. Principal plus accumulated interest will cover estimated cost. (Duquesne Light - Beaver Valley I proposal)	Ratepayers at time of service.	Can be periodically readjusted.	Some, but full amount not accum. until anticipated shutdown.	Funds exist a liquid assets.
3.	SLRL Depreciation Account - Estimated costs are depreciated over plant life by straight line remaining life method.	Ratepayers at time of service.	Can be periodically readjusted.	Some, but full amount not accum. until anticipated shutdown.	Funds exist only on books of utilit depend on income a time of shutdown.
4a.	Premature Shutdown Insurance - Bond is purchased to cover the decreasing difference between the funds accumulated by some other mechanism and the estimated cost at that point in time.	Stockholders or ratepayers at time of service.	Can be periodically readjusted.	Guarantees through third party insurer that full funds available at any time.	Insurance value decreases to zero at anticipated shutdown.
4b.	Surety Bond - Bond is purchased to guarantee that monies equivalent to those collected by a depreciation mechanism will be available at the time of decommissioning.	Stockholders or ratepayers at time of service.	Indirectly, through adjustments of depreciation mechanism.	Guarantees only that monies accum. by depreciation will be available, though these may be insufficient.	Guarantees that funds accumulated by another mechan will be available as liquid assets when needed.

Figure 3
MECHANISMS FOR FINANCING DECOMMISSIONING

Financing Mechanism	Who Pays	Handles Changing Cost Estimates	Accumulated Funds at Premature Shutdown	Funds Availability at Shutdown
1. Expensed - Costs expensed when they are incurred. Pennsylvania PUC method.	Ratepayers at time of retirement.	No	None	None
2a. Lump Sum Funded Account - Lump sum of cash deposited at reactor start in investment account. Principal plus accumulated interest will cover estimated cost.	Ratepayers at beginning of service.	Not without additions to principal.	Some, but full amount not accum. until anticipated shutdown.	Funds exist as liquid assets.
2b. Sinking Fund Account - Equal installments of cash are deposited each year of plant operation. Principal plus accumulated interest will cover estimated cost. (Duquesne Light - Beaver Valley I proposal)	Ratepayers at time of service.	Can be periodically readjusted.	Some, but full amount not accum. until anticipated shutdown.	Funds exist as liquid assets.
3. SLRL Depreciation Account - Estimated costs are depreciated over plant life by straight line remaining life method.	Ratepayers at time of service.	Can be periodically readjusted.	Some, but full amount not accum. until anticipated shutdown.	Funds exist only on books of utilit depend on income a time of shutdown.
4a. Premature Shutdown Insurance - Bond is purchased to cover the decreasing difference between the funds accumulated by some other mechanism and the estimated cost at that point in time.	Stockholders or ratepayers at time of service.	Can be periodically readjusted.	Guarantees through third party insurer that full funds available at any time.	Insurance value decreases to zero at anticipated shutdown.
4b. Surety Bond - Bond is purchased to guarantee that monies equivalent to those collected by a depreciation mechanism will be available at the time of decommissioning.	Stockholders or ratepayers at time of service.	Indirectly, through adjustments of depreciation mechanism.	Guarantees only that monies accum. by depreciation will be available, though these may be insufficient.	Guarantees that funds accumulated by another mechan will be available as liquid assets when needed.

company's books (see SLRL Depreciation Account mechanism in Figure 3). It could be argued that if uncertain future events justify the imposition of any financing mechanism, then they justify the imposition of one that does not depend on utility operating revenues at the time of decommissioning as the source of actual decommissioning monies.

An additional wrinkle is added to the problem of providing decommissioning funds if one considers the time interval between reactor shutdown and the actual dismantlement of the reactor. Assume that some mechanism has accumulated decommissioning monies from the consumers of the reactor's power. After the reactor is retired and shut down, no more money should be extracted from the ratepayers, in keeping with the previous arguments regarding their equitable treatment. Yet even if reactor decommissioning proceeded at a maximum pace, it might be 10 years after shutdown before the work would be completed. The AIF study suggested a delay of 100 years after shutdown before dismantlement should be attempted, to permit a decrease of radiation levels. Whatever funds have been accumulated must, therefore, be capable of covering the costs of decommissioning not at the time of shutdown but at times at least 10 years after shutdown and perhaps as much as 100 years after shutdown. If, after reactor shutdown, the decommissioning costs continue to inflate (in line with general prevailing inflationary trends), either more monies will have to be extracted from non-benefited ratepayers or else the accumulated monies must be able to grow by some other means in order to keep up with inflation. This other means might be the investment of these funds in income-producing securities or some similar mechanism. If financing for decommissioning during operation were accomplished by use of depreciation, for earple, it might at shutdown, by the above reasoning, be necessary to transfer the accumulated monies into incoming producing securities. Had a sinking fund been employed initially, rather than a deprecition account, the accumulated monies would already be in such a form at reactor shutdown.

In conclusion, there are reasons why one might want to select a financing mechanism of the kind that sets aside liquid assets rather than one that sets aside funds only on the company books, which must be supplied by future revenues. However, the cost of the various alternative financing methods may also impact the decision as to which method is selected.

Premature Shutdown.

Even though a financing mechanism may be capable of accumulating the necessary monies for decommissioning by the end of a reactor's estimated life, the mechanism may still be inadequate. It is the nature of most proposed financing mechanisms that they accumulate funds in an exponential fashion over time (see Figure 5). As a result, the accumulated reserve funds approach the costs of decommissioning only at the end of the estimated reactor life and are appreciably below the required amount until the final expected years of operation. Thus, if the estimate of the length of reactor lifetime is in error and shutdown comes prematurely, the accumulated assets may fall substantially short of the amount required to completely decommission at that time.

The life expectancy of a reactor may be shortened for a number of reasons. In California, the Humboldt Bay reactor is being considered for permanent shutdown[2] because of the recent discovery of suspected earthquake faults near the site.

This reactor is only 14 years into its expected 30-year life. The Dresden I reactor in Illinois, while only 17 years old, has high levels of in-plant radiation that have curtailed the operator's ability to perform routine maintenance; unless costly decontamination is successful it too may have to be prematurely retired. An accident such as the partial core metldown at the Fermi I plant in Michigan might force premature shutdown. Even accidents tht do not greatly threaten public safety may be so costly to repair that shutdown may be economically preferable.

The assumption that all reactors will meet the anticipated operating life of 30 to 40 years may not be made with certainty insofar as there has been insufficient long-term experience in this area. No commercial reactor has operated this long. In fact, the whole industry is hardly 30 years old. Given our brief experience, the question of the accuracy of estimates of reactor lifetime(s) is a legitimate one.

Since there appears to be reason for doubt regarding the absolute reliability of reactor lifetime estimates, the question arises as to how financing mechanisms might protect ratepayers or the public in general from the need to make up the deficit in accumulated decommissioning funds in a case of premature shutdown. Whatever financing procedure is adopted should be capable of providing sufficient monies to decommission even if the reactor is forced to shut down prematurely.

Uncertain Estimates.

Assuming for the moment that an estimate has been made of the cost of decommissioning a particular reactor at some expected future date and that a mechanism has been devised to collect the required monies by the predicted time of shutdown and at all times in between in case of premature shutdown, what other requirements might be warranted? A financing mechanism should be capable of accommodating errors not only in the estimated reactor lifespan but also in the original estimate of decommissioning costs.

The initial estimate of decommissioning costs may be predicated on certain assumptions regarding the inflation rate between now and shutdown, the relevant government regulations that will be in the force at shutdown, and the procedures that will be followed and the technology that will be employed to accomplish this decommissioning. All of these factors (and others) can and will quite likely change between now and the time of decommissioning.

Such uncertainties have led some to argue that the uncertainties of decommissioning are so great that we should do nothing at the present.[3] It has been further argued that the costs might eventually prove to be much lower than expected, and we might, therefore, needlessly collect more funds than necessary. Unfortunately, recent examples in the nuclear field as well as other new high-technology fields have shown that unknowns and uncertainties are often resolved at the expense of more regulation and higher costs. It would be imprudent to do nothing regarding decommissioning until all uncertainties are resolved, for these will, ultimately, only be resolved after a larger body of decommissioning experience has been accumulated. There are, however, modifications that can be made to financing mechanisms that can attempt to cope with whatever cost uncertainty exists.

The resolution of this apparent dilemma is fairly simple: annual reassessments of the future estimated costs, the future inflation rate, and/or the rate of return on invested monies and the remaining reactor life could all be factored into the financing mechanism to provide a readjustment of the amount of funds that would need to be accumulated that year. Such an "adjustable" financing mechanism would have the feature of "homing in" on the eventual decommissioning costs and, therefore, any mechanism adopted should have the ability to be periodically readjusted for changes in the estimated costs of decommissioning.

Summary of Criteria for Selecting Financing Mechanisms.

In summary, factors that should be considered in selecting a financing method should include:

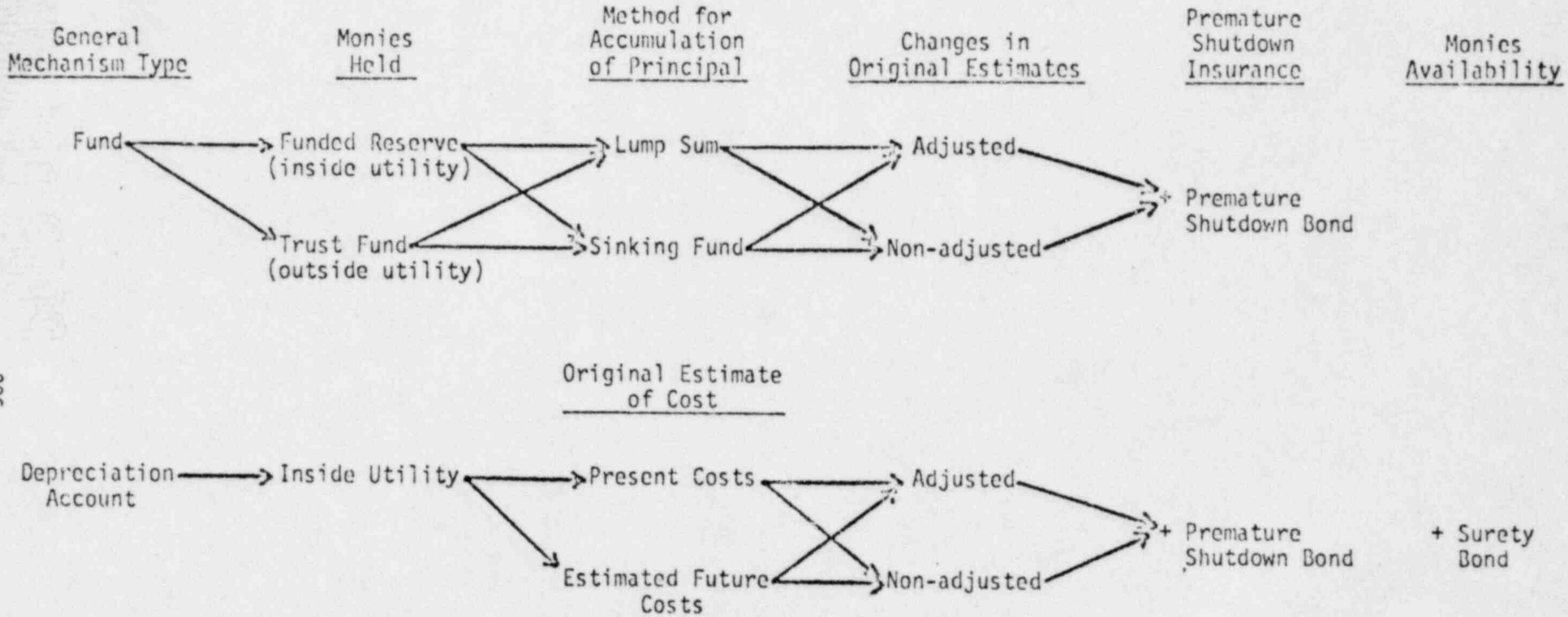
- o Collection of all funds from the consumers of the reactor's electricity;
- o Maintenance of the funds in cash, negotiable securities, or other liquid assets to protect against future utility insolvency;
- o Provisions to ensure that the total decommissioning costs will be available at any time in case of premature shutdown; and
- o Ability to readjust the rate of accumulation to account for uncertainties in original cost estimates.

MECHANISMS FOR FINANCING DECOMMISSIONING

The discussion above focused on four criteria by which potential financing mechanisms may be evaluated and compared. A large number of potential schemes for accumulating decommissioning costs can be constructed from the possible combinations of financing features which attempt to deal with the four criteria. It would be extremely laborious to discuss and evaluate all possible combinations but a sample of representative and distinctive financing possibilities will be considered in this section. As displayed in Figure 3, there are several mechanisms, and these are discussed below in the following groups: (1) expensed, (2) funded, including lump sum funded account and sinking fund account, (3) depreciation account (straight line remaining life method), and (4) bonding including premature-shutdown insurance and surety bonds. Figure 4 demonstrates that a variety of mechanisms can be constructed that are of either the funded or depreciation account type.

(1) Expensing: Future Power Users Pay Decommissioning Costs. As argued above, whatever mechanism is adopted, it must be structured to obtain decommissioning funds to the greatest degree possible from the ratepayers during the operating life of the reactor. While it is theoretically possible that decommissioning costs could be expensed and paid at the time they are incurred (see Figure 3), such an approach would be inequitable given the substantial costs that would be borne by non-benefiting future ratepayers. Additionally, such a mechanism might increase the possibility of the state or other governmental body becoming financially responsible. The financing option of simply expensing and paying for decommissioning at the time of dismantling is, therefore, rejected as an inequitable alternative.

Figure 4
SOME POSSIBLE FINANCING SCHEMES



(2) Funded Mechanisms: Real Assets Accumulate to Pay for Decommissioning. Funded schemes are, for the purposes of this discussion, briefly defined to be those financing methods in which cash or negotiable assets readily convertible into cash such as stocks and bonds, are accumulated by the utility to pay the costs of decommissioning (see Figure 3). Such monies, collected from the ratepayers, are not available to the utility for their general operating needs and may be spent only for decommissioning.

The money accumulated by a funded-type mechanism could either (a) be held under the direct control of the utility, but as a separate account or fund, or (b) the monies could be turned over to a third party, such as a bank, to be held essentially as a trust fund. Such collected monies would not be allowed to sit idly but would be invested or otherwise put to work to earn interest or other income. This would enable the accumulated monies to keep pace with the inflating costs of decommissioning. If the rate of return earned by this invested money was greater than the inflation rate, the income from investment would also help the total worth of the fund increase and thereby decrease the amount of funds that future-year ratepayers would have to add. While there is some risk that some of the investments could lose value, the investments could, of course, be made in high-grade securities and spread over a diverse group of issues to minimize the potential for any loss.

The funds established either inside or outside the utility could be structured so that the rate at which monies are collected from ratepayers over the reactor's life could vary considerably. At one exteme would be the lump sum method (see Figure 3). Estimates are first made of the present costs of decommissioning, the inflation rate between now and the time of decommissioning, and the expected rate of return on invested income over the same period. The estimated future costs are then calculated, as well as the present amount of money that, when invested earning the estimated rate of return, will grow to equal the predicted cost at the expected time of decommissioning. This calculated amount of principal is then provided at the start of reactor operation and, if all estimates are correct, no future money need be extracted from the ratepayers.

In order to spread the contribution of funds over the entire reactor lifetime, a sinking fund could alternatively be established. Given the same information and predictions of inflation and investment return, calculations can be performed that will determine the amounts of money that ratepayers might pay on a yearly basis over the reactor life than when totaled, along with interest earned, would equal the anticipated final decommissioning costs. Sinking funds, as commonly calculated, require that the yearly additions to the principal of the fund by ratepayers will be equal over the expected reactor life. If inflation continues during the life of a reactor, it might be argued that the ratepayers in later years of reactor life will be making their contributions to the sinking fund in dollars that are inflated and, therefore, worth less than those contributed by ratepayers in the early years. It should be possible to calculate a sinking fund, however, that incorporates some inflation rate for the value of money. In this manner later-year ratepayers might make a larger dollar contribution to the fund but one whose constant dollar worth is close to that of earlier contributors.

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Since either the lump sum or the sinking funds can be originally calculated for certain estimates of decommissioning cost inflation, investment return and reactor life, it might be possible to set these mechanisms in motion and leave them unchanged until the date of anticipated shutdown is reached. If, however, the estimates of the parameters of inflation, return, and lifetime are off, even by small amounts,the amount of funds accumulated and the time course of this accumulation may be substantially different from the eventual time and funds required. For this reason either of these funded mechanisms could be implemented in an "adjusted" manner to accommodate these uncertainties.

An adjusted fund, either lump sum or sinking, would be one in which periodic (yearly, for example) reassessments are made of present estimates of future inflation rates, rates of return, and remaining reactor life. Using the amount of funds accumulated at that point in time plus the above new estimates, the funds could be recalculated and new figures for the amount and schedule of additions to principal could be produced. As a result, an addition or reduction might be necessary in the principal contained in the lump sum fund or in the yearly installments of sinking fund. For either mechanism, periodic readjustments should guarantee that the funds accumulated will approximate the eventual amount required, barring some sudden and unexpected premature shutdowns.

That even an adjusted fund might be unable to accumulate sufficient monies in the event of premature shutdown may not be immediately obvious. Figure 5 graphically displays the rate at which funds would accumulate under a variety of mechanisms for one set of assumptions. The assumptions made are:

- o If the reactor in question were decommissioned immediately after construction, the cost would be $40 million at that time;
- o The expected reactor lifetime is 30 years;
- o The costs of decommissioning will inflate at five percent per year;
- o Money invested will return 10 percent tax free; and
- o Present tax laws applicable to utilities remain for the next 30 years.

Looking first at the line for decommissioning costs, one can see that the cost grows exponentially to a value of $172.8 million after 30 years, more than a four-fold increase. The lump sum fund under these assumptions would require $9.9 million in Year 0 to accumulate $172.8 million in principal and earnings in 30 years, while a sinking fund with equal yearly payments by the ratepayers would require the addition of $1.05 million per year to do the same.

For either fund, only within the last few years of reactor life do the accumulated monies come close to equaling the cost of decommissioning. If the reactor shuts down 15, 10, or even 5 years prematurely, the monies accumulated would be substantially deficient and non-benefiting ratepayers, utility shareholders, or the public would have to provide the difference. It is for this reason that consideration should be given to the addition of a bond to any fund; section (4) below discusses bonding.

(3) Depreciation Account: Decommissioning Funds Exist Only on Utility's Books. An alternative to setting aside funds or gradually accumulating funds for decomissioning is the depreciation account mechanism. Briefly, a utility, upon collection of monies for decommissioning from ratepayers but finding that the monies are not needed for 30 or more years, might decide to use these funds for the general operation of the company or the purchase of new equiment. While the actual money collected would be spent for non-decommissioning purposes, the utility would keep track on its books of the dollar amount of the accumulated depreciation. The transformation of this "accumulated depreciation" into cash to pay the costs of decommissioning would not occur until the actual work was performed and would be accomplished by using utility income at that future time.

One commonly employed form of depreciation assumes that the value of an object decreases linearly over the estimated remaining useful life of the item. This method of calculating depreciation is termed straight line remaining life (SLRL). In the case of a reactor, the operating utility estimates that over the anticipted life (usually 30 years), the value of the plant will decline to a worth less than zero. This results from the fact that when a reactor is no longer useful, it cannot simply be abandoned at no cost to the utility but must be decommissioned, requiring an additional expenditure of funds. As a result, its worth decreases not just to zero but actually crosses zero to become a negative amount symbolizing these decommissioning costs.

Using SLRL depreciation, a utility would claim that for a reactor with a 30-year life, one-thirtieth of the original construciton cost plus eventual decommissioning costs must be recovered each year from the ratepayers so that not only the original costs can be recovered, but also money for decommissioning will be available at shutdown.

In the case of the fund-type mechanisms previously discussed, the use made in the interim of money collected for eventual decommissioning was specific and restrictive. The incoming money would be kept separate from other utility income and invested to earn a rate of return in a manner which would permit ready conversion back into cash. For depreciation-type methods, the interim use of money collected during the reactor's operating life is not restricted. The money may be treated as ordinary income and used as such to pay any expenses the utility might have or to invest in capital improvements, such as new non-reactor facilities and equipment. The amount of the decommissioning money collected under these depreciation procedures would be entered on the company books in an account for "accumulated depreciation". Since the actual money collected from ratepayers was spent shortly after collection for non-decommissioning purposes, the payment of decommissioning expenses, when they are finally realized, would have to be made out of utility income at that time. An important component of the depreciation-type mechanism that deserves particular attention, therefore, is the expected ability of a utility to generate at the time of decommissioning income sufficient not only to meet normal operating needs at that time but also sufficient to meet the costs of decommissioning without burdening future ratepayers.

Depreciation-type mechanisms keep the accumulated decommissioning monies inside the utility--as opposed to the funded mechanisms, which might be set up either within the utility or with outside agencies. Figure 4 shows that the depreciation approach can be of either the adjusted or nonadjusted variety. In a nonadjusted SLRL format, the estimated costs of decommissioning are simply divided by the years of remaining life and that amount is added to the depreciation account each year. Adjusted mechanisms, as with the funded approach, periodically reevaluate the magnitude of estimated costs and the expected remaining life. A new number may thereby be derived for the yearly amount depreciated for purposes of decommissioning. Nonadjusted depreciation methods suffer the same fault as nonadjusted funds: if the original guesses prove to be inaccurate, the funds eventually accumulated may differ substantially from the required amount.

Either adjusted or nonadjusted depreciation methods might in theory be established that use, as their basis for calculating the initial rate of asset accumulation, either the estimates of decommissioning costs at the present time or an estimate of costs at the future time of decommissioning. For a nonadjusted depreciation method, use of the estimated future costs is essential if the utility hopes to be even close to the eventual costs incurred. This results from the enormous increase in costs over 30 or more years for even low rates of annual inflation (see Figure 5). While an adjusted depreciation mechanism should, at least on paper, accumulate the proper amount of money by the time of expected reactor retirement, if the present cost is used as the basis for calculating depreciation at the start, the rate of accumulation will be slow until the last few years of reactor life. In this case the difference between accumulated money and decommissioning costs in the event of premature shutdown will be greater than if some estimate of inflated future costs were originally used as the basis for depreciation at the outset.

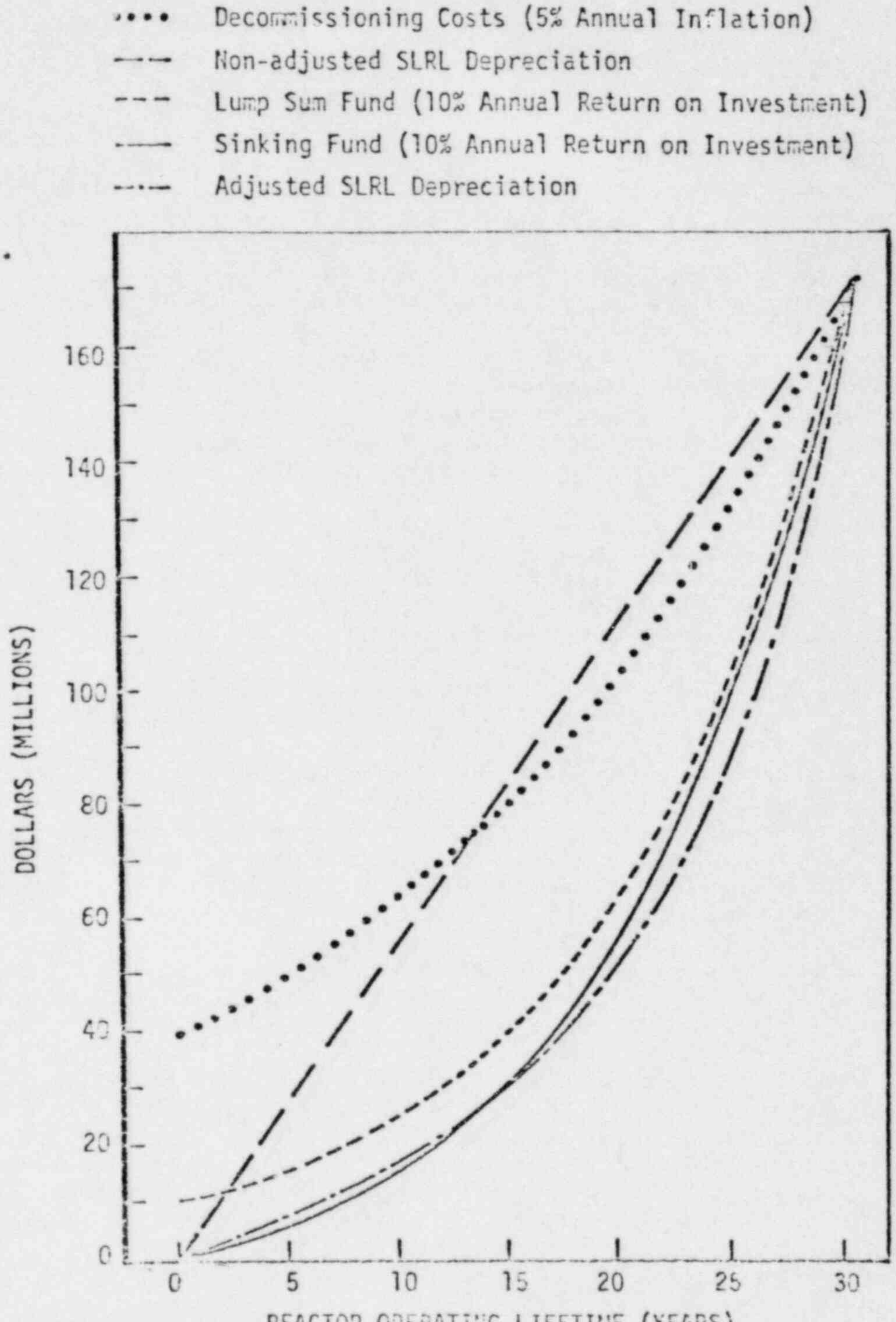
Just as with funded methods of providing for decommissioning, the depreciation methods are generally inadequate to handle the possibility of premature shutdown, especially if present costs are used as the initial basis for calculating depreciation. As a result, the depreciation approach might also be benefited by the addition of a performance bond or other mechanism to cover the deficit in the event of premature shutdown.

<u>(4) Bonding: Insurance of Sufficiency of Funds to Pay for Decommissioning.</u> The preceding discussion has focused on financing mechanisms in which all monies for decommissioning would be accumulated by the reactor operator. There is another approach to ensuring that in certain unusual circumstances, monies will not have to be extracted from the public or non-benefiting ratepayers and that is the use of a bond. While there might be many uses of bonding as components of a complete financing mechanism for reactor decommissioning, this report will focus on two.

<u>Premature-Shutdown Insurance.</u> As discussed previously, if the financing of decommissioning relied solely on the use of the funded or depreciation mechanisms, it is likely that in the event the reactor is forced to shut down before the anticipated end of its normal life, insufficient monies would have been accumulated to cover the costs of premature decommissioning. With funded or depreciation mechanisms, the accumulated monies reach the full amount required only at the originally predicted date of shutdown (see Figure 5). Given the past and present experience in the commercial reactor industry, it is not unlikely that there may be instances in the future in which a reactor will

Figure 5

A COMPARISON OF THE RATE AT WHICH SEVERAL FINANCING MECHANISMS ACCUMULATE DECOMMISSIONING MONIES



Based on the model presented in "Accounting Today for Future Nuclear Plant Decommissioning Cost" by Benjamin J. Evers, Jr., presented at A.G.A. - E.E.I. Accounting Conference, Dearborn, Michigan, May 1977.

be forced to shut down prematurely. One possible method to ensure that the public or non-benefitting ratepayers will not be asked to make up any deficiency in the needed funds would be to require that the reactor operator purchase a bond that would provide the money necessary to cover the deficit in this event.

Surety for Availability of Accumulated Decommissioning Monies. It was previously pointed out that depreciation-type financing mechanisms depend upon the income of the utility at the time of decommissioning to provide the monies to cover this expense, and that financial or economic difficulties might restrict the availability of such income. A bond might be obtained by the utility that would require the bonding institution to provide monies in an amount up to the amount collected previously by the utility from ratepayers for decommissioning under depreciation in the event that the financial position of the utility at the time decommissioning will not enable the utility to generate sufficient cash from income to equal the amount it had collected as depreciation. The coupling, therefore, of (a) a requirement to obtain a bond to cover the accumulated monies in the event of non-payment by the utility and (b) some kind of premature-shutdown insurance could provide increased assurance that no part of the ultimate costs will be borne by the public or post-shutdown ratepayers.

It would appear that this latter use of bonding has been recently adopted by the Connecticut Public Utilities Control Authority in their decision permitting Connecticut Light and Power to use a depreciation mechanism to provide for the eventual costs of mothballing Millstone I and II. Connecticut Light and Power was required to file annually with the Connecticut PUCA a corporate surety bond to ensure that monies collected by depreciation will be used for decommissioning.[4]

The use of bonds in the manner described above may not be that dissimilar to the bonding authority that seven states presently have to require bonding of the operators of state licensed non-reactor facilities handling radioactive materials to ensure the eventual decontamination of these facilities.[5] The State of Kentucky is considering the use of bonding to ensure that the operator of a low-level waste burial facility in that state will pay both the costs of decommissioning that facility and of its perpetual care to protect future public health.[6] The NRC presently requires bonding of new licensees who operate uranium mills to similarly guarantee that decommissioning these facilities will be funded by the licensee.[7]

Costs of Bonding. Further study of the concept of bonding will be required in order to better determine who might be potential suppliers of such decommissioning bonds, what the exact costs of such bonds might be, and the factors that will affect these costs. It may be possible that the utilities affected could construct a pooling arrangement for these bonds such as that which presently exists to provide liability insurance and indemnification for reactor operators.

COSTS OF THE FINANCING MECHANISMS

All mechanisms under certain circumstances will recover the total expense of decommissioning, but some mechanisms may better reduce the risk that parties other than the ratepayers consuming the electricity will pay in the event of less than ideal circumstances. Estimating the total costs to the ratepayer and utility of possible funding mechanisms is a complex and arduous task.[8] Since the primary reason for implementing any special procedures for gathering monies for reactor decommissioning is to provide some level of assurance that the total cost will be borne by the appropriate parties, it seems more important at the present level of this review to concentrate on the benefits and disadvantages of different mechanisms rather than on the net costs to ratepayers of implementing different mechanisms. In this light, detailed discussion of the comparative costs of implementing various mechanisms will be deferred for future analysis. It is appropriate at the present time, however, to give some indication as to the number of factors than can influence the eventual implementation costs.

From the previous discussion of various financing mechanisms, it should be clear that two important factors in predicting the total cost of implementing any mechanism are the future inflation rates and the future rate of return on invested income. The estimated total costs of any mechanism involving a fund or a depreciation account are very sensitive to the predicted inflation rate since inflation compounded is a power function and one property of such a function is that the value at some future point can be drastically altered by small changes in the rate at which it increases (i.e., the inflation rate). As an example, 4 percent annual inflation rate over 30 years will produce a 224 percent increase in the original cost of an item. Doubling the rate to 8 percent per year does not simply double the 30-year increase to 448 percent but rather to 906 percent.

For funded procedures, such as the sinking fund or the lump sum fund, the expected rate of return from investing the accumulated principal is similarly sensitive since, if accumulated principal and interest are reinvested, the total accumulated funds will grow rapidly. If the original estimate of the amount of total funds that will result from interest or other income earned from investing the ratepayers contribution is even slightly inaccurate, the eventual amount that ratepayers must contribute to the fund, and therefore the total cost to ratepayers, may change dramatically.

In addition to these two factors, tax laws play a large part in determining the total costs to ratepayers. For mechanisms such as the depreciation account, present tax laws do not permit the utility to subtract the yearly funds set aside for decommissioning from that year's income. As a result income taxes must be paid on the money received from ratepayers for decommissioning. Since taxes are in theory almost half of income (48 percent) for utilities, almost $2 must be collected from ratepayers in order to have $1 after taxes to put aside for decommissioning.[9] The situation may be even more complex. The ratepayers may receive a credit based on the interest the utility would have had to have paid to go outside the company to borrow money equivalent to the collected decommissioning monies it was allowed to use. In addition, there may be future tax credits piled on top of this credit.

For a mechanism involving a fund, the total costs are affected by whether or not tax has to be paid on the interest earned from investing the collected principal. If investments are made in tax-free securities or if a special tax break were allowed this interest income, the effective rate of return would be altered. The California PUC staff has pointed out in a recent decommissioning

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action regarding San Onofre 1 that, under present tax law, when decommissioning is actually performed the utility will have a large tax deductible expense and consequently will have a tax break that will benefit the utility's shareholders or its post-decommissioning ratepayers but not those ratepayers who actually paid the decommissioning costs.[10] Handling this tax break equitably will not be easy. The costs of a bond used to cover premature shutdown might also be difficult to predict since, if original predictions of the frequency of premature shutdown and the costs of decommissioning at those times prove inaccurate, the annual fees for the bonds will have to be adjusted just as would the annual premiums of an insurance policy.

CONCLUSIONS

1. When selecting a financing mechanism for decommissioning, care must be taken to ensure that the mechanism chosen is selected on the basis of why a mechanism is thought to be needed and what the mechanism is intended to ensure rather than solely or largely on the basis of how much the mechanism costs.

   Financing methods for reactor decommissioning are intended to be insurance devices ensuring that the appropriate parties will bear the costs whenever the need for this terminal disposition arises. As a result, it is important that decisions as to the need for and form of such a mechanism result from a determination of what amount and type of "insurance" is needed before consideration of its cost. The possible financing methods are clearly not equal in the extent and breadth of protection they afford.

2. Old financing solutions may not be appropriate for reactor decommissioning.

   It may not be prudent to automatically extend financing procedures that have previously been found useful for providing for disposal and replacement of certain other utility equipment to reactors. Because reactors concentrate very large sums of money in very few items and because of the relatively large negative salvage value and short history, procedures which may prove adequate for retiring, replacing and disposing of transformers and pick-up trucks need to be reevaluated before being applied to billion dollar nuclear reactors.

3. Reactor specific detailed decommissioning cost estimates should be obtained for each reactor before implementing any financing mechanism.

   Few cost estimates presently available appear to have been the result of a thorough evaluation of the costs of terminally disposing of a reactor. The costs are highly dependent on the degree and manner of decommissioning envisioned. Detailed, thorough cost estimates can be prepared at a relatively small cost with the cooperation of the operating utility.

4. Efforts need to be undertaken immediately to resolve questions regarding the effect of taxation on costs of implementing various financing alternatives.

   The costs of employing the various financing alternatives discussed will vary depending upon the tax treatment monies accrued under these mechanisms received. Resolution or revision of state and federal tax policies could hopefully enable mechanisms which afford the greatest protection to the public and most equitable distribution of decommissioning costs to absorb the most inexpensive to the ratepayers paying for decommissioning.

5. Arrangements should be explored which would permit reactor operators to obtain surety bonds and premature shutdown insurance at the lowest cost.

Reactor operators presently use pooling arrangements to provide accident insurance. Similar pooling arrangements between reactor operators, private bonding organizations and/or state and federal agencies should be examined as a means to ensure that the surety bonds and premature shutdown bond discussed above will be available and at the lowest possible cost.

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6. Stephen A. Johnston and John L. Warren, Financial Analysis of Perpetual Care and Maintenance for the Maxey Flats Low-Level Nuclear Waste Disposal Site, RF 230-1492 (Kentucky Legislative Research Commission, September 1977).

7. Nuclear Regulatory Commission, Regulatory Guide 3.5, "Standard Format and Content of License Applications for Uranium Mills", Sec. C5.5.

8. A more thorough discussion of the costs of some financing alternatives can be found in Benjamin J. Ewers, Jr., of Northern States Power, Minneapolis, "Accounting Today for Future Nuclear Plant Decommissioning Cost", presented at the American Gas Association-Edison Electric Institute Accounting Conference, Dearborn, Mich., May 1977.

9. Ibid.

10. Report on the Results of Operation of Southern California Edison Company: 1978 Estimated; Test Year 1979, Staff Report, Application No. 57602 (California Public Utilities Commission, Operations Division, February 3, 1978).

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APPENDIX C

[7590-01]

REVIEW OF NRC DECOMMISSIONING POLICY

State Workshops

The Nuclear Regulatory Commission (NRC) is now considering development of a more explicit overall policy for nuclear facility decommissioning and amending its regulations in 10 CFR Parts 30, 40, 50, and 70 to include more specific guidance on decommissioning criteria for production and utilization facility licensees and byproduct, source, and special nuclear material licensees. An advance notice of proposed rulemaking was published in the FEDERAL REGISTER on March 13, 1978 (FR 43 10370-10371, FR Doc. 78-6461). The NRC staff set forth in detail its proposed plan for the development of an overall NRC policy on decommissioning of nuclear facilities in NUREG-0436, "Plan for Reevaluation of NRC Policy on Decommissioning of Nuclear Facilities," March 1978.

To obtain the views of the States on its policy, NRC is holding three regional workshops to discuss the specifics of the NRC plan (NUREG-0436) as well as its first two decommissioning reports (NUREG-0278),"Technology, Safety, and Costs of Decommissioning a Reference Nuclear Fuel Reprocessing Plant" and NUREG/ CR-0130 "Technology, Safety, and Costs of Decommissioning a Reference Pressurized Water Reactor." The Governors, legislative leadership and public utility chairmen of each State have been invited to send representatives to participate in any one of the three workshops. Information developed at the workshops will be considered in the reevaluation of NRC's decommissioning policy. The results of additional studies now underway, involving other types of nuclear activities, will be discussed at workshops planned for 1979.

The workshop locations and dates are as follows:

September 18-20, Holiday Inn Midtown, 1305-11 Walnut Street, Philadelphia, Pa. 19107.

September 25-27, Sheraton-Biltmore Hotel, 817 West Peachtree Street NE., Atlanta, Ga. 30383.

September 28-30, Sheraton Old Town, 800 Rio Grande Boulevard NW., Alburquerque, N. Mex. 87104

These workshops are being held to obtain the views of, and to provide the opportunity for discussion among, State officials; however, all sessions will be open to public attendance and observation on a space available basis. Reports will be filed in the NRC Public Document Room.

Persons who wish further information about these workshops or who wish to observe should write Ms. Shirley Ingebritsen, Workshop Coordinator, SCS Engineers, 11800 Sunrise Valley Drive, Reston, Va. 22091, or call 703-620-3677, giving name, address, and phone number.

Dated at Bethesda, Md., this 28th day of July 1978.

For the Nuclear Regulatory Commission.

HAROLD E. COLLINS,
Acting Director,
Office of State Programs.

[FR Doc.78-21506 Filed 8-3-78; 8:45 am]

APPENDIX D

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

AUG 0 4 1978

The Honorable George C. Wallace
Governor of Alabama
Montgomery, Alabama 36104

Dear Governor Wallace:

The Nuclear Regulatory Commission (NRC) is now engaged in the development of a more explicit overall policy for nuclear facility decommissioning. A detailed reevaluation plan of our current policy (NUREG-0436) was issued in March 1978 and sent to all States for comment. The NRC will hold the first set of regional workshops to review with State officials the specifics of its plan at these dates and locations: September 18-20, Philadelphia, Pennsylvania; September 25-27, Atlanta, Georgia; and September 28-30, Albuquerque, New Mexico.

I would like to invite you to designate representatives from your staff and from appropriate State agencies to participate in these workshops. We hope that knowledgeable participation would come from the areas of radiation control, environmental protection, power plant siting authorities, land use policy, and if possible the attorney general's office. I ask that you designate three individuals to represent your State. You may, of course, send other individuals as observers. In the event that there are budgetary difficulties, we have some money available for travel. I am also sending letters of invitation to the leadership of the State legislatures and the public utilities commissions.

I would appreciate it if at your earliest convenience you could send us a list of the names, positions, addresses and telephone numbers of the participants from your State to the contractor providing support for the workshops: SCS Engineers, Attn. Ms. Shirley Ingebritsen, 11800 Sunrise Valley Drive, Reston, Virginia 22901, (703) 620-3677. So that we can make the necessary arrangements, we would like to have your list by August 15.

I am enclosing background material on the issues to be discussed.

Sincerely,

Robert G. Ryan

Robert G. Ryan, Director
Office of State Programs

Enclosure

cc: Aubrey Godwin, Director
Dept. of Public Health

Ed Hudspeth, Staff Director
Energy Management Board

IDENTICAL LETTER AND ENCLOSURE SENT TO THE FOLLOWING ADDRESSEES

ALABAMA

Governor George C. Wallace

cc: Aubrey Godwin, Director
Alabama Dept of Public Health

Ed Hudspeth, Staff Director
Alabama Energy Mgt Board

ALASKA

Governor Jay S. Hammond

cc: Ernest W. Mueller, Commissioner
Alaska Environ Conserv Dept

ARIZONA

Governor Bruce Babbit

cc: Donald C. Gilbert, Executive Director
Arizona Atomic Energy Commission

ARKANSAS

Governor David H. Pryor

cc: Rex Ramsey, Director
Arkansas Dept of Health

CALIFORNIA

Governor Edmund G. Brown Jr

cc: Frank Hahn
California Energy Commission

COLORADO

Governor Richard D. Lamm

cc. Robert D. Si k
Colorado Dept of Nat Resources

CONNECTICUT

Governor Ella T. Grasso

cc: Maryann Guitar, Chairman
Conn PWR Facilities Eval Cncl

DELAWARE

Governor Pierre S. Dupont

cc: Austin P. Olney, Secretary
Delaware Dept of Nat Resources

David L. Press, Governors Energy Advisor
Delaware Energy Office

FLORIDA

Governor Reubin Askew

cc: Hamilton Oven Jr, Administrator
Florida Dept of Envir Regulation

GEORGIA

Governor George Busbee

cc: J. L. Ledbetter Director
Georgia Dept of Natl Resources

HAWAII

Governor George R. Ariyoshi

cc: James S. Kumagai, Deputy Director
Hawaii Dept of Health

IDAHO

Governor John Evans

cc: Lee W. Stokes
Idaho Dept of Health & Welfare

ILLINOIS

Governor James R. Thompson

cc: Frank Beal, Director
Institute of Energy & Environ Resources

INDIANA

Governor Otis R. Bowen

cc: Ralph C. Pickard, Asst Commissioner
Environ Health
Indiana Board of Health

IOWA

Governor Robert D. Ray

cc: Maurice Van Nostrand, Chairman
Iowa Commerce Commission

KANSAS

Governor Robert F. Bennett

cc: Gerald W. Allen, Director
Kansas Dept of Health & Envron

KENTUCKY

Governor Julian M. Carroll

cc: Frank Harscher, Special Asst to
Governor
Kentucky Office of Governor

LOUISIANA

Governor Edwin Edwards

cc: Jim Porter
Louisiana Dept of Conservation

MAINE

Governor James B. Longley

Henry Warren, Commissioner
Maine Envir Protection Dept

MARYLAND

Governor Blair Lee (Acting)

cc: Paul Massicot, Dir Power Plant
Siting Program
Maryland Energy & Coast Zone Admin

MASSACHUSETTS

Governor Michael S. Dukakis

cc: Edward J. Daily, Director
Mass Energy Facil Siting Cncl

MICHIGAN

Governor William G. Milliken

cc: Jonathan Cain, Special Assistant
Michigan Office of Governor

MINNESOTA

Governor Rudy Perpich

cc: Peter Vanderpoel, Chairman
Minnesota Environ Quality Bd

MISSISSIPPI

Governor Cliff Finch

cc: P. T. Bankston, Director
MS Fuel & Ener Mgt Comm

MISSOURI

Governor Joseph Teasdale

cc: Weston A. Fisher, Program Director
Missouri Energy Agency

MONTANA

Governor Thomas L. Judge

cc: Lawrence Lloyd, Chief
Montana Bur of Occupation Hlth

Ted Schwinden, Lt Governor

Robert Anderson, Administrator
Montana Div Energy Planning

NEBRASKA

Governor J. J. Exon

cc: Richard H. Hansen, Senior Legal Counsel
Nebarska Dept of Envir Control

NEVADA

Governor Mike O'Callaghan

cc: Noel A. Clark, Director
Nevada Dept of Energy

NEW HAMPSHIRE

Governor Meldrim Thomson Jr

cc: Marshall Cobleigh
New Hampshire Off of Governor

Phil Weymuth, Special Assistant
New Hampshire Off of Governor

NEW JERSEY

Governor Brendan T. Byrne

cc: Joel R. Jacobson, Commissioner
New Jersey Dept of Energy

NEW MEXICO

Governor Jerry Apodaca

cc: Theodore Wolff, Program Manager
New Mexico Radiation Prot Agen

NEW YORK

Governor Hugh L. Carey

cc: Jeffrey C. Cohen
New York Energy Office

NORTH CAROLINA

Governor James Hunt Jr

cc: Hugh Wells, Executive Director
North Carolina Utilities Comm

NORTH DAKOTA

Governor Arthur A. Link

cc: Dr. T. Dwight Connor
Energy Management Conservation Office

OHIO

Governor James A. Rhodes

cc: William B. McGorum Jr, Secretary
Ohio Power Siting Commission

OKLAHOMA

Governor David L. Boren

cc: Dale McHard, Chief Occupa & Rad
Hlth Svc
Oklahoma Dept of Health

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Governor Dolph Briscoe

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Governor Scott M. Matheson

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WASHINGTON

Governor Dixie Lee Ray

cc: Larry Bradley, Director
Washington State Energy Office

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WISCONSIN

Governor Martin J. Schreiber

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WYOMING

Governor Edward Herschler

cc: Blaine Dinger
Wyoming Off of Indust Fac Site

PUERTO RICO

Governor Carlos Romero Barcelo

cc: Frank Castellon, Director
Puerto Rico Energy Office

IDENTICAL ENCLOSURE SENT WITH ALL LETTERS

BACKGROUND PAPER

State Review of NRC
Policy on Decommissioning of
Nuclear Facilities

The responsibility for assuring safe and environmentally acceptable decommissioning of nuclear facilities rests with 1) the Nuclear Regulatory Commission (NRC) because it regulates the private users of nuclear materials, including power plants, uranium mills and processors of nuclear fuels; 2) the Agreement States because of their regulatory responsibility over source, byproduct, and special nuclear materials in less than critical quantities; 3) the Department of Energy (DOE) because it must dispose of or decommission the facilities it owns; and 4) the Environmental Protection Agency (EPA) because it is responsible for setting standards for the protection of the environment from all sources of radiation.

NRC regulations currently in effect cover the requirements and criteria for decommissioning in only a limited way. These regulations and specific requirements are described in some detail in a reevaluation plan of current NRC policy (NUREG-0436) issued in March 1978. Regulatory guidance is presented in Regulatory Guide 1.86, a copy of which is contained in NUREG-0436. This guide defines four methods for retirement of a facility: mothballing; in-place entombment; removal and dismantlement; and conversion to a new facility. The guide also gives advice on decontamination for unrestricted release, including a table of acceptable surface contamination levels.

Conversion of the nonnuclear and uncontaminated components of a facility (i.e., electrical generating components, structures) is irrelevant to the issue of radiological health and safety. There then remain three modes of decommissioning. Mothballing consists of removing all fuel and source material, the disposal of all liquid and solid waste and placing the facility in a state of protective storage. Entombment requires similar treatment and, additionally, the remaining radioactive materials and components are sealed with concrete or steel and isolated until they decay to unrestricted levels. Dismantlement means total removal from the site of all radioactive materials above accepted unrestricted activity levels. After dismantlement, the facility owner may have unrestricted use of the site with no requirement for a license.

When NRC licenses a reactor, the licensee is required to identify the tentative mode of decommissioning and how much it is expected to cost. According to a recent NRC study (NUREG/CR-0130), the approximate cost for immediate dismantlement of a pressurized water reactor (PWR) is estimated to be $42 million in 1978 dollars. The staff considers cost and timing in the finding of financial integrity. The National Environmental Policy Act (NEPA) requires that the staff look at the alternatives to the generation of electrical power via nuclear energy, fossil fuel, water power, geothermal steam, etc. One comparison is the net cost of power generation, where decommissioning cost is a factor. NRC does not now require that a licensee of a nuclear power plant provide any specific method of funding to assure that the future cost of decommissioning will be defrayed. There are several areas in the present NRC policy requiring further definition:

Recognized Criteria For Radioactive Residue

- In Soils -- On Surface -- In Burial

- Clear Policy on Permissible Modes of Decommissioning
  - Removal vs. Fixed-In-Place
  - Timing
- Financial Assurance
- Designed to Facilitate Decommissioning

While the actual act of decommissioning is not presently considered imminent for many nuclear facilities, NRC is convinced that the clear assignment of responsibility for decommissioning is urgent. NRC is looking toward revision of Federal policy and the necessary rule making to define residual contamination limits for decommissioning, the timing of decommissioning and the financial surety arrangements. EPA and the States have jurisdiction over how much radioactivity may be left in the environment. The financial surety arrangements at least for reactors appear to be within the jurisdiction of the States and to some extent the Federal Energy Regulatory Commission (FERC).

The NRC is developing an information base (technical studies, workshop results, etc.) in order to reevaluate its policy. The first two decommissioning reports are available: NUREG-0278 "Technology, Safety, and Cost of Decommissioning a Reference Nuclear Fuel Reprocessing Plant" and NUREG/CR-0130 "Technology, Safety and Costs of Decommissioning a Reference Pressurized Water Reactor". Other reports on other types of facilities will be published over the next two years. Together, these reports will give the States and NRC a detailed basis for considering relevant aspects of the decommissioning process. A description of the policy development plan has been issued in NUREG-0436 "Plan for Reevaluation of NRC Policy on Decommissioning of Nuclear Facilities".

Our plan is to proceed in two stages: first, NRC consultation with other Federal agencies, the States, the industry and the public. Then armed with that advice, we will prepare the necessary base of information reports and an environmental impact statement (EIS). The policy statement and proposed rule will then be developed and a public rule making proceeding will be initiated.

For State review, we are holding three workshops: September 18 - 20, 1978 --Philadelphia; September 25 - 27 -- Atlanta; September 28 - 30 -- Albuquerque. We want State views on jurisdiction, on residue requirements, and on financial requirements. At these workshops we will discuss the overall plan and the first two major information reports. In June 1979, we plan another set of workshops to discuss the major reports then available and tentative NRC staff views on financial assurance, residues and generic applicability. It is our hope that we can have essentially the same State representatives at both workshops.

Through the workshops NRC will be seeking comments on:

- clarification of jurisdiction
- financial assurance
- extent of decommissioning required
- residual activity limits
- critique of technical reports

We will prepare a report from the workshops which will be part of the documentation used by the NRC staff, and available to the general public.

The workshops will prove most useful if all participants are fully prepared to contribute to discussions. Prior to the workshop, NRC will provide to participants the necessary information on issues pertinent to decommissioning.

NRC is committed to improved consultation and cooperation with the States. Since we are beginning a major policy effort, we want to make sure that the States are consulted early in the decisionmaking process and that their views are given proper weight and consideration.

A tentative agenda is attached.

TENTATIVE AGENDA

1st. day

6:30-9:30 pm

Registration 5:00-7:00 pm

Opening Plenary 6:30-9:00 pm

Welcome - Overview -	Office of State Programs Nuclear Regulatory Commission
Policy Issue Presentation -	Robert Bernero, Assistant Director for Material Safety Standards Division of Engineering Standards Office of Standards Development

Question and Answer Session

Divide into groups

9:00 - 9:30 pm

- discussion of questions

NOTE: Cash Bar at 9:30

2nd Day

8:00 - 10:00 a.m.

- Technical Presentation · Results of Decommissioning Reports	D. Smith Battelle
- Summary of Comments received by NRC on Decommissioning Policy	D. F. Harmon Division of Engineering Standards Office of Standards Development

10:30 - 5:30 - Working Groups

Rooms will be available in evening for additional discussion if necessary.

3rd Day

8:30 - 9:30 - Groups meet to review papers

coffee break

9:45 - 12 noon - Closing Plenary

WORKSHOP LOCATIONS

September 18-20	Holiday Inn Midtown 1305-11 Walnut St. Philadelphia, PA 19107
September 25-27	Sheraton-Biltmore Hotel 817 West Peachtree St., NE Atlanta, GA 30383
September 28-30	Sheraton Old Town 800 Rio Grande Blvd., NW Albuquerque, New Mexico 87104

APPENDIX E

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

AUG 0 4 1978

The Honorable Joe Fine
Alabama Senate
Montgomery, Alabama 36130

Dear Senator Fine:

The Nuclear Regulatory Commission (NRC) is now engaged in the development of a more explicit overall policy for nuclear facility decommissioning. A detailed reevaluation plan of our current policy (NUREG-0436) was issued in March 1978 and sent to all States for comment. The NRC will hold the first set of regional workshops to review with State officials the specifics of its plan at these dates and locations: September 18-20, Philadelphia, Pennsylvania; September 25-27, Atlanta, Georgia; and September 28-30, Albuquerque, New Mexico.

I would like to invite you to designate two members of your legislative body to participate in these workshops. You may, of course, send other individuals as observers. In the event that there are budgetary difficulties, we have some money available for travel. I am also sending letters of invitation to the governor and his staff and the public utilities commissions.

I would appreciate it if at your earliest convenience you could send us a list of the names, positions, addresses and telephone numbers of the participants from your State to the contractor providing support for the workshops: SCS Engineers, Attn. Ms. Shirley Ingebritsen, 11800 Sunrise Valley Drive, Reston, Virginia 22901, (703) 620-3677. So that we can make the necessary arrangements, we would like to have your list by August 15.

I am enclosing background material on the issues to be discussed.

Sincerely,

Robert G. Ryan

Robert G. Ryan, Director
Office of State Programs

Enclosure

IDENTICAL LETTER SENT TO ALL ADDRESSEES

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State Capitol
Montgomery, AL 36130

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State Capitol
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Rep. Hugh Malone
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APPENDIX F

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

AUG 0 4 1978

The Honorable Juanita W. McDaniel, President
Public Service Commission
State Office Building
Montgomery, Alabama 36104

Dear Madam President:

The Nuclear Regulatory Commission (NRC) is now engaged in the development of a more explicit overall policy for nuclear facility decommissioning. A detailed reevaluation plan of our current policy (NUREG-0436) was issued in March 1978 and sent to all States for comment. The NRC will hold the first set of regional workshops to review with State officials the specifics of its plan at these dates and locations: September 18-20, Philadelphia, Pennsylvania; September 25-27, Atlanta, Georgia; and September 28-30, Albuquerque, New Mexico.

I would like to invite you to designate a representative from your staff to participate in these workshops. You may, of course, send other individuals as observers. In the event that there are budgetary difficulties, we have some money available for travel. I am also sending letters of invitation to the leadership of your State legislature and the governor and his staff.

I would appreciate it if at your earliest convenience you could send the name, position, address and telephone number of the participant from your State to the contractor providing support for the workshops: SCS Engineers, Attn. Ms. Shirley Ingebritsen, 11800 Sunrise Valley Drive, Reston, Virginia 22901, (703) 620-3677. So that we can make the necessary arrangements, we would like to have the name of the participant by August 15.

I am enclosing background material on the issues to be discussed.

Sincerely,

Robert G. Ryan

Robert G. Ryan, Director
Office of State Programs

Enclosure

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APPENDIX G

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The Nuclear Regulatory Commission is developing a more explicit overall decommissioning policy and amending current regulations 10 CFR, Parts 20,40,50 & 70. To provide for State comment on the plan and the first two major decommissioning studies, that of a PWR (NUREG/CR-0130) and a fuel reprocessing plant (NUREG-0278), a series of workshops were held. This report contains the workshop proceedings.

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